Appendix H

Cost Estimation for 7 Projects

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Appendix H

Cost Estimation for 7 Projects

1. Kalagala

KALAGALA

Items	Unit	KALAGALA
		Dam
General		
Installed Capacity (Maximum Output)	MW	330
Maximum Discharge (For Installed Capacity)	m^3/s	1375
Annual Firm Energy Production (90%)	GWh/Y	1,113
Annual Total Energy Production	GWh/Y	1,801
Dam		
Type		Concrete
Dam Height	m	45
Crest Length	m	235
Width of River Bed	m	175
Design Flood Discharge	m^3/s	4,500
Waterway		
Intake		
Number of Intake	nos	10
Inner Diameter	m	8.40
Available drawdaown	m	2
Headrace Tunnel Type		
Number of Tunnel	nos	0
Inner Diameter	m	0
Length	m	0
Lining concrete thickness	m	0.00
Penstock		
Number of Tunnel	nos	0
Inner Diameter	m	0
Length	m	0
Lining concrete thickness	m	0.0
Design Head	m	0
Tailrace		
Number of Tunnel	nos	0
Inner Diameter	m	0.00
Length	m	0
Lining concrete thickness		0.00
Surge Chamber		
Number of Chamber	nos	5
Length	m	0
Available drawdaown	m	0
Outlet		
Number of Tunnel	nos	10
Inner Diameter	m	8.4
Powerhouse (Surface)		
Number of Unit	nos	10
Effective Head	m	27.5
Powerhouse Access Tunnel		
Over Burden	m	0
Transformer Hall (Underground)		
Height	m	0
Effective Head	m	0
Electromechanical Equipment		
Lamp sum cost	10^3USD	151,800
Transmission Line		
Length	km	28
Access Road		
Length	km	3

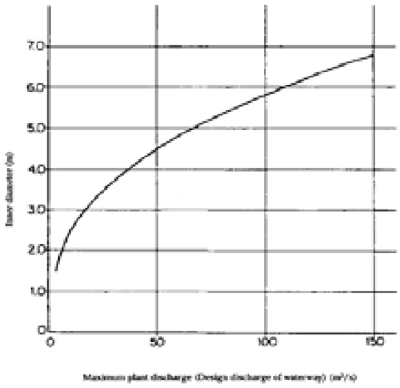


Figure 6.2.1 Inner Diameter of Waterway

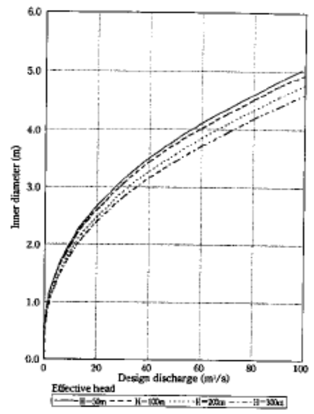
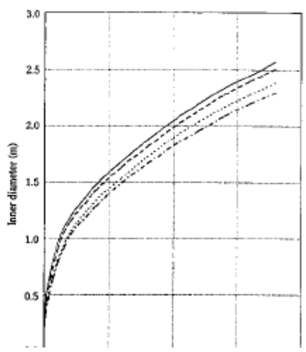


Figure 6.2.2 (1) Inner Diameter of Penstock



Civil Work Quantities :

1) Dam

Hd:	Dam Height	45	m
L:	Crest Length of Dam	235	m
B:	Width of River Bed	175	m
Qf:	Design Flood Discharge	4500	m^3/s

Part of Concrete Dam

Ve: Excavation volume	10 × Hd×L	105,750	m^3
Vc: Concrete volume	$0.34\times(Hd^2\times L)$	161,798	m^3
Wg: Weight of gate	0.13×Qf	585.00	ton

Part of Fill Dam

Ve: Excavation volume	Acc. Drawing	540,000	m^3
Vb: Banking Volume	Acc. Drawing	2,900,000	m^3

2) Intake

Q:	Maximun Plant Discharge	1375	m^3/s
ha:	Available drawdaown	2	m
D:	Inner diameter of waterway	8.40	m
n:	Number of waterway channels	10	
q:	Design discharge (Q/n)	137.5	m^3/s

Ve: Excavation volume	$130\times(((ha+D)\times Q)^{1/2}\times n^{1/3})^{1.27}$	149,925	m^3
Vc: Concrete volume	$56.5\times(((ha+D)\times Q)^{1/2}\times n^{1/3})^{1.23}$	52,184	m^3
Wr: Weight of reinforcement bars	0.04×Vc	2,087.37	ton
Wg: Weight of gate	$0.9\times(ha+D)^{1/9}\times Q$	1,605.27	ton
Ws: Weight of screen	$0.5\times(ha+D)^{1/9}\times Q$	891.82	ton

3) Powerhouse

Q:	Maximun Plant Discharge	1375	m^3/s
He:	Effective head	28	m
n:	Number of Units	10	nos

Ve: Excavation volume	$97.8\times(Q\times He^{2/3}\times n^{1/2})^{0.727}$	215,442	m^3
Vc: Concrete volume	$28.1\times(Q\times He^{2/3}\times n^{1/2})^{0.795}$	127,170	m^3
Wr: Weight of reinforcement bars	$0.05\times Vc$	6,358.50	ton

4) Outlet

Q:	Maximun Plant Discharge	1375	m^3/s
R:	Tuunel radius	4.2	m
n:	Number of waterway	10	
q:	Design discharge (Q/n)	137.5	m^3/s

Ve: Excavation volume	$395\times(R\times Q)^{0.479}$	25,025	m^3
Vc: Concrete volume	$40.4\times(R\times Q)^{0.684}$	15,111	m^3
Wr: Weight of reinforcement bars	$0.278\times Vc^{0.610}$	98	ton

Civil Work Cost **Kalagala Dam**

Item	Unit	Quantity	Unit cost (US$)	Cost (10^3US$)	Calculation method of construction cost
1. Dam				113,328	(1.1)+(1.2)
1.1. Care of river				22,666	(1.1)=(1.2)× 0.25
1.2. Dam				90,663	(1.2)=(i)+(ii)+(iii)+(iv)+(v)
(i) Excavation	m^3	645,750	14	9,041	(i)
(ii) Concrete	m^3	161,798	178	28,800	(ii)
(iii)Banking		2,900,000	11	31,900	(iii)
(iv) Reinforcement ba	ton	0.00	1,115	0	(iv)
(v) Others	L.S.			20,922	(v)=((i)+(ii)+(iii)+(iv)) 0.3
2. Intake				17,310	(2)=(i)+(ii)+(iii)+(iv)
(i) Excavation	m^3	149,925	16	2,399	(i)
(ii) Concrete	m^3	52,184	174	9,080	(ii)
(iii) Reinforcement ba	ton	2,087.37	1,135	2,369	(iii)
(iv) Others	L.S.			3,462	(iv)=((i)+(ii)+(iii))× 0.25
3. Headrace				0	(3)=(i)+(ii)+(iii)+(iv)
(i) Excavation	m^3	0	69	0	(i)
(ii) Concrete	m^3	0	163	0	(ii)
(iii) Reinforcement ba	ton	0.00	1,184	0	(iii)
(iv) Others	L.S.			0	(iv)=((i)+(ii)+(iii))× 0.15
4. Penstock				0	(4)=(i)+(ii)+(iii)+(iv)
(i) Excavation	m^3	0	73	0	(i)
(ii) Concrete	m^3	0	119	0	(ii)
(iii) Reinforcement ba	ton	0.00	1,184	0	(iii)
(iv) Others	L.S.			0	(iv)=((i)+(ii)+(iii))× 0.2
5. Powerhouse				79,845	(5)=(i)+(ii)+(iii)+(iv)
(i) Excavation	m^3	215,442	75	16,260	(i)
(ii) Concrete	m^3	127,170	232	29,452	(ii)
(iii) Reinforcement ba	ton	6,358.50	1,182	7,518	(iii)
(iv) Others	L.S.			26,615	(iv)=((i)+(ii)+(iii))× 0.5
6. Transformer Hall				0	(5)=(i)+(ii)+(iii)+(iv)
(i) Excavation	m^3	0	75	0	(i)
(ii) Concrete	m^3	0	232	0	(ii)
(iii) Reinforcement ba	ton	0.00	1,182	0	(iii)
(iv) Others	L.S.			0	(iv)=((i)+(ii)+(iii))× 0.5
7. Surge Chamber				0	(6)=(i)+(ii)+(iii)+(iv)
(i) Excavation	m^3	0	73	0	(i)
(ii) Concrete	m^3	0	119	0	(ii)
(iii) Reinforcement ba	ton	0	1,184	0	(iii)
(iv) Others	L.S.			0	(iv)=((i)+(ii)+(iii))× 0.55
8. Tailrace Tunnel				0	(7)=(i)+(ii)+(iii)+(iv)
(i) Excavation	m^3	0	69	0	(i)
(ii) Concrete	m^3	0	163	0	(ii)
(iii) Reinforcement ba	ton	0	1,184	0	(iii)
(iv) Others	L.S.			0	(iv)=((i)+(ii)+(iii))× 0.3
9. Outlet				3,950	(7)=(i)+(ii)+(iii)+(iv)
(i) Excavation	m^3	25,025	16	411	(i)
(ii) Concrete	m^3	15,111	174	2,637	(ii)
(iii) Reinforcement ba	ton	98	1,135	112	(iii)
(iv) Others	L.S.			790	(iv)=((i)+(ii)+(iii))× 0.25
10. Access Tunnel				0	(8)=(i)+(ii)+(iii)+(iv)
(i) Excavation	m^3	0	64	0	(i)
(ii) Concrete	m^3	0	212	0	(ii)
(iii) Reinforcement ba	ton	0	1,068	0	(iii)
(iv) Others	L.S.			0	(iv)=((i)+(ii)+(iii))× 0.2
11. Miscellaneous	L.S.			10,722	(9)=Σ((1)−(9))× 0.05
Sub Total				225,155	

Total Excavation Volume (m3) 1,036,142
Total Concrete Volume (m3) 356,262

Hydromechanical Equipment Cost

Item	Unit	Quantity	Unit cost (US$)	Cost (10^3US$)
1. Intake Dam				5,792
Regulating Radial Gate	ton	585	9,900	5,792
2. Intake				17,159
Gate	ton	1,605	8,300	13,324
Screen	ton	892	4,300	3,835
3. Penstock (steel pipe)	ton	0	4,700	0
4. Tailrace gate	ton	1,605	8,300	13,324
5. Others	L.S.	20%		7,255
Subtotal				43,529

Electromechanical Equipment Cost

No.	Item	Cost (10^3US$)
	ELECTRO MECHANICAL EQUIPMENT	
	Inlet Valves & Handling Equipment	
	Turbines	
	Mechanical auxiliaries	
	Generators	
	Generation Voltage Connection	
	Electrical auxiliaries	
	Overhead Traveling Crane	
	Transformers	
	Control, protection, metering	
	GIS switching station	
	Cable yard & outstation equipment	
	400kV XLPE Power Cable	
	Cable and earthing	
	Communication	
	Spare parts	
	TOTAL	**213,200**

Hydropower Project Total Construction Cost

Location : KALAGALA

Maximum Dischrge :	1375	m^3/s
Installed Capacity :	330	MW
Annual Firm Energy Production :	1,113	GWh
Annual Total Energy Production :	1,801	GWh

Item	Cost (x10^3US$)	Note
1. Preparation and Land acquision	17,503	
(1) Access road	3,000	1,000x10^3US$/km › 3 km
(2) Compensation & Resettlment	10,000	
(3) Camp & Facilities	4,503	(3. Civil work)× 2%
2. Environmental mitigation cost	6,755	(3. Civil work)× 3%
3. Civil work	225,155	
(1) Dam	113,328	
(2) Intake	17,310	
(3) Headrace	0	
(4) Penstock	0	
(5) Powerhouse	79,845	
(6) Transformer Hall	0	
(7) Surge chamber	0	
(8) Tailrace tunnel	0	
(9) Outlet	3,950	
(10) Access tunnel	0	
(11) Miscellaneous	10,722	
4. Hydraulic euipment	43,529	
(1) Gate and screen	43,529	
(2) Penstock	0	
5. Electro-mechanical equipment	151,800	Installed Capacity 330 MW
6. Transmission line	7,812	Ayago-Karuma 28 km
Direct cost	452,554	
7. Administration and Engineering service	67,883	Direct cost × 15%
8. Contingency	45,255	Direct cost × 10%
9. Interest during construction	90,511	Interest Rate 10% 4years
Total cost	656,203	

Construction Cost	1988.5 USD/kW
Generation Cost for Firm Energy	6.54 cent/kWh
Generation Cost for Total Energy	4.04 cent/kWh

2. Isimba

ISHIMBA

Items	Unit	ISHIMBA
		Dam
General		
Installed Capacity (Maximum Output)	MW	138
Maximum Discharge (For Installed Capacity)	m^3/s	1375
Annual Firm Energy Production (90%)	GWh/Y	465
Annual Total Energy Production	GWh/Y	752
Dam		
Type		Concrete
Dam Height	m	30
Crest Length	m	320
Width of River Bed	m	70
Design Flood Discharge	m^3/s	4500
Waterway		
Intake		
Number of Intake	nos	6
Inner Diameter	m	8.4
Available drawdaown	m	2
Headrace Tunnel Type		
Number of Tunnel	nos	0
Inner Diameter	m	0
Length	m	0
Lining concrete thickness	m	0.00
Penstock		
Number of Tunnel	nos	0
Inner Diameter	m	0
Length	m	0
Lining concrete thickness	m	0.0
Design Head	m	0
Tailrace		
Number of Tunnel	nos	0
Inner Diameter	m	0.00
Length	m	0
Lining concrete thickness		0.00
Surge Chamber		
Number of Chamber	nos	0
Length	m	0
Available drawdaown	m	0
Outlet		
Number of Tunnel	nos	6
Inner Diameter	m	8.4
Powerhouse (Surface)		
Number of Unit	nos	6
Area of powerhouse	m2	
Height	m	28
Effective Head	m	12.5
Powerhouse Access Tunnel		
Over Burden	m	0
Transformer Hall (Underground)		
Area of Transformer Hall	m2	
Height	m	0
Effective Head	m	0
Electromechanical Equipment		
Lamp sum cost	10^3USD	114,000
Transmission Line		
Length	km	47
Access Road		
Length	km	15

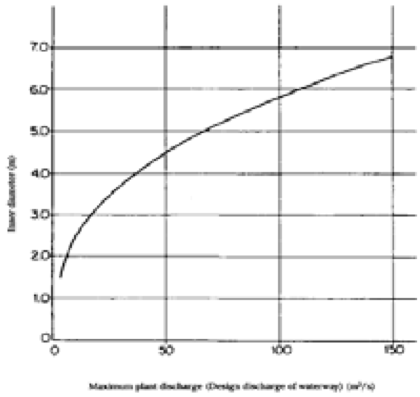


Figure 6.2.1 Inner Diameter of Waterway

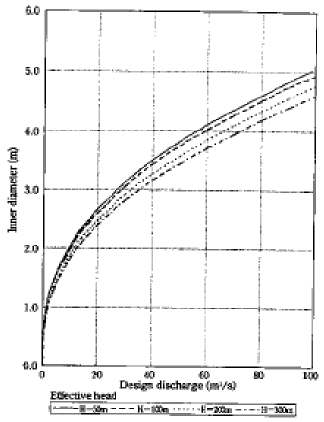
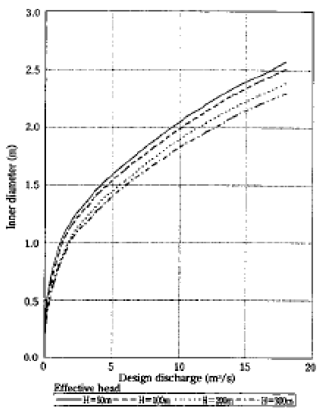


Figure 6.2.2 (1) Inner Diameter of Penstock



Civil Work Quantities :

1) Dam

Hd:	Dam Height	30	m
L:	Crest Length of Dam	1420	m
B:	Width of River Bed	70	m
Qf:	Design Flood Discharge	4500	m^3/s

Part of Concrete Dam

Ve: Excavation volume	10×Hd×L	426,000	m^3
Vc: Concrete volume	$0.34\times(Hd^2\times L)$	434,520	m^3
Wg: Weight of gate	0.13×Qf	585.00	ton

Part of Fill Dam

Ve: Excavation volume	Acc. Drawing	129,900	m^3
Vb: Banking Volume	Acc. Drawing	513,000	m^3

2) Intake

Q:	Maximun Plant Discharge	1375	m^3/s
ha:	Available drawdaown	2	m
D:	Inner diameter of waterway	8.40	m
n:	Number of waterway channels	6	
q:	Design discharge (Q/n)	229.16667	m^3/s

Ve: Excavation volume	$130\times(((ha+D)\times Q)^{1/2}\times n^{1/3})^{1.27}$	120,772	m^3
Vc: Concrete volume	$56.5\times(((ha+D)\times Q)^{1/2}\times n^{1/3})^{1.23}$	42,324	m^3
Wr: Weight of reinforcement bars	0.04×Vc	1,692.97	ton
Wg: Weight of gate	$0.9\times(ha+D)^{1/9}\times Q$	1,605.27	ton
Ws: Weight of screen	$0.5\times(ha+D)^{1/9}\times Q$	891.82	ton

3) Powerhouse

Q:	Maximun Plant Discharge	1375	m^3/s
He:	Effective head	13	m
n:	Number of Units	6	nos

Ve: Excavation volume	$97.8\times(Q\times He^{2/3}\times n^{1/2})^{0.727}$	122,080 m^3
Vc: Concrete volume	$28.1\times(Q\times He^{2/3}\times n^{1/2})^{0.795}$	68,332 m^3
Wr: Weight of reinforcement bars	$0.05\times Vc$	3,416.61 ton

4) Outlet

Q:	Maximun Plant Discharge	1375 m^3/s
R:	Tuunel radius	4.2 m
n:	Number of waterway	6
q:	Design discharge (Q/n)	229 m^3/s

Ve: Excavation volume	$395\times(R\times Q)^{0.479}$	25,025 m^3
Vc: Concrete volume	$40.4\times(R\times Q)^{0.684}$	15,111 m^3
Wr: Weight of reinforcement bars	$0.278\times Vc^{0.610}$	98 ton

Civil Work Cost **Ishimba** **Dam**

Item	Unit	Quantity	Unit cost (US$)	Cost (10^3US$)	Calculation method of construction cost
1. Dam				147,502	(1.1)+(1.2)
1.1. Care of river				29,500	(1.1)=(1.2)× 0.25
1.2. Dam				118,001	(1.2)=(i)+(ii)+(iii)+(iv)+(v)
(i) Excavation	m^3	555,900	14	7,783	(i)
(ii) Concrete	m^3	434,520	178	77,345	(ii)
(iii)Banking	m^3	513,000	11	5,643	(iii)
(iv) Reinforcement ba	ton	0.00	1,115	0	(iv)
(v) Others	L.S.			27,231	(v)=((i)+(ii)+(iii)+(iv) 0.3
2. Intake				14,023	(2)=(i)+(ii)+(iii)+(iv)
(i) Excavation	m^3	120,772	16	1,932	(i)
(ii) Concrete	m^3	42,324	174	7,364	(ii)
(iii) Reinforcement ba	ton	1,692.97	1,135	1,922	(iii)
(iv) Others	L.S.			2,805	(iv)=((i)+(ii)+(iii)) × 0.25
3. Headrace				0	(3)=(i)+(ii)+(iii)+(iv)
(i) Excavation	m^3	0	69	0	(i)
(ii) Concrete	m^3	0	163	0	(ii)
(iii) Reinforcement ba	ton	0.00	1,184	0	(iii)
(iv) Others	L.S.			0	(iv)=((i)+(ii)+(iii)) × 0.15
4. Penstock				0	(4)=(i)+(ii)+(iii)+(iv)
(i) Excavation	m^3	0	73	0	(i)
(ii) Concrete	m^3	0	119	0	(ii)
(iii) Reinforcement ba	ton	0.00	1,184	0	(iii)
(iv) Others	L.S.			0	(iv)=((i)+(ii)+(iii))× 0.2
5. Powerhouse				43,618	(5)=(i)+(ii)+(iii)+(iv)
(i) Excavation	m^3	122,080	75	9,214	(i)
(ii) Concrete	m^3	68,332	232	15,825	(ii)
(iii) Reinforcement ba	ton	3,416.61	1,182	4,039	(iii)
(iv) Others	L.S.			14,539	(iv)=((i)+(ii)+(iii)) × 0.5
6. Transformer Hall				0	(5)=(i)+(ii)+(iii)+(iv)
(i) Excavation	m^3	0	75	0	(i)
(ii) Concrete	m^3	0	232	0	(ii)
(iii) Reinforcement ba	ton	0.00	1,182	0	(iii)
(iv) Others	L.S.			0	(iv)=((i)+(ii)+(iii)) × 0.5
7. Surge Chamber				0	(6)=(i)+(ii)+(iii)+(iv)
(i) Excavation	m^3	0	73	0	(i)
(ii) Concrete	m^3	0	119	0	(ii)
(iii) Reinforcement ba	ton	0	1,184	0	(iii)
(iv) Others	L.S.			0	(iv)=((i)+(ii)+(iii)) × 0.55
8. Tailrace Tunnel				0	(7)=(i)+(ii)+(iii)+(iv)
(i) Excavation	m^3	0	69	0	(i)
(ii) Concrete	m^3	0	163	0	(ii)
(iii) Reinforcement ba	ton	0	1,184	0	(iii)
(iv) Others	L.S.			0	(iv)=((i)+(ii)+(iii)) × 0.3
9. Outlet				3,950	(7)=(i)+(ii)+(iii)+(iv)
(i) Excavation	m^3	25,025	16	411	(i)
(ii) Concrete	m^3	15,111	174	2,637	(ii)
(iii) Reinforcement ba	ton	98	1,135	112	(iii)
(iv) Others	L.S.			790	(iv)=((i)+(ii)+(iii)) × 0.25
10. Access Tunnel				0	(8)=(i)+(ii)+(iii)+(iv)
(i) Excavation	m^3	0	64	0	(i)
(ii) Concrete	m^3	0	212	0	(ii)
(iii) Reinforcement ba	ton	0	1,068	0	(iii)
(iv) Others	L.S.			0	(iv)=((i)+(ii)+(iii)) × 0.2
11. Miscellaneous	L.S.			10,455	(9)=Σ((1)−(9))× 0.05
Sub Total				219,547	

Total Excavation Volume (m3) 823,777
Total Concrete Volume (m3) 560,287

Hydromechanical Equipment Cost

Item	Unit	Quantity	Unit cost (US$)	Cost (10^3US$)
1. Intake Dam				5,792
Regulating Radial Gate	ton	585	9,900	5,792
2. Intake				17,159
Gate	ton	1,605	8,300	13,324
Screen	ton	892	4,300	3,835
3. Penstock (steel pipe)	ton	0	4,700	0
4. Tailrace gate	ton	1,605	8,300	13,324
5. Others	L.S.	20%		7,255
Subtotal				43,529

Electromechanical Equipment Cost

No.	Item	Cost (10^3US$)
	ELECTRO MECHANICAL EQUIPMENT	
	Inlet Valves & Handling Equipment	
	Turbines	
	Mechanical auxiliaries	
	Generators	
	Generation Voltage Connection	
	Electrical auxiliaries	
	Overhead Traveling Crane	
	Transformers	
	Control, protection, metering	
	GIS switching station	
	Cable yard & outstation equipment	
	400kV XLPE Power Cable	
	Cable and earthing	
	Communication	
	Spare parts	
	TOTAL	**213,200**

Hydropower Project Total Construction Cost

Location : ISHIMBA

Maximum Dischrge :	1375 m^3/s
Installed Capacity :	138 MW
Annual Firm Energy Production :	465 GWh
Annual Total Energy Production :	752 GWh

Item	Cost (x10^{3}US$)	Note
1. Preparation and Land acquision	29,391	
(1) Access road	15,000	1,000x10^{3}US$/km › 15 km
(2) Compensation & Resettlment	10,000	
(3) Camp & Facilities	4,391	(3. Civil work)× 2%
2. Environmental mitigation cost	6,586	(3. Civil work)× 3%
3. Civil work	219,547	
(1) Dam	147,502	
(2) Intake	14,023	
(3) Headrace	0	
(4) Penstock	0	
(5) Powerhouse	43,618	
(6) Transformer Hall	0	
(7) Surge chamber	0	
(8) Tailrace tunnel	0	
(9) Outlet	3,950	
(10) Access tunnel	0	
(11) Miscellaneous	10,455	
4. Hydraulic euipment	43,529	
(1) Gate and screen	43,529	
(2) Penstock	0	
5. Electro-mechanical equipment	114,000	Installed Capacity 138 MW
6. Transmission line	13,113	Ayago-Karuma 47 km
Direct cost	426,166	
7. Administration and Engineering service	63,925	Direct cost × 15%
8. Contingency	42,617	Direct cost × 10%
9. Interest during construction	85,233	Interest Rate 10% 4years
Total cost	617,940	

Construction Cost	4477.8 USD/kW
Generation Cost for Firm Energy	14.73 cent/kWh
Generation Cost for Total Energy	9.11 cent/kWh

3. Karuma

KARUMA

Items	Unit	KARUMA
		Run-of-River
General		
Installed Capacity (Maximum Output)	MW	587
Maximum Discharge (For Installed Capacity)	m^3/s	840
Annual Firm Energy Production (90%)	GWh/Y	2,514
Annual Total Energy Production	GWh/Y	4,145
Weir		
Type		Concrete
Dam Height	m	20
Crest Length	m	620
Design Flood Discharge	m^3/s	4,000
Waterway		
Intake		
Number of Intake	nos	6
Inner Diameter	m	8.4
Available drawdaown	m	1
Headrace Tunnel Type		
Number of Tunnel	nos	6
Inner Diameter	m	8.4
Length	m	555
Lining concrete thickness	m	0.8
Penstock		
Number of Tunnel	nos	12
Inner Diameter	m	3.8
Length	m	70
Lining concrete thickness	m	0.5
Design Head	m	85
Tailrace		
Number of Tunnel	nos	6
Inner Diameter	m	8.4
Length	m	11,000
Lining concrete thickness		0.60
Surge Chamber		
Number of Chamber	nos	6
Length	m	0
Available drawdaown	m	0
Outlet		
Number of Tunnel	nos	6
Inner Diameter	m	8.40
Powerhouse (Underground)		
Number of Unit	nos	12
Height	m	32
Effective Head	m	79
Powerhouse Access Tunnel		
Over Burden	m	170
Transformer Hall (Underground)		
Area of Transformer Hall	m2	
Height	m	12.5
Effective Head	m	79
Electromechanical Equipment		
Lamp sum cost	10^3USD	241,700
Transmission Line		
Length	km	1
Access Road		
Length	km	1

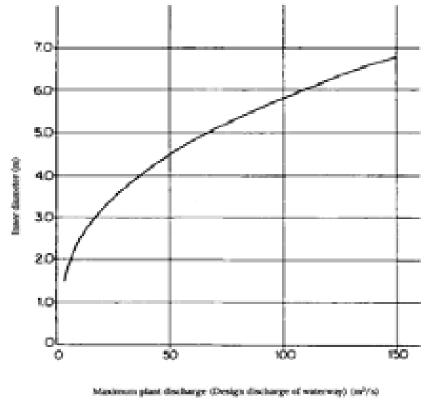


Figure 6.2.1 Inner Diameter of Waterway

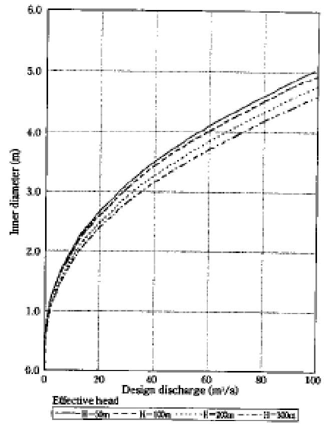
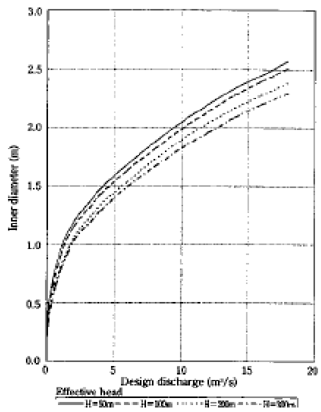


Figure 6.2.2 (1) Inner Diameter of Penstock



Civil Work Quantities :

1) Intake Weir

Hd:	Weir Height	20	m
L:	Crest Length of Weir	620	m
Qf:	Design Flood Discharge	4000	m^3/s

Ve: Excavation volume	$8.69 \times (Hd \times L)^{1.14}$	403,200	m^3
Vc: Concrete volume	$16.1 \times (Hd^2 \times L)^{0.695}$	90,359	m^3
Wr: Weight of reinforcement bars	$0.0274 \times Vc^{0.83}$	355.80	ton
Wg: Weight of gate	$0.145 \times Qf^{0.692}$	45.08	ton

2) Intake

Q:	Maximun Plant Discharge	840	m^3/s
ha:	Available drawdaown	1	m
D:	Inner diameter of waterway	8.40	m
n:	Number of waterway channels	6	
q:	Design discharge (Q/n)	140	m^3/s

Ve: Excavation volume	$130 \times (((ha+D) \times Q)^{1/2} \times n^{1/3})^{1.27}$	82,829	m^3
Vc: Concrete volume	$56.5 \times (((ha+D) \times Q)^{1/2} \times n^{1/3})^{1.23}$	29,374	m^3
Wr: Weight of reinforcement bars	$0.04 \times Vc$	1,174.96	ton
Wg: Weight of gate	$0.9 \times (ha+D)^{1/9} \times Q$	969.72	ton
Ws: Weight of screen	$0.5 \times (ha+D)^{1/9} \times Q$	538.73	ton

3) Headrace

R:	Tuunel radius	4.2 m
$t_{0:}$	Lining concrete thickness	0.80 m
L:	Total length of waterway	555 m
n:	Number of waterway channels	6

Ve: Excavation volume	$3.2\times(R+t_0)^2\times L\times n$	266,400 m^3
Vc: Concrete volume	$(3.2\times(R+t_0)^2-\pi R^2)\times L\times n$	81,953 m^3
Wr: Weight of reinforcement bars	0.04×Vc	3,278.11 ton

4) Penstock

$D_{m:}$	Inner diameter of penstock	3.8 m
t:	Thickness of backfill concrete	0.5 m
L:	Total length of penstock	70 m
H:	Desigh Head	85 m
n:	Number of waterway channels	12

t_m: Thickness of steel penstock	$0.0313\times H\times D_m+2$	12.110 mm
Ve: Excavation volume	$\pi/4\times(Dm+2t)^2\times L\times n$	15,193 m^3
Vc: Concrete volume	$\pi/4\times((Dm+2t)^2-Dm^2)\times L\times n$	5,671 m^3
Wr: Weight of reinforcement bars	0.012×Vc	68.05 ton
Wp: Weight of steel conduit	$7.85\times\pi\times D_m\times t_m\times 1.1\times L\times n$	1,048 ton

5) Powerhouse

Q:	Maximun Plant Discharge	840	m^3/s
He:	Effective head	79	m
d:	Height of powerhouse	32	m

A: Area of powerhouse	$20\times Q^{1/2}\times He^{1/3}$	2,487	m^2
Ve: Excavation volume	27×A+1.3×A×d	170,598	m^3
Vc: Concrete volume	15×A	37,303	m^3
Wr: Weight of reinforcement bars	0.6×A	1,492.11	ton

6) Transformer Hall

Q:	Maximun Plant Discharge	840	m^3/s
He:	Effective head	79	m
d:	Height of Hall	13	m

A: Area of powerhouse	$20\times Q^{1/2}\times He^{1/3}$	2,487	m^2
Ve: Excavation volume	27×A+1.3×A×d	107,556	m^3
Vc: Concrete volume	15×A	37,303	m^3
Wr: Weight of reinforcement bars	0.6×A	1,492.11	ton

7) Tailrace

R:	Tuunel radius	4.2	m
$t_{0:}$	Lining concrete thickness	0.60	m
L:	Total length of waterway	11,000	m
n:	Number of waterway	6	

Ve: Excavation volume	$3.2\times(R+t_0)^2\times L\times n$	4,866,048	m^3
Vc: Concrete volume	$(3.2\times(R+t_0)^2-\pi R^2)\times L\times n$	1,210,334	m^3
Wr: Weight of reinforcement bars	0.04×Vc	48,413	ton

8) Outlet

Q:	Maximun Plant Discharge	840	m^3/s
R:	Tuunel radius	4.2	m
n:	Number of waterway	6	
q:	Design discharge (Q/n)	140	m^3/s

Ve: Excavation volume	$395\times(R\times Q)^{0.479}$	19,763	m^3
Vc: Concrete volume	$40.4\times(R\times Q)^{0.684}$	10,787	m^3
Wr: Weight of reinforcement bars	$0.278\times Vc^{0.610}$	80	ton

9) Access Tunnel for Underground Powerhouse

i:	Gradient of tunnel	0.1	
He:	Over Burden	170	m

L: Length of access tunnel	He/i	1,700	m
Ve: Excavation volume	45×L	76,500	m^3
Vc: Concrete volume	10×L	17,000	m^3
Wr: Weight of reinforcement bars	0.3×Vc	5,100	ton

Civil Work Cost **Karuma Run-of-River**

Item	Unit	Quantity	Unit cost (US$)	Cost (10^3US$)	Calculation method of construction cost
1. Dam				35,954	(1.1)+(1.2)
1.1. Care of river				7,191	(1.1)=(1.2)× 0.25
1.2. Weir				28,763	(1.2)=(i)+(ii)+(iii)+(iv)
(i) Excavation	m^3	403,200	14	5,645	(i)
(ii) Concrete	m^3	90,359	178	16,084	(ii)
(iii) Reinforcement b	ton	355.80	1,115	397	(iii)
(iv) Others	L.S.			6,638	(iv)=((i)+(ii)+(iii) 0.3
2. Intake				9,712	(2)=(i)+(ii)+(iii)+(iv)
(i) Excavation	m^3	82,829	16	1,325	(i)
(ii) Concrete	m^3	29,374	174	5,111	(ii)
(iii) Reinforcement b	ton	1,174.96	1,135	1,334	(iii)
(iv) Others	L.S.			1,942	(iv)=((i)+(ii)+(iii) 0.25
3. Headrace				40,964	(3)=(i)+(ii)+(iii)+(iv)
(i) Excavation	m^3	266,400	69	18,382	(i)
(ii) Concrete	m^3	81,953	163	13,358	(ii)
(iii) Reinforcement b	ton	3,278.11	1,184	3,881	(iii)
(iv) Others	L.S.			5,343	(iv)=((i)+(ii)+(iii) 0.15
4. Penstock				2,235	(4)=(i)+(ii)+(iii)+(iv)
(i) Excavation	m^3	15,193	73	1,106	(i)
(ii) Concrete	m^3	5,671	119	676	(ii)
(iii) Reinforcement b	ton	68.05	1,184	81	(iii)
(iv) Others	L.S.			372	(iv)=((i)+(ii)+(iii) 0.2
5. Powerhouse				34,919	(5)=(i)+(ii)+(iii)+(iv)
(i) Excavation	m^3	170,598	75	12,876	(i)
(ii) Concrete	m^3	37,303	232	8,639	(ii)
(iii) Reinforcement b	ton	1,492.11	1,182	1,764	(iii)
(iv) Others	L.S.			11,640	(iv)=((i)+(ii)+(iii) 0.5
6. Transformer Hall				27,782	(5)=(i)+(ii)+(iii)+(iv)
(i) Excavation	m^3	107,556	75	8,118	(i)
(ii) Concrete	m^3	37,303	232	8,639	(ii)
(iii) Reinforcement b	ton	1,492.11	1,182	1,764	(iii)
(iv) Others	L.S.			9,261	(iv)=((i)+(ii)+(iii) 0.5
7. Surge Chamber				0	(6)=(i)+(ii)+(iii)+(iv)
(i) Excavation	m^3	0	73	0	(i)
(ii) Concrete	m^3	0	119	0	(ii)
(iii) Reinforcement b	ton	0	1,184	0	(iii)
(iv) Others	L.S.			0	(iv)=((i)+(ii)+(iii) 0.55
8. Tailrace Tunnel				769,895	(7)=(i)+(ii)+(iii)+(iv)
(i) Excavation	m^3	4,866,048	69	337,524	(i)
(ii) Concrete	m^3	1,210,334	163	197,392	(ii)
(iii) Reinforcement b	ton	48,413	1,184	57,311	(iii)
(iv) Others	L.S.			177,668	(iv)=((i)+(ii)+(iii) 0.3
9. Outlet				2,873	(7)=(i)+(ii)+(iii)+(iv)
(i) Excavation	m^3	19,763	16	325	(i)
(ii) Concrete	m^3	10,787	174	1,882	(ii)
(iii) Reinforcement b	ton	80	1,135	91	(iii)
(iv) Others	L.S.			575	(iv)=((i)+(ii)+(iii) 0.25
10. Access Tunnel				16,741	(8)=(i)+(ii)+(iii)+(iv)
(i) Excavation	m^3	76,500	64	4,904	(i)
(ii) Concrete	m^3	17,000	212	3,603	(ii)
(iii) Reinforcement b	ton	5,100	1,068	5,445	(iii)
(iv) Others	L.S.			2,790	(iv)=((i)+(ii)+(iii) 0.2
11. Miscellaneous	L.S.			45,665	(9)=Σ((1)−(9))× 0.05
Sub Total				986,739	

Total Excavation Volume (m3) 6,008,086
Total Concrete Volume (m3) 1,520,083

Hydromechanical Equipment Cost

Item	Unit	Quantity	Unit cost (US$)	Cost (10^3US$)
1. Intake Dam				446
Regulating Radial Gate	ton	45	9,900	446
2. Intake				10,365
Gate	ton	970	8,300	8,049
Screen	ton	539	4,300	2,317
3. Penstock (steel pipe)	ton	1,048	4,700	4,926
4. Tailrace gate	ton	970	8,300	8,049
5. Others	L.S.	20%		4,757
Subtotal				28,543

Electromechanical Equipment Cost

No.	Item	Cost (10^3US$)
	ELECTRO MECHANICAL EQUIPMENT	
	Inlet Valves & Handling Equipment	
	Turbines	
	Mechanical auxiliaries	
	Generators	
	Generation Voltage Connection	
	Electrical auxiliaries	
	Overhead Traveling Crane	
	Transformers	
	Control, protection, metering	
	GIS switching station	
	Cable yard & outstation equipment	
	400kV XLPE Power Cable	
	Cable and earthing	
	Communication	
	Spare parts	
	TOTAL	**241,700**

Hydropower Project Total Construction Cost

Location : KARUMA

Maximum Dischrge :	840 m^3/s
Installed Capacity :	587 MW
Annual Firm Energy Production :	2,514 GWh
Annual Total Energy Production :	4,145 GWh

Item	Cost (x10^3US$)	Note
1. Preparation and Land acquision	30,735	
(1) Access road	1,000	1,000x10^3US$/km › 1 km
(2) Compensation & Resettlment	10,000	
(3) Camp & Facilities	19,735	(3. Civil work)× 2%
2. Environmental mitigation cost	29,602	(3. Civil work)× 3%
3. Civil work	986,739	
(1) Weir	35,954	
(2) Intake	9,712	
(3) Headrace	40,964	
(4) Penstock	2,235	
(5) Powerhouse	34,919	
(6) Transformer Hall	27,782	
(7) Surge chamber	0	
(8) Tailrace tunnel	769,895	
(9) Outlet	2,873	
(10) Access tunnel	16,741	
(11) Miscellaneous	45,665	
4. Hydraulic euipment	28,543	
(1) Gate and screen	23,617	
(2) Penstock	4,926	
5. Electro-mechanical equipment	241,700	Installed Capacity 587 MW
6. Transmission line	390	Ayago-Karuma 1 km
Direct cost	1,317,710	
7. Administration and Engineering service	197,656	Direct cost × 15%
8. Contingency	131,771	Direct cost × 10%
9. Interest during construction	329,427	Interest Rate 10% 5years
Total cost	1,976,565	

Construction Cost	3367.2 USD/kW
Generation Cost for Firm Energy	8.72 cent/kWh
Generation Cost for Total Energy	5.29 cent/kWh

4. Oriang

ORIANG

Items	Unit	ORIANG
		Run-of-River
General		
Installed Capacity (Maximum Output)	MW	392
Maximum Discharge (For Installed Capacity)	m^3/s	840
Annual Firm Energy Production (90%)	GWh/Y	1,679
Annual Total Energy Production	GWh/Y	2,768
Weir		
Type		Concrete
Dam Height	m	20
Crest Length	m	610
Design Flood Discharge	m^3/s	4,000
Waterway		
Intake		
Number of Intake	nos	4
Inner Diameter	m	9.80
Available drawdaown	m	1
Headrace Tunnel Type		
Number of Tunnel	nos	4
Inner Diameter	m	9.8
Length	m	740
Lining concrete thickness	m	1.0
Penstock		
Number of Tunnel	nos	8
Inner Diameter	m	4.9
Length	m	90
Lining concrete thickness	m	0.5
Design Head	m	58
Tailrace		
Number of Tunnel	nos	4
Inner Diameter	m	9.8
Length	m	11,000
Lining concrete thickness		0.6
Surge Chamber		
Number of Chamber	nos	4
Length	m	0
Available drawdaown	m	0
Outlet		
Number of Tunnel	nos	4
Inner Diameter	m	9.8
Powerhouse (Underground)		
Number of Unit	nos	8
Height	m	35
Effective Head	m	53
Powerhouse Access Tunnel		
Over Burden	m	140
Transformer Hall (Underground)		
Height	m	15
Effective Head	m	53
Electromechanical Equipment		
Lamp sum cost	10^3USD	178,700
Transmission Line		
Length	km	34
Access Road		
Length	km	30

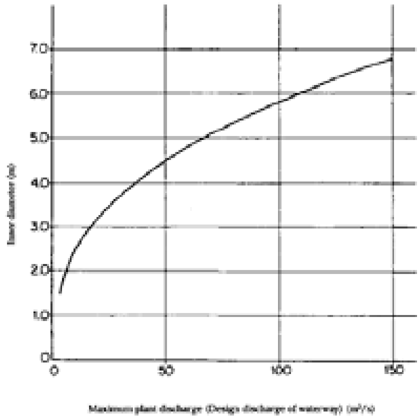


Figure 6.2.1 Inner Diameter of Waterway

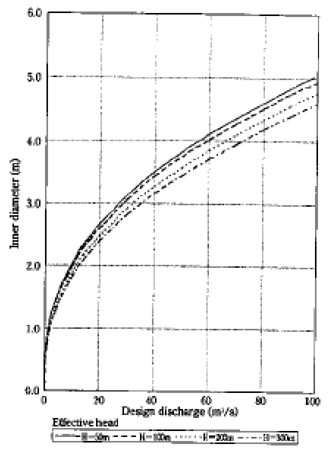
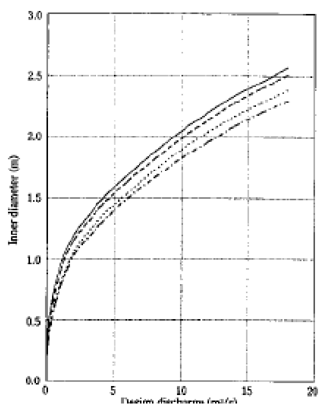


Figure 6.2.2 (1) Inner Diameter of Penstock



Civil Work Quantities :

1) Intake Weir

Hd:	Weir Height	20	m
L:	Crest Length of Weir	610	m
Qf:	Design Flood Discharge	4000	m^3/s

Ve: Excavation volume	$8.69 \times (Hd \times L)^{1.14}$	395,795	m^3
Vc: Concrete volume	$16.1 \times (Hd^2 \times L)^{0.695}$	89,343	m^3
Wr: Weight of reinforcement bars	$0.0274 \times Vc^{0.83}$	352.48	ton
Wg: Weight of gate	$0.145 \times Qf^{0.692}$	45.08	ton

2) Intake

Q:	Maximun Plant Discharge	840	m^3/s
ha:	Available drawdaown	1	m
D:	Inner diameter of waterway	9.80	m
n:	Number of waterway channels	4	
q:	Design discharge (Q/n)	210	m^3/s

Ve: Excavation volume	$130 \times (((ha+D) \times Q)^{1/2} \times n^{1/3})^{1.27}$	76,196	m^3
Vc: Concrete volume	$56.5 \times (((ha+D) \times Q)^{1/2} \times n^{1/3})^{1.23}$	27,093	m^3
Wr: Weight of reinforcement bars	$0.04 \times Vc$	1,083.72	ton
Wg: Weight of gate	$0.9 \times (ha+D)^{1/9} \times Q$	984.80	ton
Ws: Weight of screen	$0.5 \times (ha+D)^{1/9} \times Q$	547.11	ton

3) Headrace

R:	Tuunel radius	4.9	m
$t_{0:}$	Lining concrete thickness	1.00	m
L:	Total length of waterway	740	m
n:	Number of waterway channels	4	

Ve: Excavation volume	$3.2 \times (R+t_0)^2 \times L \times n$	329,720	m^3
Vc: Concrete volume	$(3.2 \times (R+t_0)^2 - \pi R^2) \times L \times n$	106,562	m^3
Wr: Weight of reinforcement bars	$0.04 \times Vc$	4,262.47	ton

4) Penstock

D_m:	Inner diameter of penstock	4.9	m
t:	Thickness of backfill concrete	0.5	m
L:	Total length of penstock	90	m
H:	Desigh Head	58	m
n:	Number of waterway channels	8	

t_m: Thickness of steel penstock	$0.0313\times H\times D_m+2$	10.895	mm
Ve: Excavation volume	$\pi/4\times(Dm+2t)^2\times L\times n$	19,675	m^3
Vc: Concrete volume	$\pi/4\times((Dm+2t)^2-Dm^2)\times L\times n$	6,104	m^3
Wr: Weight of reinforcement bars	$0.012\times Vc$	73.25	ton
Wp: Weight of steel conduit	$7.85\times\pi\times D_m\times t_m\times 1.1\times L\times n$	1,042	ton

5) Powerhouse

Q:	Maximun Plant Discharge	840	m^3/s
He:	Effective head	53	m
d:	Height of powerhouse	35	m

A: Area of powerhouse	$20\times Q^{1/2}\times He^{1/3}$	2,177	m^2
Ve: Excavation volume	$27\times A+1.3\times A\times d$	157,837	m^3
Vc: Concrete volume	$15\times A$	32,656	m^3
Wr: Weight of reinforcement bars	$0.6\times A$	1,306.24	ton

6) Transformer Hall

Q:	Maximun Plant Discharge	840	m^3/s
He:	Effective head	53	m
d:	Height of Hall	15	m

A: Area of powerhouse	$20 \times Q^{1/2} \times He^{1/3}$	2,177	m^2
Ve: Excavation volume	$27 \times A + 1.3 \times A \times d$	101,233	m^3
Vc: Concrete volume	$15 \times A$	32,656	m^3
Wr: Weight of reinforcement bars	$0.6 \times A$	1,306.24	ton

7) Tailrace

R:	Tuunel radius	4.9	m
$t_{0:}$	Lining concrete thickness	0.60	m
L:	Total length of waterway	11,000	m
n:	Number of waterway	4	

Ve: Excavation volume	$3.2 \times (R+t_0)^2 \times L \times n$	4,259,200	m^3
Vc: Concrete volume	$(3.2 \times (R+t_0)^2 - \pi R^2) \times L \times n$	941,978	m^3
Wr: Weight of reinforcement bars	$0.04 \times Vc$	37,679	ton

8) Outlet

Q:	Maximun Plant Discharge	840	m^3/s
R:	Tuunel radius	4.9	m
n:	Number of waterway	4	
q:	Design discharge (Q/n)	210	m^3/s

Ve: Excavation volume	$395 \times (R \times Q)^{0.479}$	21,278	m^3
Vc: Concrete volume	$40.4 \times (R \times Q)^{0.684}$	11,986	m^3
Wr: Weight of reinforcement bars	$0.278 \times Vc^{0.610}$	86	ton

9) Access Tunnel for Underground Powerhouse

i:	Gradient of tunnel	0.1	
He:	Over Burden	140	m

L: Length of access tunnel	He/i	1,400	m
Ve: Excavation volume	45×L	63,000	m^3
Vc: Concrete volume	10×L	14,000	m^3
Wr: Weight of reinforcement bars	0.3×Vc	4,200	ton

Civil Work Cost **Oriang Run-of-River**

Item	Unit	Quantity	Unit cost (US$)	Cost (10^3US$)	Calculation method of construction cost
1. Dam				35,486	(1.1)+(1.2)
1.1. Care of river				7,097	(1.1)=(1.2)× 0.25
1.2. Weir				28,388	(1.2)=(i)+(ii)+(iii)+(iv)
(i) Excavation	m^3	395,795	14	5,541	(i)
(ii) Concrete	m^3	89,343	178	15,903	(ii)
(iii) Reinforcement ba	ton	352.48	1,115	393	(iii)
(iv) Others	L.S.			6,551	(iv)=((i)+(ii)+(iii)) 0.3
2. Intake				8,954	(2)=(i)+(ii)+(iii)+(iv)
(i) Excavation	m^3	76,196	16	1,219	(i)
(ii) Concrete	m^3	27,093	174	4,714	(ii)
(iii) Reinforcement ba	ton	1,083.72	1,135	1,230	(iii)
(iv) Others	L.S.			1,791	(iv)=((i)+(ii)+(iii)) 0.25
3. Headrace				51,942	(3)=(i)+(ii)+(iii)+(iv)
(i) Excavation	m^3	329,720	69	22,751	(i)
(ii) Concrete	m^3	106,562	163	17,370	(ii)
(iii) Reinforcement ba	ton	4,262.47	1,184	5,047	(iii)
(iv) Others	L.S.			6,775	(iv)=((i)+(ii)+(iii)) 0.15
4. Penstock				2,696	(4)=(i)+(ii)+(iii)+(iv)
(i) Excavation	m^3	19,675	73	1,432	(i)
(ii) Concrete	m^3	6,104	119	728	(ii)
(iii) Reinforcement ba	ton	73.25	1,184	87	(iii)
(iv) Others	L.S.			449	(iv)=((i)+(ii)+(iii)) 0.2
5. Powerhouse				31,530	(5)=(i)+(ii)+(iii)+(iv)
(i) Excavation	m^3	157,837	75	11,913	(i)
(ii) Concrete	m^3	32,656	232	7,563	(ii)
(iii) Reinforcement ba	ton	1,306.24	1,182	1,544	(iii)
(iv) Others	L.S.			10,510	(iv)=((i)+(ii)+(iii)) 0.5
6. Transformer Hall				25,122	(5)=(i)+(ii)+(iii)+(iv)
(i) Excavation	m^3	101,233	75	7,641	(i)
(ii) Concrete	m^3	32,656	232	7,563	(ii)
(iii) Reinforcement ba	ton	1,306.24	1,182	1,544	(iii)
(iv) Others	L.S.			8,374	(iv)=((i)+(ii)+(iii)) 0.5
7. Surge Chamber				0	(6)=(i)+(ii)+(iii)+(iv)
(i) Excavation	m^3	0	73	0	(i)
(ii) Concrete	m^3	0	119	0	(ii)
(iii) Reinforcement ba	ton	0	1,184	0	(iii)
(iv) Others	L.S.			0	(iv)=((i)+(ii)+(iii)) 0.55
8. Tailrace Tunnel				641,760	(7)=(i)+(ii)+(iii)+(iv)
(i) Excavation	m^3	4,259,200	69	295,432	(i)
(ii) Concrete	m^3	941,978	163	153,626	(ii)
(iii) Reinforcement ba	ton	37,679	1,184	44,604	(iii)
(iv) Others	L.S.			148,098	(iv)=((i)+(ii)+(iii)) 0.3
9. Outlet				3,173	(7)=(i)+(ii)+(iii)+(iv)
(i) Excavation	m^3	21,278	16	350	(i)
(ii) Concrete	m^3	11,986	174	2,091	(ii)
(iii) Reinforcement ba	ton	86	1,135	97	(iii)
(iv) Others	L.S.			635	(iv)=((i)+(ii)+(iii)) 0.25
10. Access Tunnel				13,787	(8)=(i)+(ii)+(iii)+(iv)
(i) Excavation	m^3	63,000	64	4,038	(i)
(ii) Concrete	m^3	14,000	212	2,967	(ii)
(iii) Reinforcement ba	ton	4,200	1,068	4,484	(iii)
(iv) Others	L.S.			2,298	(iv)=((i)+(ii)+(iii)) 0.2
11. Miscellaneous	L.S.			39,466	(9)=Σ((1)−(9))× 0.05
Sub Total				853,915	

Total Excavation Volume (m3) 5,423,934
Total Concrete Volume (m3) 1,262,379

Hydromechanical Equipment

Cost

Item	Unit	Quantity	Unit cost (US$)	Cost (10^3US$)
1. Intake Dam				446
Regulating Radial Gate	ton	45	9,900	446
2. Intake				10,526
Gate	ton	985	8,300	8,174
Screen	ton	547	4,300	2,353
3. Penstock (steel pipe)	ton	1,042	4,700	4,899
4. Tailrace gate	ton	985	8,300	8,174
5. Others	L.S.	20%		4,809
Subtotal				28,854

Electromechanical Equipment Cost

No.	Item	Cost (10^3US$)
	ELECTRO MECHANICAL EQUIPMENT	
	Inlet Valves & Handling Equipment	
	Turbines	
	Mechanical auxiliaries	
	Generators	
	Generation Voltage Connection	
	Electrical auxiliaries	
	Overhead Traveling Crane	
	Transformers	
	Control, protection, metering	
	GIS switching station	
	Cable yard & outstation equipment	
	400kV XLPE Power Cable	
	Cable and earthing	
	Communication	
	Spare parts	
	TOTAL	**178,700**

Hydropower Project Total Construction Cost

Location : ORIANG

Maximum Dischrge :	840 m^3/s
Installed Capacity :	392 MW
Annual Firm Energy Production :	1,679 GWh
Annual Total Energy Production :	2,768 GWh

Item	Cost (x10³US$)	Note
1. Preparation and Land acquision	52,078	
(1) Access road	30,000	1,000x10³US$/km × 30 km
(2) Compensation & Resettlment	5,000	
(3) Camp & Facilities	17,078	(3. Civil work)× 2%
2. Environmental mitigation cost	42,696	(3. Civil work)× 5%
3. Civil work	853,915	
(1) Weir	35,486	
(2) Intake	8,954	
(3) Headrace	51,942	
(4) Penstock	2,696	
(5) Powerhouse	31,530	
(6) Transformer Hall	25,122	
(7) Surge chamber	0	
(8) Tailrace tunnel	641,760	
(9) Outlet	3,173	
(10) Access tunnel	13,787	
(11) Miscellaneous	39,466	
4. Hydraulic euipment	28,854	
(1) Gate and screen	23,955	
(2) Penstock	4,899	
5. Electro-mechanical equipment	178,700	Installed Capacity 392 MW
6. Transmission line	13,260	Ayago-Karuma 34 km
Direct cost	1,169,503	
7. Administration and Engineering service	175,426	Direct cost × 15%
8. Contingency	116,950	Direct cost × 10%
9. Interest during construction	292,376	Interest Rate 10% 5years
Total cost	1,754,255	

Construction Cost	4475.1 USD/kW
Generation Cost for Firm Energy	11.58 cent/kWh
Generation Cost for Total Energy	7.03 cent/kWh

5. Ayago

AYAGO

Items	Unit	AYAGO
		Run-of-River
General		
Installed Capacity (Maximum Output)	MW	616
Maximum Discharge (For Installed Capacity)	m^3/s	840
Annual Firm Energy Production (90%)	GWh/Y	2,641
Annual Total Energy Production	GWh/Y	4,357
Weir		
Type		Concrete
Dam Height	m	20
Crest Length	m	480
Design Flood Discharge	m^3/s	4000
Waterway		
Intake		
Number of Intake	nos	6
Inner Diameter	m	8.4
Available drawdaown	m	1
Headrace Tunnel Type		
Number of Tunnel	nos	6
Inner Diameter	m	8.4
Length	m	96
Lining concrete thickness	m	0.8
Penstock		
Number of Tunnel	nos	12
Inner Diameter	m	3.8
Length	m	50
Lining concrete thickness	m	0.5
Design Head	m	87
Tailrace		
Number of Tunnel	nos	6
Inner Diameter	m	8.4
Length	m	7,600
Lining concrete thickness		0.6
Surge Chamber		
Number of Chamber	nos	6
Length	m	0
Available drawdaown	m	0
Outlet		
Number of Tunnel	nos	6
Inner Diameter	m	8.4
Powerhouse (Underground)		
Number of Unit	nos	12
Height	m	32
Effective Head	m	83
Powerhouse Access Tunnel		
Over Burden	m	130
Transformer Hall (Underground)		
Height	m	12.5
Effective Head	m	83
Electromechanical Equipment		
Lamp sum cost	10^3USD	245,200
Transmission Line		
Length	km	46
Access Road		
Length	km	45

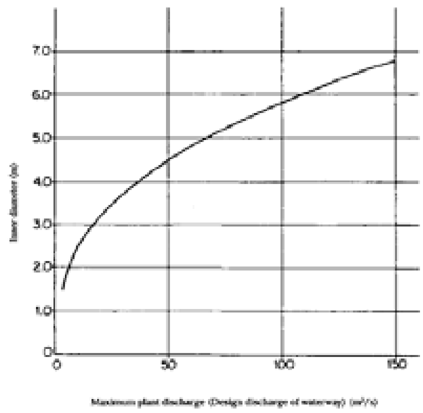


Figure 6.2.1 Inner Diameter of Waterway

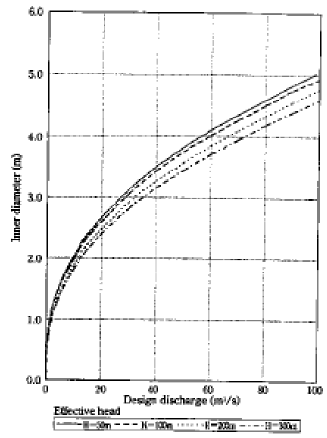
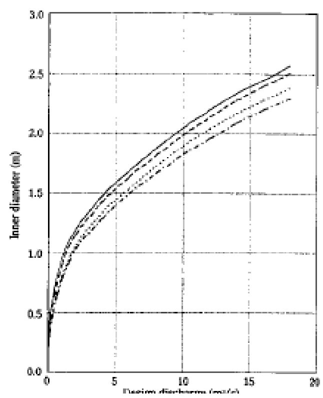


Figure 6.2.2 (1) Inner Diameter of Penstock



Civil Work Quantities :

1) Intake Weir

Hd:	Weir Height	20	m
L:	Crest Length of Weir	480	m
Qf:	Design Flood Discharge	4000	m^3/s

Ve: Excavation volume	$8.69 \times (Hd \times L)^{1.14}$	301,168	m^3
Vc: Concrete volume	$16.1 \times (Hd^2 \times L)^{0.695}$	75,635	m^3
Wr: Weight of reinforcement bars	$0.0274 \times Vc^{0.83}$	306.96	ton
Wg: Weight of gate	$0.145 \times Qf^{0.692}$	45.08	ton

2) Intake

Q:	Maximun Plant Discharge	840	m^3/s
ha:	Available drawdaown	1	m
D:	Inner diameter of waterway	8.40	m
n:	Number of waterway channels	6	
q:	Design discharge (Q/n)	140	m^3/s

Ve: Excavation volume	$130 \times (((ha+D) \times Q)^{1/2} \times n^{1/3})^{1.27}$	82,829	m^3
Vc: Concrete volume	$56.5 \times (((ha+D) \times Q)^{1/2} \times n^{1/3})^{1.23}$	29,374	m^3
Wr: Weight of reinforcement bars	$0.04 \times Vc$	1,174.96	ton
Wg: Weight of gate	$0.9 \times (ha+D)^{1/9} \times Q$	969.72	ton
Ws: Weight of screen	$0.5 \times (ha+D)^{1/9} \times Q$	538.73	ton

3) Headrace

R:	Tuunel radius	4.2	m
$t_{0:}$	Lining concrete thickness	0.80	m
L:	Total length of waterway	96	m
n:	Number of waterway channels	6	

Ve: Excavation volume	$3.2 \times (R+t_0)^2 \times L \times n$	46,080	m^3
Vc: Concrete volume	$(3.2 \times (R+t_0)^2 - \pi R^2) \times L \times n$	14,176	m^3
Wr: Weight of reinforcement bars	$0.04 \times Vc$	567.02	ton

4) Penstock

D_m:	Inner diameter of penstock	3.8	m
t:	Thickness of backfill concrete	0.5	m
L:	Total length of penstock	50	m
H:	Desigh Head	87	m
n:	Number of waterway channels	12	

t_m: Thickness of steel penstock	$0.0313 \times H \times D_m + 2$	12.348	mm
Ve: Excavation volume	$\pi/4 \times (Dm+2t)^2 \times L \times n$	10,852	m^3
Vc: Concrete volume	$\pi/4 \times ((Dm+2t)^2 - Dm^2) \times L \times n$	4,051	m^3
Wr: Weight of reinforcement bars	$0.012 \times Vc$	48.61	ton
Wp: Weight of steel conduit	$7.85 \times \pi \times D_m \times t_m \times 1.1 \times L \times n$	763	ton

5) Powerhouse

Q:	Maximun Plant Discharge	840	m^3/s
He:	Effective head	83	m
d:	Height of powerhouse	32	m

A: Area of powerhouse	$20 \times Q^{1/2} \times He^{1/3}$	2,528	m^2
Ve: Excavation volume	$27 \times A + 1.3 \times A \times d$	173,429	m^3
Vc: Concrete volume	$15 \times A$	37,922	m^3
Wr: Weight of reinforcement bars	$0.6 \times A$	1,516.87	ton

6) Transformer Hall

Q:	Maximun Plant Discharge	840	m^3/s
He:	Effective head	83	m
d:	Height of Hall	13	m

A: Area of powerhouse	$20 \times Q^{1/2} \times He^{1/3}$	2,528	m^2
Ve: Excavation volume	27×A+1.3×A×d	109,341	m^3
Vc: Concrete volume	15×A	37,922	m^3
Wr: Weight of reinforcement bars	0.6×A	1,516.87	ton

7) Tailrace

R:	Tuunel radius	4.2	m
$t_{0:}$	Lining concrete thickness	0.60	m
L:	Total length of waterway	7,600	m
n:	Number of waterway	6	

Ve: Excavation volume	$3.2 \times (R+t_0)^2 \times L \times n$	3,361,997	m^3
Vc: Concrete volume	$(3.2 \times (R+t_0)^2 - \pi R^2) \times L \times n$	836,231	m^3
Wr: Weight of reinforcement bars	0.04×Vc	33,449	ton

8) Outlet

Q:	Maximun Plant Discharge	840	m^3/s
R:	Tuunel radius	4.2	m
n:	Number of waterway	6	
q:	Design discharge (Q/n)	140	m^3/s

Ve: Excavation volume	$395 \times (R \times Q)^{0.479}$	19,763	m^3
Vc: Concrete volume	$40.4 \times (R \times Q)^{0.684}$	10,787	m^3
Wr: Weight of reinforcement bars	$0.278 \times Vc^{0.610}$	80	ton

9) Access Tunnel for Underground Powerhouse

i:	Gradient of tunnel	0.1	
He:	Over Burden	130	m

L: Length of access tunnel	He/i	1,300	m
Ve: Excavation volume	45×L	58,500	m^3
Vc: Concrete volume	10×L	13,000	m^3
Wr: Weight of reinforcement bars	0.3×Vc	3,900	ton

Civil Work Cost **Ayago** **Run-of-River**

Item	Unit	Quantity	Unit cost (US$)	Cost (10^3US$)	Calculation method of construction cost
1. Dam				29,285	(1.1)+(1.2)
1.1. Care of river				5,857	(1.1)=(1.2)× 0.25
1.2. Weir				23,428	(1.2)=(i)+(ii)+(iii)+(iv)
(i) Excavation	m^3	301,168	14	4,216	(i)
(ii) Concrete	m^3	75,635	178	13,463	(ii)
(iii) Reinforcement ba	ton	306.96	1,115	342	(iii)
(iv) Others	L.S.			5,406	(iv)=((i)+(ii)+(iii)) 0.3
2. Intake				9,712	(2)=(i)+(ii)+(iii)+(iv)
(i) Excavation	m^3	82,829	16	1,325	(i)
(ii) Concrete	m^3	29,374	174	5,111	(ii)
(iii) Reinforcement ba	ton	1,174.96	1,135	1,334	(iii)
(iv) Others	L.S.			1,942	(iv)=((i)+(ii)+(iii)) 0.25
3. Headrace				7,086	(3)=(i)+(ii)+(iii)+(iv)
(i) Excavation	m^3	46,080	69	3,180	(i)
(ii) Concrete	m^3	14,176	163	2,311	(ii)
(iii) Reinforcement ba	ton	567.02	1,184	671	(iii)
(iv) Others	L.S.			924	(iv)=((i)+(ii)+(iii)) 0.15
4. Penstock				1,596	(4)=(i)+(ii)+(iii)+(iv)
(i) Excavation	m^3	10,852	73	790	(i)
(ii) Concrete	m^3	4,051	119	483	(ii)
(iii) Reinforcement ba	ton	48.61	1,184	58	(iii)
(iv) Others	L.S.			266	(iv)=((i)+(ii)+(iii)) 0.2
5. Powerhouse				35,498	(5)=(i)+(ii)+(iii)+(iv)
(i) Excavation	m^3	173,429	75	13,090	(i)
(ii) Concrete	m^3	37,922	232	8,783	(ii)
(iii) Reinforcement ba	ton	1,516.87	1,182	1,793	(iii)
(iv) Others	L.S.			11,833	(iv)=((i)+(ii)+(iii)) 0.5
6. Transformer Hall				28,243	(5)=(i)+(ii)+(iii)+(iv)
(i) Excavation	m^3	109,341	75	8,253	(i)
(ii) Concrete	m^3	37,922	232	8,783	(ii)
(iii) Reinforcement ba	ton	1,516.87	1,182	1,793	(iii)
(iv) Others	L.S.			9,414	(iv)=((i)+(ii)+(iii)) 0.5
7. Surge Chamber				0	(6)=(i)+(ii)+(iii)+(iv)
(i) Excavation	m^3	0	73	0	(i)
(ii) Concrete	m^3	0	119	0	(ii)
(iii) Reinforcement ba	ton	0	1,184	0	(iii)
(iv) Others	L.S.			0	(iv)=((i)+(ii)+(iii)) 0.55
8. Tailrace Tunnel				531,928	(7)=(i)+(ii)+(iii)+(iv)
(i) Excavation	m^3	3,361,997	69	233,199	(i)
(ii) Concrete	m^3	836,231	163	136,380	(ii)
(iii) Reinforcement ba	ton	33,449	1,184	39,596	(iii)
(iv) Others	L.S.			122,753	(iv)=((i)+(ii)+(iii)) 0.3
9. Outlet				2,873	(7)=(i)+(ii)+(iii)+(iv)
(i) Excavation	m^3	19,763	16	325	(i)
(ii) Concrete	m^3	10,787	174	1,882	(ii)
(iii) Reinforcement ba	ton	80	1,135	91	(iii)
(iv) Others	L.S.			575	(iv)=((i)+(ii)+(iii)) 0.25
10. Access Tunnel				12,802	(8)=(i)+(ii)+(iii)+(iv)
(i) Excavation	m^3	58,500	64	3,750	(i)
(ii) Concrete	m^3	13,000	212	2,755	(ii)
(iii) Reinforcement ba	ton	3,900	1,068	4,164	(iii)
(iv) Others	L.S.			2,134	(iv)=((i)+(ii)+(iii)) 0.2
11. Miscellaneous	L.S.			31,539	(9)=Σ((1)-(9))× 0.05
Sub Total				690,562	

Total Excavation Volume (m3) 4,163,960
Total Concrete Volume (m3) 1,059,096

Hydromechanical Equipment Cost

Item	Unit	Quantity	Unit cost (US$)	Cost (10^3US$)
1. Intake Dam				446
Regulating Radial Gate	ton	45	9,900	446
2. Intake				10,365
Gate	ton	970	8,300	8,049
Screen	ton	539	4,300	2,317
3. Penstock (steel pipe)	ton	763	4,700	3,588
4. Tailrace gate	ton	970	8,300	8,049
5. Others	L.S.	20%		4,490
Subtotal				26,937

Electromechanical Equipment Cost

No.	Item	Cost (103US$)
	ELECTRO MECHANICAL EQUIPMENT Inlet Valves & Handling Equipment Turbines Mechanical auxiliaries Generators Generation Voltage Connection Electrical auxiliaries Overhead Traveling Crane Transformers Control, protection, metering GIS switching station Cable yard & outstation equipment 400kV XLPE Power Cable Cable and earthing Communication Spare parts	
	TOTAL	**245,200**

Hydropower Project Total Construction Cost

Location : AYAGO Run-of-River

Maximum Dischrge :	840	m^3/s
Installed Capacity :	616	MW
Annual Firm Energy Production :	2,641	GWh
Annual Total Energy Production :	4,357	GWh

Item	Cost (x10³US$)	Note
1. Preparation and Land acquision	63,811	
(1) Access road	45,000	1,000x10³US$/km› 45 km
(2) Compensation & Resettlment	5,000	
(3) Camp & Facilities	13,811	(3. Civil work)× 2%
2. Environmental mitigation cost	34,528	(3. Civil work)× 5%
3. Civil work	690,562	
(1) Weir	29,285	
(2) Intake	9,712	
(3) Headrace	7,086	
(4) Penstock	1,596	
(5) Powerhouse	35,498	
(6) Transformer Hall	28,243	
(7) Surge chamber	0	
(8) Tailrace tunnel	531,928	
(9) Outlet	2,873	
(10) Access tunnel	12,802	
(11) Miscellaneous	31,539	
4. Hydraulic euipment	26,937	
(1) Gate and screen	23,350	
(2) Penstock	3,588	
5. Electro-mechanical equipment	245,200	Installed Capacity 616 MW
6. Transmission line	17,940	Ayago-Karuma 46 km
Direct cost	1,078,978	
7. Administration and Engineering service	161,847	Direct cost × 15%
8. Contingency	107,898	Direct cost × 10%
9. Interest during construction	269,745	Interest Rate 10% 5years
Total cost	1,618,468	

Construction Cost	2627.4	USD/kW
Generation Cost for Firm Energy	6.79	cent/kWh
Generation Cost for Total Energy	4.12	cent/kWh

6. Kiba

KIBA

Items	Unit	KIBA
		Run-of-River
General		
Installed Capacity (Maximum Output)	MW	292
Maximum Discharge (For Installed Capacity)	m^3/s	840
Annual Firm Energy Production (90%)	GWh/Y	1,253
Annual Total Energy Production	GWh/Y	2,066
Weir		
Type		Concrete
Dam Height	m	20
Crest Length	m	550
Design Flood Discharge	m^3/s	4,000
Waterway		
Intake		
Number of Intake	nos	6
Inner Diameter	m	8.40
Available drawdaown	m	1
Headrace Tunnel Type		
Number of Tunnel	nos	6
Inner Diameter	m	8.4
Length	m	390
Lining concrete thickness	m	0.8
Penstock		
Number of Tunnel	nos	6
Inner Diameter	m	5.4
Length	m	55
Lining concrete thickness	m	0.5
Design Head	m	47
Tailrace		
Number of Tunnel	nos	6
Inner Diameter	m	8.4
Length	m	14,000
Lining concrete thickness		0.6
Surge Chamber		
Number of Chamber	nos	6
Length	m	0
Available drawdaown	m	0
Outlet		
Number of Tunnel	nos	6
Inner Diameter	m	8.4
Powerhouse (Underground)		
Number of Unit	nos	6
Height	m	45
Effective Head	m	40
Powerhouse Access Tunnel		
Over Burden	m	100
Transformer Hall (Underground)		
Area of Transformer Hall	m2	
Height	m	15
Effective Head	m	40
Electromechanical Equipment		
Lamp sum cost	10^3USD	146,500
Transmission Line		
Length	km	56
Access Road		
Length	km	55

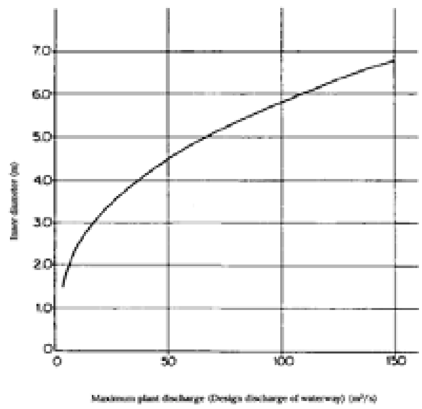


Figure 6.2.1 Inner Diameter of Waterway

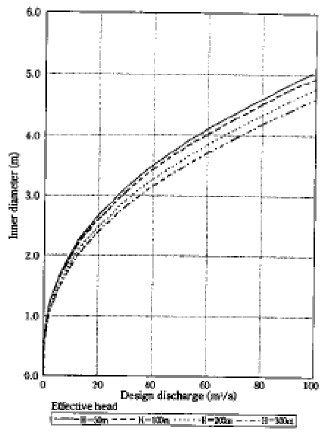
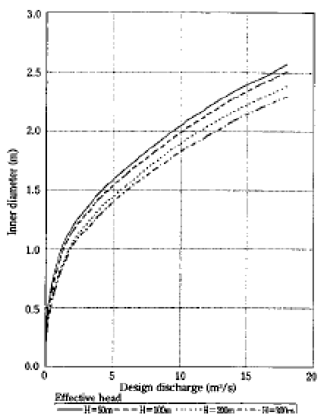


Figure 6.2.2 (1) Inner Diameter of Penstock



Civil Work Quantities :

1) Intake Weir

Hd:	Weir Height	20	m
L:	Crest Length of Weir	550	m
Qf:	Design Flood Discharge	4,000	m^3/s

Ve: Excavation volume	$8.69 \times (Hd \times L)^{1.14}$	351,728	m^3
Vc: Concrete volume	$16.1 \times (Hd^2 \times L)^{0.695}$	83,140	m^3
Wr: Weight of reinforcement bars	$0.0274 \times Vc^{0.83}$	332.04	ton
Wg: Weight of gate	$0.145 \times Qf^{0.692}$	45.08	ton

2) Intake

Q:	Maximun Plant Discharge	840	m^3/s
ha:	Available drawdaown	1	m
D:	Inner diameter of waterway	8.40	m
n:	Number of waterway channels	6	
q:	Design discharge (Q/n)	140	m^3/s

Ve: Excavation volume	$130 \times (((ha+D) \times Q)^{1/2} \times n^{1/3})^{1.27}$	82,829	m^3
Vc: Concrete volume	$56.5 \times (((ha+D) \times Q)^{1/2} \times n^{1/3})^{1.23}$	29,374	m^3
Wr: Weight of reinforcement bars	$0.04 \times Vc$	1,174.96	ton
Wg: Weight of gate	$0.9 \times (ha+D)^{1/9} \times Q$	969.72	ton
Ws: Weight of screen	$0.5 \times (ha+D)^{1/9} \times Q$	538.73	ton

3) Headrace

R:	Tuunel radius	4.2	m
t_0:	Lining concrete thickness	0.80	m
L:	Total length of waterway	390	m
n:	Number of waterway channels	6	

Ve: Excavation volume	$3.2 \times (R+t_0)^2 \times L \times n$	187,200	m^3
Vc: Concrete volume	$(3.2 \times (R+t_0)^2 - \pi R^2) \times L \times n$	57,588	m^3
Wr: Weight of reinforcement bars	$0.04 \times Vc$	2,303.53	ton

4) Penstock

D_{m}:	Inner diameter of penstock	5.4 m
t:	Thickness of backfill concrete	0.5 m
L:	Total length of penstock	55 m
H:	Desigh Head	47 m
n:	Number of waterway channels	6

t_m: Thickness of steel penstock	$0.0313 \times H \times D_m + 2$	9.944 mm
Ve: Excavation volume	$\pi/4 \times (Dm+2t)^2 \times L \times n$	10,611 m^3
Vc: Concrete volume	$\pi/4 \times ((Dm+2t)^2 - Dm^2) \times L \times n$	3,057 m^3
Wr: Weight of reinforcement bars	$0.012 \times Vc$	36.68 ton
Wp: Weight of steel conduit	$7.85 \times \pi \times D_m \times t_m \times 1.1 \times L \times n$	480 ton

5) Powerhouse

Q:	Maximun Plant Discharge	840 m^3/s
He:	Effective head	40 m
d:	Height of powerhouse	45 m

A: Area of powerhouse	$20 \times Q^{1/2} \times He^{1/3}$	1,982 m^2
Ve: Excavation volume	$27 \times A + 1.3 \times A \times d$	169,474 m^3
Vc: Concrete volume	$15 \times A$	29,732 m^3
Wr: Weight of reinforcement bars	$0.6 \times A$	1,189.29 ton

6) Transformer Hall

Q:	Maximun Plant Discharge	840	m^3/s
He:	Effective head	40	m
d:	Height of Hall	15	m

A: Area of powerhouse	$20 \times Q^{1/2} \times He^{1/3}$	1,982	m^2
Ve: Excavation volume	27×A+1.3×A×d	92,170	m^3
Vc: Concrete volume	15×A	29,732	m^3
Wr: Weight of reinforcement bars	0.6×A	1,189.29	ton

7) Tailrace

R:	Tuunel radius	4.2	m
$t_{0:}$	Lining concrete thickness	0.60	m
L:	Total length of waterway	14,000	m
n:	Number of waterway	6	

Ve: Excavation volume	$3.2 \times (R+t_0)^2 \times L \times n$	6,193,152	m^3
Vc: Concrete volume	$(3.2 \times (R+t_0)^2 - \pi R^2) \times L \times n$	1,540,426	m^3
Wr: Weight of reinforcement bars	0.04×Vc	61,617	ton

8) Outlet

Q:	Maximun Plant Discharge	840	m^3/s
R:	Tuunel radius	4.2	m
n:	Number of waterway	6	
q:	Design discharge (Q/n)	140	m^3/s

Ve: Excavation volume	$395 \times (R \times Q)^{0.479}$	19,763	m^3
Vc: Concrete volume	$40.4 \times (R \times Q)^{0.684}$	10,787	m^3
Wr: Weight of reinforcement bars	$0.278 \times Vc^{0.610}$	80	ton

9) Access Tunnel for Underground Powerhouse

i:	Gradient of tunnel	0.1	
He:	Over Burden	100	m

L: Length of access tunnel	He/i	1,000	m
Ve: Excavation volume	45×L	45,000	m^3
Vc: Concrete volume	10×L	10,000	m^3
Wr: Weight of reinforcement bars	0.3×Vc	3,000	ton

Civil Work Cost **Kiba** **Run-of-River**

Item	Unit	Quantity	Unit cost (US$)	Cost (10^3US$)	Calculation method of construction cost
1. Dam				32,652	(1.1)+(1.2)
1.1. Care of river				6,530	(1.1)=(1.2)× 0.25
1.2. Weir				26,121	(1.2)=(i)+(ii)+(iii)+(iv)
(i) Excavation	m^3	351,728	14	4,924	(i)
(ii) Concrete	m^3	83,140	178	14,799	(ii)
(iii) Reinforcement ba	ton	332.04	1,115	370	(iii)
(iv) Others	L.S.			6,028	(iv)=((i)+(ii)+(iii)) 0.3
2. Intake				9,712	(2)=(i)+(ii)+(iii)+(iv)
(i) Excavation	m^3	82,829	16	1,325	(i)
(ii) Concrete	m^3	29,374	174	5,111	(ii)
(iii) Reinforcement ba	ton	1,174.96	1,135	1,334	(iii)
(iv) Others	L.S.			1,942	(iv)=((i)+(ii)+(iii)) 0.25
3. Headrace				28,786	(3)=(i)+(ii)+(iii)+(iv)
(i) Excavation	m^3	187,200	69	12,917	(i)
(ii) Concrete	m^3	57,588	163	9,387	(ii)
(iii) Reinforcement ba	ton	2,303.53	1,184	2,727	(iii)
(iv) Others	L.S.			3,755	(iv)=((i)+(ii)+(iii)) 0.15
4. Penstock				1,416	(4)=(i)+(ii)+(iii)+(iv)
(i) Excavation	m^3	10,611	73	772	(i)
(ii) Concrete	m^3	3,057	119	364	(ii)
(iii) Reinforcement ba	ton	36.68	1,184	43	(iii)
(iv) Others	L.S.			236	(iv)=((i)+(ii)+(iii)) 0.2
5. Powerhouse				31,624	(5)=(i)+(ii)+(iii)+(iv)
(i) Excavation	m^3	169,474	75	12,791	(i)
(ii) Concrete	m^3	29,732	232	6,886	(ii)
(iii) Reinforcement ba	ton	1,189.29	1,182	1,406	(iii)
(iv) Others	L.S.			10,541	(iv)=((i)+(ii)+(iii)) 0.5
6. Transformer Hall				22,873	(5)=(i)+(ii)+(iii)+(iv)
(i) Excavation	m^3	92,170	75	6,957	(i)
(ii) Concrete	m^3	29,732	232	6,886	(ii)
(iii) Reinforcement ba	ton	1,189.29	1,182	1,406	(iii)
(iv) Others	L.S.			7,624	(iv)=((i)+(ii)+(iii)) 0.5
7. Surge Chamber				0	(6)=(i)+(ii)+(iii)+(iv)
(i) Excavation	m^3	0	73	0	(i)
(ii) Concrete	m^3	0	119	0	(ii)
(iii) Reinforcement ba	ton	0	1,184	0	(iii)
(iv) Others	L.S.			0	(iv)=((i)+(ii)+(iii)) 0.55
8. Tailrace Tunnel				979,867	(7)=(i)+(ii)+(iii)+(iv)
(i) Excavation	m^3	6,193,152	69	429,577	(i)
(ii) Concrete	m^3	1,540,426	163	251,227	(ii)
(iii) Reinforcement ba	ton	61,617	1,184	72,941	(iii)
(iv) Others	L.S.			226,123	(iv)=((i)+(ii)+(iii)) 0.3
9. Outlet				2,873	(7)=(i)+(ii)+(iii)+(iv)
(i) Excavation	m^3	19,763	16	325	(i)
(ii) Concrete	m^3	10,787	174	1,882	(ii)
(iii) Reinforcement ba	ton	80	1,135	91	(iii)
(iv) Others	L.S.			575	(iv)=((i)+(ii)+(iii)) 0.25
10. Access Tunnel				9,848	(8)=(i)+(ii)+(iii)+(iv)
(i) Excavation	m^3	45,000	64	2,884	(i)
(ii) Concrete	m^3	10,000	212	2,119	(ii)
(iii) Reinforcement ba	ton	3,000	1,068	3,203	(iii)
(iv) Others	L.S.			1,641	(iv)=((i)+(ii)+(iii)) 0.2
11. Miscellaneous	L.S.			54,839	(9)=Σ((1)-(9))× 0.05
Sub Total				1,174,489	

Total Excavation Volume (m3) 7,151,927
Total Concrete Volume (m3) 1,793,836

Hydromechanical Equipment Cost

Item	Unit	Quantity	Unit cost (US$)	Cost (10^3US$)
1. Intake Dam				446
Regulating Radial Gate	ton	45	9,900	446
2. Intake				10,365
Gate	ton	970	8,300	8,049
Screen	ton	539	4,300	2,317
3. Penstock (steel pipe)	ton	480	4,700	2,258
4. Tailrace gate	ton	970	8,300	8,049
5. Others	L.S.	20%		4,224
Subtotal				25,342

Electromechanical Equipment Cost

No.	Item	Cost (10^3US$)
	ELECTRO MECHANICAL EQUIPMENT	
	Inlet Valves & Handling Equipment	
	Turbines	
	Mechanical auxiliaries	
	Generators	
	Generation Voltage Connection	
	Electrical auxiliaries	
	Overhead Traveling Crane	
	Transformers	
	Control, protection, metering	
	GIS switching station	
	Cable yard & outstation equipment	
	400kV XLPE Power Cable	
	Cable and earthing	
	Communication	
	Spare parts	
	TOTAL	**146,500**

Hydropower Project Total Construction Cost

Location : KIBA

Maximum Dischrge :	840	m^3/s
Installed Capacity :	292	MW
Annual Primary Energy Production	1,253	GWh
Annual Total Energy Production :	2,066	GWh

Item	Cost (x10^3US$)	Note
1. Preparation and Land acquision	83,490	
(1) Access road	55,000	1,000x10^3US$/km › 55 km
(2) Compensation & Resettlment	5,000	
(3) Camp & Facilities	23,490	(3. Civil work)× 2%
2. Environmental mitigation cost	58,724	(3. Civil work)× 5%
3. Civil work	1,174,489	
(1) Weir	32,652	
(2) Intake	9,712	
(3) Headrace	28,786	
(4) Penstock	1,416	
(5) Powerhouse	31,624	
(6) Transformer Hall	22,873	
(7) Surge chamber	0	
(8) Tailrace tunnel	979,867	
(9) Outlet	2,873	
(10) Access tunnel	9,848	
(11) Miscellaneous	54,839	
4. Hydraulic euipment	25,342	
(1) Gate and screen	23,084	
(2) Penstock	2,258	
5. Electro-mechanical equipment	146,500	Installed Capacity 292 MW
6. Transmission line	21,840	Ayago-Karuma 56 km
Direct cost	1,510,385	
7. Administration and Engineering service	226,558	Direct cost × 15%
8. Contingency	151,039	Direct cost × 10%
9. Interest during construction	377,596	Interest Rate 10% 5years
Total cost	2,265,578	

Construction Cost	7758.8	USD/kW
Generation Cost for Firm Energy	20.04	cent/kWh
Generation Cost for Total Energy	12.16	cent/kWh

7. Murchison

MURCHISON

Items	Unit	MURCHISON
		Dam & Waterway
General		
Installed Capacity (Maximum Output)	MW	655
Maximum Discharge (For Installed Capacity)	m^3/s	840
Annual Firm Energy Production (90%)	GWh/Y	1,403
Annual Total Energy Production	GWh/Y	2,314
Dam		
Type		Concrete
Dam Height	m	45
Crest Length	m	650
Width of River Bed	m	240
Design Flood Discharge	m^3/s	4,000
Waterway		
Intake		
Number of Intake	nos	6
Inner Diameter	m	8.4
Available drawdaown	m	2
Headrace Tunnel Type		
Number of Tunnel	nos	6
Inner Diameter	m	8.4
Length	m	290
Lining concrete thickness	m	0.8
Penstock		
Number of Tunnel	nos	12
Inner Diameter	m	4.8
Length	m	46
Lining concrete thickness	m	0.5
Design Head	m	90
Tailrace		
Number of Tunnel	nos	6
Inner Diameter	m	8.4
Length	m	1,800
Lining concrete thickness		0.60
Surge Chamber		
Number of Chamber	nos	6
Length	m	0
Available drawdaown	m	0
Outlet		
Number of Tunnel	nos	6
Inner Diameter	m	8.4
Powerhouse (Underground)		
Number of Unit	nos	12
Height	m	32
Effective Head	m	88
Powerhouse Access Tunnel		
Over Burden	m	100
Transformer Hall (Underground)		
Height	m	12.5
Effective Head	m	88
Electromechanical Equipment		
Lamp sum cost	10^3USD	249,100
Transmission Line		
Length	km	122
Access Road		
Length	km	30

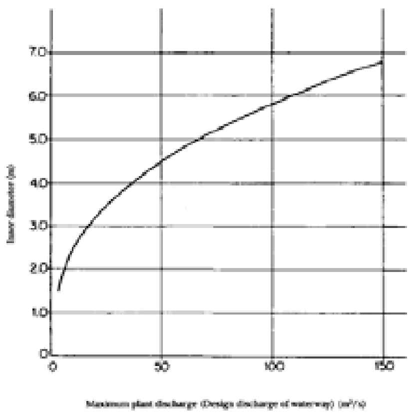


Figure 6.2.1 Inner Diameter of Waterway

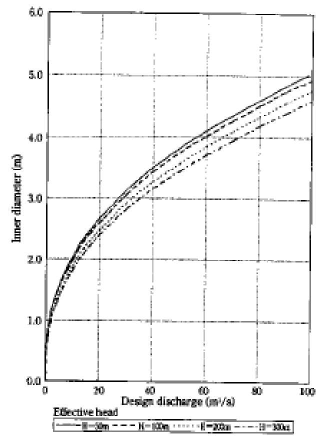
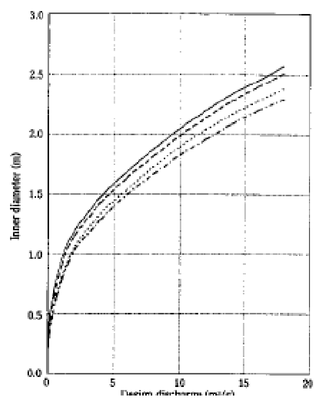


Figure 6.2.2 (1) Inner Diameter of Penstock



Civil Work Quantities :

1) Dam

Hd:	Dam Height	45	m
L:	Crest Length of Dam	650	m
B:	Width of River Bed	240	m
Qf:	Design Flood Discharge	4,000	m^3/s

Ve: Excavation volume	10×Hd×L	292,500	m^3
Vc: Concrete volume	$0.34\times(Hd^2\times L)$	447,525	m^3
Wg: Weight of gate	0.13×Qf	520.00	ton

2) Intake

Q:	Maximun Plant Discharge	840	m^3/s
ha:	Available drawdaown	2	m
D:	Inner diameter of waterway	8.40	m
n:	Number of waterway channels	6	
q:	Design discharge (Q/n)	140	m^3/s

Ve: Excavation volume	$130\times(((ha+D)\times Q)^{1/2}\times n^{1/3})^{1.27}$	88,320	m^3
Vc: Concrete volume	$56.5\times(((ha+D)\times Q)^{1/2}\times n^{1/3})^{1.23}$	31,258	m^3
Wr: Weight of reinforcement bars	0.04×Vc	1,250.33	ton
Wg: Weight of gate	$0.9\times(ha+D)^{1/9}\times Q$	980.68	ton
Ws: Weight of screen	$0.5\times(ha+D)^{1/9}\times Q$	544.82	ton

3) Headrace

R:	Tuunel radius	4.2	m
t_0:	Lining concrete thickness	0.80	m
L:	Total length of waterway	290	m
n:	Number of waterway channels	6	

Ve: Excavation volume	$3.2\times(R+t_0)^2\times L\times n$	139,200	m^3
Vc: Concrete volume	$(3.2\times(R+t_0)^2-\pi R^2)\times L\times n$	42,822	m^3
Wr: Weight of reinforcement bars	0.04×Vc	1,712.88	ton

4) Penstock

D_{m}:	Inner diameter of penstock	4.8	m
t:	Thickness of backfill concrete	0.5	m
L:	Total length of penstock	46	m
H:	Desigh Head	90	m
n:	Number of waterway channels	12	

t_m: Thickness of steel penstock	$0.0313 \times H \times D_m + 2$	15.522	mm
Ve: Excavation volume	$\pi /4 \times (Dm+2t)^2 \times L \times n$	14,577	m^3
Vc: Concrete volume	$\pi /4 \times ((Dm+2t)^2 - Dm^2) \times L \times n$	4,593	m^3
Wr: Weight of reinforcement bars	$0.012 \times Vc$	55.12	ton
Wp: Weight of steel conduit	$7.85 \times \pi \times D_m \times t_m \times 1.1 \times L \times n$	1,115	ton

5) Powerhouse

Q:	Maximun Plant Discharge	840	m^3/s
He:	Effective head	88	m
d:	Height of powerhouse	32	m

A: Area of powerhouse	$20 \times Q^{1/2} \times He^{1/3}$	2,578	m^2
Ve: Excavation volume	$27 \times A + 1.3 \times A \times d$	176,844	m^3
Vc: Concrete volume	$15 \times A$	38,668	m^3
Wr: Weight of reinforcement bars	$0.6 \times A$	1,546.74	ton

6) Transformer Hall

Q:	Maximun Plant Discharge	840	m^3/s
He:	Effective head	88	m
d:	Height of Hall	12.5	m

A: Area of powerhouse	$20\times Q^{1/2}\times He^{1/3}$	2,578	m^2
Ve: Excavation volume	$27\times A+1.3\times A\times d$	111,494	m^3
Vc: Concrete volume	$15\times A$	38,668	m^3
Wr: Weight of reinforcement bars	$0.6\times A$	1,546.74	ton

7) Tailrace

R:	Tuunel radius	4.2	m
t_{0}:	Lining concrete thickness	0.60	m
L:	Total length of waterway	1,800	m
n:	Number of waterway	6	

Ve: Excavation volume	$3.2\times(R+t_0)^2\times L\times n$	796,262	m^3
Vc: Concrete volume	$(3.2\times(R+t_0)^2-\pi R^2)\times L\times n$	198,055	m^3
Wr: Weight of reinforcement bars	$0.04\times Vc$	7,922	ton

8) Outlet

Q:	Maximun Plant Discharge	840	m^3/s
R:	Tuunel radius	4.2	m
n:	Number of waterway	6	
q:	Design discharge (Q/n)	140	m^3/s

Ve: Excavation volume	$395\times(R\times Q)^{0.479}$	19,763	m^3
Vc: Concrete volume	$40.4\times(R\times Q)^{0.684}$	10,787	m^3
Wr: Weight of reinforcement bars	$0.278\times Vc^{0.610}$	80	ton

9) Access Tunnel for Underground Powerhouse

i:	Gradient of tunnel	0.1	
He:	Over Burden	100	m

L: Length of access tunnel	He/i	1,000	m
Ve: Excavation volume	45×L	45,000	m^3
Vc: Concrete volume	10×L	10,000	m^3
Wr: Weight of reinforcement bars	0.3×Vc	3,000	ton

Civil Work Cost **Murchison Dam**

Item	Unit	Quantity	Unit cost (US$)	Cost (10^3US$)	Calculation method of construction cost
1. Dam				136,101	(1.1)+(1.2)
1.1. Care of river				27,220	(1.1)=(1.2)× 0.25
1.2. Dam				108,881	(1.2)=(i)+(ii)+(iii)+(iv)
(i) Excavation	m^3	292,500	14	4,095	(i)
(ii) Concrete	m^3	447,525	178	79,659	(ii)
(iii) Reinforcement ba	ton	0.00	1,115	0	(iii)
(iv) Others	L.S.			25,126	(iv)=((i)+(ii)+(iii)˙ 0.3
2. Intake				10,339	(2)=(i)+(ii)+(iii)+(iv)
(i) Excavation	m^3	88,320	16	1,413	(i)
(ii) Concrete	m^3	31,258	174	5,439	(ii)
(iii) Reinforcement ba	ton	1,250.33	1,135	1,419	(iii)
(iv) Others	L.S.			2,068	(iv)=((i)+(ii)+(iii)˙ 0.25
3. Headrace				21,405	(3)=(i)+(ii)+(iii)+(iv)
(i) Excavation	m^3	139,200	69	9,605	(i)
(ii) Concrete	m^3	42,822	163	6,980	(ii)
(iii) Reinforcement ba	ton	1,712.88	1,184	2,028	(iii)
(iv) Others	L.S.			2,792	(iv)=((i)+(ii)+(iii)˙ 0.15
4. Penstock				2,008	(4)=(i)+(ii)+(iii)+(iv)
(i) Excavation	m^3	14,577	73	1,061	(i)
(ii) Concrete	m^3	4,593	119	548	(ii)
(iii) Reinforcement ba	ton	55.12	1,184	65	(iii)
(iv) Others	L.S.			335	(iv)=((i)+(ii)+(iii)˙ 0.2
5. Powerhouse				36,197	(5)=(i)+(ii)+(iii)+(iv)
(i) Excavation	m^3	176,844	75	13,347	(i)
(ii) Concrete	m^3	38,668	232	8,955	(ii)
(iii) Reinforcement ba	ton	1,546.74	1,182	1,829	(iii)
(iv) Others	L.S.			12,066	(iv)=((i)+(ii)+(iii)˙ 0.5
6. Transformer Hall				28,799	(5)=(i)+(ii)+(iii)+(iv)
(i) Excavation	m^3	111,494	75	8,415	(i)
(ii) Concrete	m^3	38,668	232	8,955	(ii)
(iii) Reinforcement ba	ton	1,546.74	1,182	1,829	(iii)
(iv) Others	L.S.			9,600	(iv)=((i)+(ii)+(iii)˙ 0.5
7. Surge Chamber				0	(6)=(i)+(ii)+(iii)+(iv)
(i) Excavation	m^3	0	73	0	(i)
(ii) Concrete	m^3	0	119	0	(ii)
(iii) Reinforcement ba	ton	0	1,184	0	(iii)
(iv) Others	L.S.			0	(iv)=((i)+(ii)+(iii)˙ 0.55
8. Tailrace Tunnel				125,983	(7)=(i)+(ii)+(iii)+(iv)
(i) Excavation	m^3	796,262	69	55,231	(i)
(ii) Concrete	m^3	198,055	163	32,301	(ii)
(iii) Reinforcement ba	ton	7,922	1,184	9,378	(iii)
(iv) Others	L.S.			29,073	(iv)=((i)+(ii)+(iii)˙ 0.3
9. Outlet				2,873	(7)=(i)+(ii)+(iii)+(iv)
(i) Excavation	m^3	19,763	16	325	(i)
(ii) Concrete	m^3	10,787	174	1,882	(ii)
(iii) Reinforcement ba	ton	80	1,135	91	(iii)
(iv) Others	L.S.			575	(iv)=((i)+(ii)+(iii)˙ 0.25
10. Access Tunnel				9,848	(8)=(i)+(ii)+(iii)+(iv)
(i) Excavation	m^3	45,000	64	2,884	(i)
(ii) Concrete	m^3	10,000	212	2,119	(ii)
(iii) Reinforcement ba	ton	3,000	1,068	3,203	(iii)
(iv) Others	L.S.			1,641	(iv)=((i)+(ii)+(iii)˙ 0.2
11. Miscellaneous	L.S.			17,238	(9)=Σ((1)−(9))× 0.05
Sub Total				390,790	

Total Excavation Volume (m3) 1,683,961
Total Concrete Volume (m3) 822,377

Hydromechanical Equipment

Cost

Item	Unit	Quantity	Unit cost (US$)	Cost (10^3US$)
1. Intake Dam				5,148
Regulating Radial Gate	ton	520	9,900	5,148
2. Intake				10,482
Gate	ton	981	8,300	8,140
Screen	ton	545	4,300	2,343
3. Penstock (steel pipe)	ton	1,115	4,700	5,241
4. Tailrace gate	ton	981	8,300	8,140
5. Others	L.S.	20%		5,802
Subtotal				34,813

Electromechanical Equipment Cost

No.	Item	Cost (10^3US$)
	ELECTRO MECHANICAL EQUIPMENT	
	Inlet Valves & Handling Equipment	
	Turbines	
	Mechanical auxiliaries	
	Generators	
	Generation Voltage Connection	
	Electrical auxiliaries	
	Overhead Traveling Crane	
	Transformers	
	Control, protection, metering	
	GIS switching station	
	Cable yard & outstation equipment	
	400kV XLPE Power Cable	
	Cable and earthing	
	Communication	
	Spare parts	
	TOTAL	**249,100**

Hydropower Project Total Construction Cost

Location : MURCHISON **Dam & Waterway**

Maximum Dischrge :	840	m^3/s
Installed Capacity :	655	MW
Annual Firm Energy Production :	1,403	GWh
Annual Total Energy Production :	2,314	GWh

Item	Cost (x10^{3}US$)	Note
1. Preparation and Land acquision	42,816	
(1) Access road	30,000	1,000x10^{3}US$/km x 30 km
(2) Compensation & Resettlment	5,000	
(3) Camp & Facilities	7,816	(3. Civil work)× 2%
2. Environmental mitigation cost	19,540	(3. Civil work)× 5%
3. Civil work	390,790	
(1) Dam	136,101	
(2) Intake	10,339	
(3) Headrace	21,405	
(4) Penstock	2,008	
(5) Powerhouse	36,197	
(6) Transformer Hall	28,799	
(7) Surge chamber	0	
(8) Tailrace tunnel	125,983	
(9) Outlet	2,873	
(10) Access tunnel	9,848	
(11) Miscellaneous	17,238	
4. Hydraulic euipment	34,813	
(1) Gate and screen	29,572	
(2) Penstock	5,241	
5. Electro-mechanical equipment	249,100	Installed Capacity 655 MW
6. Transmission line	47,580	Ayago-Karuma 122 km
Direct cost	784,639	
7. Administration and Engineering service	117,696	Direct cost × 15%
8. Contingency	78,464	Direct cost × 10%
9. Interest during construction	156,928	Interest Rate 10% 4years
Total cost	1,137,727	

Construction Cost	1737	USD/kW
Generation Cost for Firm Energy	8.99	cent/kWh
Generation Cost for Total Energy	5.45	cent/kWh

Appendix I

Hydropower

LIST OF CONTENTS

Appendix I-1

Energy Calculation for Hydropower in Upper Nile River

Victoria Lake Monthly Outflow			Annual Average Power Discharge (m^3/s)	Energy Calculation for MP				
Duration (Month)	Probability	Flow / Maximum Power Discharge (m^3/s)		Plant Factor (%)	Annual Energy Production (GWh)			
					Owen Falls	Bujagali	Kalagala	Isimba
1	0.04%	1,722.3	865	50.20	1,354	1,377	1,817	759
2	0.11%	1,715.9	865	50.38	1,354	1,377	1,817	759
3	0.18%	1,704.7	864	50.71	1,354	1,377	1,817	759
4	0.26%	1,698.4	864	50.90	1,354	1,377	1,817	759
5	0.33%	1,697.5	864	50.93	1,354	1,377	1,817	759
6	0.41%	1,668.9	864	51.79	1,354	1,377	1,817	758
7	0.48%	1,664.0	864	51.95	1,354	1,377	1,816	758
8	0.55%	1,653.2	864	52.28	1,354	1,377	1,816	758
9	0.63%	1,643.9	864	52.57	1,354	1,377	1,816	758
10	0.70%	1,640.4	864	52.68	1,354	1,376	1,816	758
11	0.77%	1,631.9	864	52.95	1,354	1,376	1,816	758
12	0.85%	1,626.0	864	53.14	1,353	1,376	1,816	758
13	0.92%	1,607.0	864	53.76	1,353	1,376	1,816	758
14	1.00%	1,599.8	864	54.00	1,353	1,376	1,815	758
15	1.07%	1,597.6	864	54.07	1,353	1,376	1,815	758
16	1.14%	1,588.7	864	54.37	1,353	1,376	1,815	758
17	1.22%	1,587.9	864	54.40	1,353	1,376	1,815	758
18	1.29%	1,585.3	864	54.48	1,353	1,376	1,815	758
19	1.36%	1,582.6	864	54.57	1,353	1,376	1,815	758
20	1.44%	1,580.6	864	54.64	1,353	1,376	1,815	758
21	1.51%	1,580.4	864	54.65	1,353	1,376	1,815	758
22	1.59%	1,580.0	864	54.66	1,353	1,376	1,815	758
23	1.66%	1,575.6	864	54.81	1,353	1,375	1,815	758
24	1.73%	1,571.8	863	54.94	1,352	1,375	1,815	758
25	1.81%	1,570.0	863	55.00	1,352	1,375	1,815	758
26	1.88%	1,564.8	863	55.17	1,352	1,375	1,814	758
27	1.95%	1,551.3	863	55.64	1,352	1,375	1,814	757
28	2.03%	1,547.6	863	55.77	1,352	1,375	1,814	757
29	2.10%	1,546.3	863	55.81	1,352	1,375	1,814	757
30	2.18%	1,545.0	863	55.86	1,352	1,375	1,814	757
31	2.25%	1,535.2	863	56.20	1,351	1,374	1,813	757
32	2.32%	1,528.6	863	56.43	1,351	1,374	1,813	757
33	2.40%	1,523.3	862	56.62	1,351	1,374	1,813	757
34	2.47%	1,511.4	862	57.05	1,350	1,373	1,812	757
35	2.54%	1,506.1	862	57.24	1,350	1,373	1,812	756
36	2.62%	1,503.1	862	57.35	1,350	1,373	1,812	756
37	2.69%	1,500.9	862	57.43	1,350	1,373	1,811	756
38	2.77%	1,500.5	862	57.44	1,350	1,373	1,811	756
39	2.84%	1,500.1	862	57.46	1,350	1,373	1,811	756
40	2.91%	1,498.3	862	57.52	1,350	1,373	1,811	756
41	2.99%	1,497.7	862	57.54	1,350	1,373	1,811	756
42	3.06%	1,497.2	862	57.56	1,350	1,373	1,811	756
43	3.13%	1,496.8	862	57.58	1,350	1,373	1,811	756
44	3.21%	1,492.3	862	57.74	1,350	1,372	1,811	756
45	3.28%	1,489.3	862	57.85	1,349	1,372	1,811	756
46	3.36%	1,481.1	861	58.15	1,349	1,372	1,810	756
47	3.43%	1,463.7	861	58.80	1,348	1,371	1,809	755
48	3.50%	1,463.7	861	58.80	1,348	1,371	1,809	755
49	3.58%	1,457.2	860	59.05	1,348	1,371	1,808	755
50	3.65%	1,454.2	860	59.16	1,348	1,370	1,808	755
51	3.72%	1,436.7	860	59.84	1,347	1,369	1,807	754
52	3.80%	1,435.2	860	59.90	1,347	1,369	1,807	754
53	3.87%	1,433.7	860	59.96	1,346	1,369	1,807	754
54	3.95%	1,433.7	860	59.96	1,346	1,369	1,807	754
55	4.02%	1,428.1	859	60.18	1,346	1,369	1,806	754
56	4.09%	1,422.1	859	60.42	1,346	1,368	1,806	754
57	4.17%	1,418.0	859	60.58	1,345	1,368	1,805	754
58	4.24%	1,417.3	859	60.61	1,345	1,368	1,805	754
59	4.31%	1,415.9	859	60.66	1,345	1,368	1,805	754
60	4.39%	1,415.4	859	60.68	1,345	1,368	1,805	754
61	4.46%	1,414.0	859	60.74	1,345	1,368	1,805	754
62	4.54%	1,413.9	859	60.74	1,345	1,368	1,805	754
63	4.61%	1,410.9	859	60.86	1,345	1,368	1,805	753
64	4.68%	1,408.2	859	60.97	1,345	1,367	1,804	753
65	4.76%	1,402.3	858	61.20	1,344	1,367	1,804	753
66	4.83%	1,393.2	858	61.57	1,344	1,366	1,803	753
67	4.90%	1,388.1	858	61.78	1,343	1,366	1,802	753
68	4.98%	1,384.8	857	61.92	1,343	1,366	1,802	752
69	5.05%	1,381.8	857	62.04	1,343	1,365	1,802	752
70	5.13%	1,376.2	857	62.27	1,342	1,365	1,801	752
71	5.20%	1,374.6	857	62.34	1,342	1,365	1,801	752
72	5.27%	1,372.4	857	62.43	1,342	1,365	1,801	752
73	5.35%	1,366.0	856	62.70	1,341	1,364	1,800	752
74	5.42%	1,365.0	856	62.74	1,341	1,364	1,800	751
75	5.49%	1,364.6	856	62.76	1,341	1,364	1,800	751
76	5.57%	1,363.5	856	62.80	1,341	1,364	1,800	751
77	5.64%	1,363.0	856	62.82	1,341	1,364	1,800	751
78	5.72%	1,361.6	856	62.88	1,341	1,364	1,799	751
79	5.79%	1,359.2	856	62.98	1,341	1,363	1,799	751
80	5.86%	1,359.0	856	62.99	1,341	1,363	1,799	751

Victoria Lake Monthly Outflow			Annual Average Power Discharge (m^3/s)	Energy Calculation for MP				
Duration (Month)	Probability	Flow / Maximum Power Discharge (m^3/s)		Plant Factor (%)	Annual Energy Production (GWh)			
					Owen Falls	Bujagali	Kalagala	Isimba
81	5.94%	1,356.4	856	63.10	1,341	1,363	1,799	751
82	6.01%	1,356.2	856	63.11	1,341	1,363	1,799	751
83	6.08%	1,354.7	856	63.17	1,340	1,363	1,798	751
84	6.16%	1,353.8	856	63.21	1,340	1,363	1,798	751
85	6.23%	1,352.7	856	63.26	1,340	1,363	1,798	751
86	6.31%	1,352.6	856	63.26	1,340	1,363	1,798	751
87	6.38%	1,352.6	856	63.26	1,340	1,363	1,798	751
88	6.45%	1,352.6	856	63.26	1,340	1,363	1,798	751
89	6.53%	1,349.7	855	63.38	1,340	1,363	1,798	751
90	6.60%	1,349.3	855	63.40	1,340	1,362	1,798	751
91	6.67%	1,347.8	855	63.46	1,340	1,362	1,798	751
92	6.75%	1,346.8	855	63.50	1,340	1,362	1,797	750
93	6.82%	1,346.0	855	63.54	1,340	1,362	1,797	750
94	6.90%	1,340.7	855	63.76	1,339	1,362	1,797	750
95	6.97%	1,340.4	855	63.78	1,339	1,362	1,796	750
96	7.04%	1,340.0	855	63.79	1,339	1,361	1,796	750
97	7.12%	1,337.5	855	63.90	1,339	1,361	1,796	750
98	7.19%	1,337.0	855	63.92	1,339	1,361	1,796	750
99	7.26%	1,336.0	855	63.96	1,338	1,361	1,796	750
100	7.34%	1,336.0	855	63.96	1,338	1,361	1,796	750
101	7.41%	1,335.9	855	63.97	1,338	1,361	1,796	750
102	7.49%	1,332.9	854	64.09	1,338	1,361	1,795	750
103	7.56%	1,332.1	854	64.13	1,338	1,361	1,795	750
104	7.63%	1,331.7	854	64.14	1,338	1,361	1,795	750
105	7.71%	1,329.2	854	64.25	1,338	1,360	1,795	749
106	7.78%	1,327.6	854	64.32	1,337	1,360	1,794	749
107	7.85%	1,325.0	854	64.43	1,337	1,360	1,794	749
108	7.93%	1,322.3	853	64.54	1,337	1,359	1,794	749
109	8.00%	1,321.7	853	64.57	1,337	1,359	1,794	749
110	8.08%	1,316.8	853	64.78	1,336	1,359	1,793	749
111	8.15%	1,316.1	853	64.81	1,336	1,359	1,793	748
112	8.22%	1,315.6	853	64.83	1,336	1,358	1,792	748
113	8.30%	1,315.3	853	64.84	1,336	1,358	1,792	748
114	8.37%	1,314.4	853	64.88	1,336	1,358	1,792	748
115	8.44%	1,314.2	853	64.89	1,336	1,358	1,792	748
116	8.52%	1,313.3	853	64.93	1,336	1,358	1,792	748
117	8.59%	1,312.4	853	64.97	1,336	1,358	1,792	748
118	8.67%	1,312.1	853	64.98	1,335	1,358	1,792	748
119	8.74%	1,305.0	852	65.29	1,335	1,357	1,791	748
120	8.81%	1,304.1	852	65.33	1,334	1,357	1,790	748
121	8.89%	1,303.0	852	65.37	1,334	1,357	1,790	747
122	8.96%	1,298.9	851	65.55	1,334	1,356	1,789	747
123	9.03%	1,297.5	851	65.62	1,333	1,356	1,789	747
124	9.11%	1,294.1	851	65.77	1,333	1,355	1,788	747
125	9.18%	1,292.9	851	65.81	1,333	1,355	1,788	747
126	9.26%	1,292.0	851	65.86	1,333	1,355	1,788	747
127	9.33%	1,291.8	851	65.86	1,333	1,355	1,788	747
128	9.40%	1,291.4	851	65.88	1,333	1,355	1,788	747
129	9.48%	1,291.4	851	65.88	1,333	1,355	1,788	747
130	9.55%	1,290.7	851	65.91	1,332	1,355	1,788	747
131	9.62%	1,290.3	851	65.93	1,332	1,355	1,788	746
132	9.70%	1,289.7	851	65.95	1,332	1,355	1,788	746
133	9.77%	1,289.0	851	65.99	1,332	1,355	1,787	746
134	9.85%	1,285.9	850	66.12	1,332	1,354	1,787	746
135	9.92%	1,284.3	850	66.19	1,332	1,354	1,787	746
136	9.99%	1,282.4	850	66.27	1,331	1,354	1,786	746
137	10.07%	1,280.6	850	66.35	1,331	1,353	1,786	746
138	10.14%	1,277.6	849	66.49	1,330	1,353	1,785	745
139	10.21%	1,277.4	849	66.50	1,330	1,353	1,785	745
140	10.29%	1,277.0	849	66.51	1,330	1,353	1,785	745
141	10.36%	1,276.9	849	66.52	1,330	1,353	1,785	745
142	10.44%	1,276.8	849	66.52	1,330	1,353	1,785	745
143	10.51%	1,276.1	849	66.55	1,330	1,353	1,785	745
144	10.58%	1,275.8	849	66.57	1,330	1,353	1,785	745
145	10.66%	1,274.6	849	66.62	1,330	1,352	1,784	745
146	10.73%	1,273.5	849	66.67	1,330	1,352	1,784	745
147	10.80%	1,273.1	849	66.68	1,330	1,352	1,784	745
148	10.88%	1,270.8	849	66.78	1,329	1,352	1,784	745
149	10.95%	1,269.7	849	66.83	1,329	1,352	1,783	745
150	11.03%	1,267.9	848	66.91	1,329	1,351	1,783	744
151	11.10%	1,267.4	848	66.94	1,329	1,351	1,783	744
152	11.17%	1,267.2	848	66.94	1,329	1,351	1,783	744
153	11.25%	1,265.3	848	67.03	1,328	1,351	1,782	744
154	11.32%	1,262.7	848	67.14	1,328	1,350	1,782	744
155	11.39%	1,261.9	848	67.18	1,328	1,350	1,782	744
156	11.47%	1,261.9	848	67.18	1,328	1,350	1,782	744
157	11.54%	1,261.9	848	67.18	1,328	1,350	1,782	744
158	11.62%	1,261.0	848	67.22	1,328	1,350	1,781	744
159	11.69%	1,259.8	847	67.27	1,327	1,350	1,781	744
160	11.76%	1,259.7	847	67.27	1,327	1,350	1,781	744

Victoria Lake Monthly Outflow			Annual Average Power Discharge (m^3/s)	Energy Calculation for MP				
Duration (Month)	Probability	Flow / Maximum Power Discharge (m^3/s)		Plant Factor (%)	Annual Energy Production (GWh)			
					Owen Falls	Bujagali	Kalagala	Isimba
161	11.84%	1,259.6	847	67.28	1,327	1,350	1,781	744
162	11.91%	1,258.9	847	67.31	1,327	1,350	1,781	744
163	11.98%	1,257.7	847	67.36	1,327	1,349	1,780	743
164	12.06%	1,257.1	847	67.39	1,327	1,349	1,780	743
165	12.13%	1,257.1	847	67.39	1,327	1,349	1,780	743
166	12.21%	1,256.3	847	67.42	1,327	1,349	1,780	743
167	12.28%	1,254.1	847	67.52	1,326	1,349	1,780	743
168	12.35%	1,250.8	846	67.67	1,326	1,348	1,779	743
169	12.43%	1,250.7	846	67.67	1,326	1,348	1,779	743
170	12.50%	1,250.0	846	67.70	1,326	1,348	1,778	743
171	12.57%	1,247.3	846	67.82	1,325	1,347	1,778	742
172	12.65%	1,246.5	846	67.86	1,325	1,347	1,778	742
173	12.72%	1,246.0	846	67.88	1,325	1,347	1,777	742
174	12.79%	1,245.4	846	67.91	1,325	1,347	1,777	742
175	12.87%	1,244.0	846	67.97	1,324	1,347	1,777	742
176	12.94%	1,242.3	845	68.04	1,324	1,346	1,776	742
177	13.02%	1,241.5	845	68.08	1,324	1,346	1,776	742
178	13.09%	1,241.1	845	68.09	1,324	1,346	1,776	742
179	13.16%	1,240.0	845	68.15	1,324	1,346	1,776	741
180	13.24%	1,239.5	845	68.16	1,323	1,346	1,776	741
181	13.31%	1,239.5	845	68.16	1,323	1,346	1,776	741
182	13.38%	1,237.0	845	68.28	1,323	1,345	1,775	741
183	13.46%	1,236.6	845	68.30	1,323	1,345	1,775	741
184	13.53%	1,236.1	844	68.32	1,323	1,345	1,775	741
185	13.61%	1,236.1	844	68.32	1,323	1,345	1,775	741
186	13.68%	1,236.0	844	68.32	1,323	1,345	1,775	741
187	13.75%	1,236.0	844	68.32	1,323	1,345	1,775	741
188	13.83%	1,234.6	844	68.39	1,322	1,345	1,774	741
189	13.90%	1,233.1	844	68.45	1,322	1,344	1,774	741
190	13.97%	1,232.5	844	68.48	1,322	1,344	1,774	741
191	14.05%	1,232.5	844	68.48	1,322	1,344	1,774	741
192	14.12%	1,232.1	844	68.50	1,322	1,344	1,774	741
193	14.20%	1,232.0	844	68.50	1,322	1,344	1,774	741
194	14.27%	1,231.7	844	68.51	1,322	1,344	1,773	740
195	14.34%	1,229.0	843	68.63	1,321	1,343	1,773	740
196	14.42%	1,229.0	843	68.63	1,321	1,343	1,773	740
197	14.49%	1,226.1	843	68.76	1,320	1,343	1,772	740
198	14.56%	1,226.0	843	68.76	1,320	1,343	1,772	740
199	14.64%	1,225.7	843	68.78	1,320	1,343	1,772	740
200	14.71%	1,224.0	843	68.85	1,320	1,342	1,771	739
201	14.79%	1,223.9	843	68.86	1,320	1,342	1,771	739
202	14.86%	1,223.5	843	68.87	1,320	1,342	1,771	739
203	14.93%	1,222.0	842	68.94	1,320	1,342	1,770	739
204	15.01%	1,221.0	842	68.98	1,319	1,342	1,770	739
205	15.08%	1,220.9	842	68.99	1,319	1,342	1,770	739
206	15.15%	1,220.5	842	69.01	1,319	1,341	1,770	739
207	15.23%	1,218.2	842	69.11	1,319	1,341	1,769	739
208	15.30%	1,218.0	842	69.12	1,319	1,341	1,769	739
209	15.38%	1,215.3	841	69.24	1,318	1,340	1,768	738
210	15.45%	1,213.0	841	69.34	1,317	1,340	1,768	738
211	15.52%	1,212.3	841	69.37	1,317	1,339	1,767	738
212	15.60%	1,211.4	841	69.41	1,317	1,339	1,767	738
213	15.67%	1,210.1	841	69.47	1,317	1,339	1,767	738
214	15.74%	1,200.0	839	69.92	1,314	1,336	1,763	736
215	15.82%	1,200.0	839	69.92	1,314	1,336	1,763	736
216	15.89%	1,199.7	839	69.93	1,314	1,336	1,763	736
217	15.97%	1,198.0	839	70.01	1,314	1,336	1,763	736
218	16.04%	1,196.0	838	70.10	1,313	1,335	1,762	736
219	16.11%	1,194.7	838	70.16	1,313	1,335	1,762	736
220	16.19%	1,194.0	838	70.19	1,313	1,335	1,761	735
221	16.26%	1,193.6	838	70.21	1,313	1,335	1,761	735
222	16.33%	1,193.0	838	70.24	1,312	1,335	1,761	735
223	16.41%	1,191.4	838	70.31	1,312	1,334	1,760	735
224	16.48%	1,190.0	837	70.37	1,312	1,334	1,760	735
225	16.56%	1,189.0	837	70.42	1,311	1,334	1,760	735
226	16.63%	1,189.0	837	70.42	1,311	1,334	1,760	735
227	16.70%	1,187.3	837	70.50	1,311	1,333	1,759	734
228	16.78%	1,187.0	837	70.51	1,311	1,333	1,759	734
229	16.85%	1,186.0	837	70.55	1,311	1,333	1,758	734
230	16.92%	1,183.3	836	70.68	1,310	1,332	1,758	734
231	17.00%	1,182.8	836	70.70	1,310	1,332	1,757	734
232	17.07%	1,182.5	836	70.71	1,310	1,332	1,757	734
233	17.15%	1,181.8	836	70.74	1,309	1,332	1,757	734
234	17.22%	1,181.7	836	70.75	1,309	1,332	1,757	734
235	17.29%	1,180.6	836	70.80	1,309	1,331	1,757	733
236	17.37%	1,180.2	836	70.82	1,309	1,331	1,756	733
237	17.44%	1,178.7	836	70.88	1,309	1,331	1,756	733
238	17.51%	1,178.3	835	70.90	1,309	1,331	1,756	733
239	17.59%	1,177.9	835	70.92	1,308	1,331	1,756	733
240	17.66%	1,177.1	835	70.96	1,308	1,330	1,755	733

Victoria Lake Monthly Outflow			Annual Average Power Discharge (m^3/s)	Energy Calculation for MP				
Duration (Month)	Probability	Flow / Maximum Power Discharge (m^3/s)		Plant Factor (%)	Annual Energy Production (GWh)			
					Owen Falls	Bujagali	Kalagala	Isimba
241	17.74%	1,176.0	835	71.01	1,308	1,330	1,755	733
242	17.81%	1,173.6	835	71.11	1,307	1,329	1,754	732
243	17.88%	1,173.2	835	71.13	1,307	1,329	1,754	732
244	17.96%	1,172.7	834	71.16	1,307	1,329	1,754	732
245	18.03%	1,171.7	834	71.20	1,307	1,329	1,753	732
246	18.10%	1,171.2	834	71.22	1,307	1,329	1,753	732
247	18.18%	1,171.0	834	71.23	1,307	1,329	1,753	732
248	18.25%	1,170.5	834	71.25	1,306	1,328	1,753	732
249	18.33%	1,168.6	834	71.34	1,306	1,328	1,752	732
250	18.40%	1,167.8	834	71.38	1,306	1,328	1,752	731
251	18.47%	1,165.0	833	71.51	1,305	1,327	1,751	731
252	18.55%	1,164.0	833	71.55	1,304	1,327	1,750	731
253	18.62%	1,163.0	833	71.60	1,304	1,326	1,750	731
254	18.69%	1,162.6	833	71.61	1,304	1,326	1,750	731
255	18.77%	1,162.3	833	71.63	1,304	1,326	1,750	731
256	18.84%	1,162.0	832	71.64	1,304	1,326	1,750	730
257	18.92%	1,158.5	832	71.80	1,303	1,325	1,748	730
258	18.99%	1,158.2	832	71.82	1,303	1,325	1,748	730
259	19.06%	1,158.0	832	71.82	1,303	1,325	1,748	730
260	19.14%	1,158.0	832	71.82	1,303	1,325	1,748	730
261	19.21%	1,157.4	832	71.85	1,303	1,325	1,748	730
262	19.28%	1,157.4	832	71.85	1,303	1,325	1,748	730
263	19.36%	1,156.6	831	71.89	1,302	1,324	1,747	730
264	19.43%	1,156.0	831	71.92	1,302	1,324	1,747	729
265	19.51%	1,155.2	831	71.95	1,302	1,324	1,747	729
266	19.58%	1,154.7	831	71.97	1,302	1,324	1,747	729
267	19.65%	1,153.5	831	72.03	1,301	1,323	1,746	729
268	19.73%	1,153.0	831	72.05	1,301	1,323	1,746	729
269	19.80%	1,152.6	831	72.07	1,301	1,323	1,746	729
270	19.87%	1,152.0	831	72.10	1,301	1,323	1,745	729
271	19.95%	1,150.0	830	72.19	1,300	1,322	1,745	728
272	20.02%	1,149.0	830	72.23	1,300	1,322	1,744	728
273	20.10%	1,148.9	830	72.24	1,300	1,322	1,744	728
274	20.17%	1,148.1	830	72.27	1,300	1,322	1,744	728
275	20.24%	1,147.3	830	72.31	1,299	1,321	1,743	728
276	20.32%	1,145.5	829	72.39	1,299	1,321	1,743	728
277	20.39%	1,144.3	829	72.44	1,298	1,320	1,742	727
278	20.46%	1,141.0	828	72.60	1,297	1,319	1,741	727
279	20.54%	1,140.0	828	72.64	1,297	1,319	1,740	727
280	20.61%	1,140.0	828	72.64	1,297	1,319	1,740	727
281	20.69%	1,139.9	828	72.65	1,297	1,319	1,740	727
282	20.76%	1,139.7	828	72.66	1,297	1,319	1,740	727
283	20.83%	1,138.4	828	72.72	1,297	1,318	1,740	726
284	20.91%	1,137.0	827	72.78	1,296	1,318	1,739	726
285	20.98%	1,137.0	827	72.78	1,296	1,318	1,739	726
286	21.05%	1,136.1	827	72.82	1,296	1,318	1,739	726
287	21.13%	1,135.4	827	72.85	1,296	1,317	1,738	726
288	21.20%	1,135.0	827	72.87	1,295	1,317	1,738	726
289	21.28%	1,135.0	827	72.87	1,295	1,317	1,738	726
290	21.35%	1,135.0	827	72.87	1,295	1,317	1,738	726
291	21.42%	1,134.3	827	72.90	1,295	1,317	1,738	726
292	21.50%	1,132.4	827	72.99	1,295	1,316	1,737	725
293	21.57%	1,132.0	826	73.01	1,294	1,316	1,737	725
294	21.64%	1,131.6	826	73.03	1,294	1,316	1,737	725
295	21.72%	1,130.9	826	73.06	1,294	1,316	1,736	725
296	21.79%	1,130.4	826	73.08	1,294	1,316	1,736	725
297	21.87%	1,130.0	826	73.10	1,294	1,316	1,736	725
298	21.94%	1,130.0	826	73.10	1,294	1,316	1,736	725
299	22.01%	1,130.0	826	73.10	1,294	1,316	1,736	725
300	22.09%	1,129.6	826	73.11	1,294	1,315	1,736	725
301	22.16%	1,129.0	826	73.14	1,293	1,315	1,735	725
302	22.23%	1,127.7	825	73.20	1,293	1,315	1,735	724
303	22.31%	1,125.3	825	73.31	1,292	1,314	1,734	724
304	22.38%	1,125.3	825	73.31	1,292	1,314	1,734	724
305	22.46%	1,124.2	825	73.36	1,292	1,314	1,733	724
306	22.53%	1,123.8	825	73.38	1,292	1,313	1,733	724
307	22.60%	1,122.7	824	73.43	1,291	1,313	1,732	723
308	22.68%	1,122.6	824	73.43	1,291	1,313	1,732	723
309	22.75%	1,122.3	824	73.45	1,291	1,313	1,732	723
310	22.82%	1,122.3	824	73.45	1,291	1,313	1,732	723
311	22.90%	1,121.1	824	73.50	1,291	1,312	1,732	723
312	22.97%	1,120.3	824	73.54	1,290	1,312	1,731	723
313	23.05%	1,119.0	824	73.60	1,290	1,312	1,731	723
314	23.12%	1,117.9	823	73.64	1,289	1,311	1,730	722
315	23.19%	1,117.8	823	73.65	1,289	1,311	1,730	722
316	23.27%	1,117.0	823	73.68	1,289	1,311	1,730	722
317	23.34%	1,114.1	822	73.82	1,288	1,310	1,728	722
318	23.41%	1,114.0	822	73.82	1,288	1,310	1,728	722
319	23.49%	1,114.0	822	73.82	1,288	1,310	1,728	722
320	23.56%	1,113.4	822	73.85	1,288	1,310	1,728	721

Victoria Lake Monthly Outflow			Annual Average Power Discharge (m^3/s)	Energy Calculation for MP				
Duration (Month)	Probability	Flow / Maximum Power Discharge (m^3/s)		Plant Factor (%)	Annual Energy Production (GWh)			
					Owen Falls	Bujagali	Kalagala	Isimba
321	23.64%	1,113.0	822	73.87	1,288	1,309	1,728	721
322	23.71%	1,112.2	822	73.90	1,287	1,309	1,727	721
323	23.78%	1,111.9	822	73.92	1,287	1,309	1,727	721
324	23.86%	1,111.0	822	73.96	1,287	1,309	1,727	721
325	23.93%	1,110.3	821	73.99	1,287	1,308	1,726	721
326	24.00%	1,110.0	821	74.00	1,287	1,308	1,726	721
327	24.08%	1,107.4	821	74.12	1,286	1,307	1,725	720
328	24.15%	1,106.9	821	74.14	1,285	1,307	1,725	720
329	24.23%	1,105.1	820	74.22	1,285	1,306	1,724	720
330	24.30%	1,105.1	820	74.22	1,285	1,306	1,724	720
331	24.37%	1,104.7	820	74.24	1,285	1,306	1,724	720
332	24.45%	1,104.2	820	74.26	1,284	1,306	1,723	720
333	24.52%	1,104.0	820	74.27	1,284	1,306	1,723	720
334	24.59%	1,104.0	820	74.27	1,284	1,306	1,723	720
335	24.67%	1,103.8	820	74.28	1,284	1,306	1,723	719
336	24.74%	1,102.9	820	74.32	1,284	1,306	1,723	719
337	24.82%	1,101.9	819	74.37	1,283	1,305	1,722	719
338	24.89%	1,101.0	819	74.41	1,283	1,305	1,722	719
339	24.96%	1,098.4	819	74.52	1,282	1,304	1,720	718
340	25.04%	1,095.7	818	74.65	1,281	1,303	1,719	718
341	25.11%	1,095.4	818	74.66	1,281	1,303	1,719	718
342	25.18%	1,093.9	817	74.73	1,280	1,302	1,718	717
343	25.26%	1,091.8	817	74.82	1,280	1,301	1,717	717
344	25.33%	1,089.9	816	74.91	1,279	1,300	1,716	716
345	25.41%	1,088.0	816	75.00	1,278	1,300	1,715	716
346	25.48%	1,084.6	815	75.15	1,277	1,298	1,713	715
347	25.55%	1,084.0	815	75.18	1,276	1,298	1,713	715
348	25.63%	1,083.1	815	75.22	1,276	1,298	1,712	715
349	25.70%	1,082.7	815	75.24	1,276	1,297	1,712	715
350	25.77%	1,082.7	815	75.24	1,276	1,297	1,712	715
351	25.85%	1,081.8	814	75.28	1,276	1,297	1,711	715
352	25.92%	1,079.0	814	75.41	1,274	1,296	1,710	714
353	26.00%	1,078.0	813	75.45	1,274	1,295	1,709	714
354	26.07%	1,077.1	813	75.49	1,274	1,295	1,709	714
355	26.14%	1,077.0	813	75.50	1,274	1,295	1,709	714
356	26.22%	1,076.4	813	75.53	1,273	1,295	1,708	713
357	26.29%	1,074.9	813	75.60	1,273	1,294	1,708	713
358	26.36%	1,071.4	812	75.76	1,271	1,293	1,706	712
359	26.44%	1,070.0	811	75.82	1,271	1,292	1,705	712
360	26.51%	1,069.6	811	75.84	1,271	1,292	1,705	712
361	26.59%	1,068.7	811	75.88	1,270	1,292	1,704	712
362	26.66%	1,067.9	811	75.92	1,270	1,291	1,704	711
363	26.73%	1,067.8	811	75.92	1,270	1,291	1,704	711
364	26.81%	1,066.0	810	76.01	1,269	1,290	1,703	711
365	26.88%	1,062.0	809	76.19	1,267	1,289	1,700	710
366	26.95%	1,061.9	809	76.19	1,267	1,289	1,700	710
367	27.03%	1,061.5	809	76.22	1,267	1,289	1,700	710
368	27.10%	1,058.3	808	76.36	1,266	1,287	1,698	709
369	27.18%	1,057.0	808	76.42	1,265	1,287	1,698	709
370	27.25%	1,056.2	808	76.46	1,265	1,286	1,697	709
371	27.32%	1,056.2	808	76.46	1,265	1,286	1,697	709
372	27.40%	1,055.9	807	76.47	1,265	1,286	1,697	709
373	27.47%	1,054.0	807	76.56	1,264	1,285	1,696	708
374	27.54%	1,052.9	807	76.61	1,263	1,285	1,695	708
375	27.62%	1,052.9	807	76.61	1,263	1,285	1,695	708
376	27.69%	1,052.9	807	76.61	1,263	1,285	1,695	708
377	27.77%	1,049.4	806	76.78	1,262	1,283	1,693	707
378	27.84%	1,049.1	806	76.79	1,262	1,283	1,693	707
379	27.91%	1,049.1	806	76.79	1,262	1,283	1,693	707
380	27.99%	1,049.0	806	76.80	1,262	1,283	1,693	707
381	28.06%	1,045.8	805	76.95	1,260	1,282	1,691	706
382	28.13%	1,045.5	805	76.96	1,260	1,282	1,691	706
383	28.21%	1,042.2	804	77.11	1,259	1,280	1,689	705
384	28.28%	1,042.0	804	77.12	1,259	1,280	1,689	705
385	28.36%	1,041.0	803	77.17	1,258	1,279	1,688	705
386	28.43%	1,038.0	802	77.31	1,257	1,278	1,686	704
387	28.50%	1,037.8	802	77.32	1,257	1,278	1,686	704
388	28.58%	1,037.4	802	77.34	1,257	1,278	1,686	704
389	28.65%	1,034.9	802	77.45	1,256	1,277	1,685	703
390	28.72%	1,034.0	801	77.50	1,255	1,276	1,684	703
391	28.80%	1,033.2	801	77.54	1,255	1,276	1,684	703
392	28.87%	1,033.0	801	77.55	1,255	1,276	1,683	703
393	28.95%	1,032.4	801	77.57	1,254	1,276	1,683	703
394	29.02%	1,031.6	801	77.61	1,254	1,275	1,683	703
395	29.09%	1,030.5	800	77.66	1,254	1,275	1,682	702
396	29.17%	1,030.5	800	77.67	1,254	1,275	1,682	702
397	29.24%	1,030.5	800	77.67	1,254	1,275	1,682	702
398	29.31%	1,029.7	800	77.70	1,253	1,274	1,681	702
399	29.39%	1,029.0	800	77.73	1,253	1,274	1,681	702
400	29.46%	1,028.2	800	77.77	1,252	1,274	1,680	702

Victoria Lake Monthly Outflow			Annual Average Power Discharge (m^3/s)	Energy Calculation for MP				
Duration (Month)	Probability	Flow / Maximum Power Discharge (m^3/s)		Plant Factor (%)	Annual Energy Production (GWh)			
					Owen Falls	Bujagali	Kalagala	Isimba
401	29.54%	1,028.0	800	77.78	1,252	1,274	1,680	702
402	29.61%	1,028.0	800	77.78	1,252	1,274	1,680	702
403	29.68%	1,026.7	799	77.84	1,252	1,273	1,680	701
404	29.76%	1,026.7	799	77.84	1,252	1,273	1,680	701
405	29.83%	1,026.2	799	77.87	1,252	1,273	1,679	701
406	29.90%	1,025.2	799	77.91	1,251	1,272	1,679	701
407	29.98%	1,023.4	798	78.00	1,250	1,271	1,677	700
408	30.05%	1,023.4	798	78.00	1,250	1,271	1,677	700
409	30.13%	1,023.0	798	78.02	1,250	1,271	1,677	700
410	30.20%	1,023.0	798	78.02	1,250	1,271	1,677	700
411	30.27%	1,023.0	798	78.02	1,250	1,271	1,677	700
412	30.35%	1,022.4	798	78.04	1,250	1,271	1,677	700
413	30.42%	1,022.4	798	78.04	1,250	1,271	1,677	700
414	30.49%	1,021.1	798	78.10	1,249	1,270	1,676	700
415	30.57%	1,021.1	798	78.10	1,249	1,270	1,676	700
416	30.64%	1,018.5	797	78.22	1,248	1,269	1,674	699
417	30.72%	1,017.4	796	78.28	1,247	1,268	1,674	699
418	30.79%	1,014.7	796	78.40	1,246	1,267	1,672	698
419	30.86%	1,014.0	795	78.43	1,246	1,267	1,671	698
420	30.94%	1,013.9	795	78.44	1,246	1,267	1,671	698
421	31.01%	1,011.5	795	78.55	1,245	1,266	1,670	697
422	31.08%	1,010.7	794	78.59	1,244	1,265	1,669	697
423	31.16%	1,010.0	794	78.62	1,244	1,265	1,669	697
424	31.23%	1,009.6	794	78.64	1,244	1,265	1,669	697
425	31.31%	1,009.3	794	78.66	1,243	1,264	1,668	697
426	31.38%	1,008.8	794	78.68	1,243	1,264	1,668	696
427	31.45%	1,008.6	794	78.69	1,243	1,264	1,668	696
428	31.53%	1,008.1	793	78.71	1,243	1,264	1,668	696
429	31.60%	1,007.3	793	78.75	1,242	1,263	1,667	696
430	31.67%	1,005.7	793	78.82	1,242	1,263	1,666	696
431	31.75%	1,004.7	792	78.87	1,241	1,262	1,665	695
432	31.82%	1,004.3	792	78.89	1,241	1,262	1,665	695
433	31.90%	1,004.0	792	78.91	1,241	1,262	1,665	695
434	31.97%	1,002.1	792	78.99	1,240	1,261	1,664	695
435	32.04%	1,000.6	791	79.06	1,239	1,260	1,663	694
436	32.12%	999.5	791	79.12	1,239	1,259	1,662	694
437	32.19%	996.0	790	79.28	1,237	1,258	1,659	693
438	32.26%	995.0	789	79.33	1,236	1,257	1,659	693
439	32.34%	990.5	788	79.54	1,234	1,255	1,656	691
440	32.41%	989.4	788	79.59	1,233	1,254	1,655	691
441	32.49%	987.9	787	79.67	1,233	1,254	1,654	691
442	32.56%	987.7	787	79.68	1,233	1,253	1,654	691
443	32.63%	987.7	787	79.68	1,233	1,253	1,654	691
444	32.71%	987.5	787	79.68	1,233	1,253	1,654	690
445	32.78%	985.7	786	79.77	1,232	1,252	1,652	690
446	32.85%	985.7	786	79.77	1,232	1,252	1,652	690
447	32.93%	985.0	786	79.80	1,231	1,252	1,652	690
448	33.00%	984.0	786	79.85	1,231	1,251	1,651	689
449	33.08%	982.3	785	79.93	1,230	1,251	1,650	689
450	33.15%	981.2	785	79.99	1,229	1,250	1,649	689
451	33.22%	980.0	784	80.04	1,229	1,249	1,648	688
452	33.30%	979.0	784	80.09	1,228	1,249	1,648	688
453	33.37%	978.9	784	80.09	1,228	1,249	1,648	688
454	33.44%	978.6	784	80.11	1,228	1,249	1,648	688
455	33.52%	978.2	784	80.13	1,228	1,248	1,647	688
456	33.59%	978.2	784	80.13	1,228	1,248	1,647	688
457	33.67%	977.1	783	80.18	1,227	1,248	1,646	687
458	33.74%	977.0	783	80.19	1,227	1,248	1,646	687
459	33.81%	976.8	783	80.20	1,227	1,248	1,646	687
460	33.89%	973.0	782	80.38	1,225	1,246	1,644	686
461	33.96%	971.5	782	80.45	1,224	1,245	1,642	686
462	34.03%	970.4	781	80.50	1,224	1,244	1,642	685
463	34.11%	969.7	781	80.53	1,223	1,244	1,641	685
464	34.18%	967.8	780	80.62	1,222	1,243	1,640	685
465	34.26%	967.7	780	80.63	1,222	1,243	1,640	685
466	34.33%	967.4	780	80.64	1,222	1,243	1,640	685
467	34.40%	967.2	780	80.65	1,222	1,242	1,639	685
468	34.48%	966.5	780	80.69	1,221	1,242	1,639	684
469	34.55%	964.9	779	80.76	1,221	1,241	1,638	684
470	34.62%	963.0	779	80.85	1,220	1,240	1,636	683
471	34.70%	962.6	778	80.88	1,219	1,240	1,636	683
472	34.77%	960.0	778	81.00	1,218	1,238	1,634	682
473	34.85%	959.1	777	81.04	1,217	1,238	1,633	682
474	34.92%	959.0	777	81.05	1,217	1,238	1,633	682
475	34.99%	956.2	776	81.18	1,216	1,236	1,631	681
476	35.07%	956.0	776	81.19	1,216	1,236	1,631	681
477	35.14%	954.3	776	81.28	1,215	1,235	1,630	681
478	35.21%	954.0	776	81.29	1,215	1,235	1,630	680
479	35.29%	952.8	775	81.35	1,214	1,234	1,629	680
480	35.36%	951.0	774	81.43	1,213	1,233	1,628	680

Victoria Lake Monthly Outflow			Annual Average Power Discharge (m^3/s)	Energy Calculation for MP				
Duration (Month)	Probability	Flow / Maximum Power Discharge (m^3/s)		Plant Factor (%)	Annual Energy Production (GWh)			
					Owen Falls	Bujagali	Kalagala	Isimba
481	35.44%	949.0	774	81.53	1,212	1,232	1,626	679
482	35.51%	948.7	774	81.55	1,212	1,232	1,626	679
483	35.58%	943.8	772	81.78	1,209	1,229	1,622	677
484	35.66%	934.5	769	82.24	1,204	1,224	1,615	674
485	35.73%	933.6	768	82.29	1,203	1,224	1,615	674
486	35.80%	933.4	768	82.30	1,203	1,223	1,614	674
487	35.88%	932.3	768	82.35	1,203	1,223	1,613	674
488	35.95%	930.2	767	82.46	1,201	1,222	1,612	673
489	36.03%	930.0	767	82.47	1,201	1,222	1,612	673
490	36.10%	928.6	766	82.54	1,200	1,221	1,611	673
491	36.17%	927.0	766	82.62	1,200	1,220	1,610	672
492	36.25%	927.0	766	82.62	1,200	1,220	1,610	672
493	36.32%	925.9	765	82.67	1,199	1,219	1,609	672
494	36.39%	925.9	765	82.67	1,199	1,219	1,609	672
495	36.47%	923.4	765	82.80	1,198	1,218	1,607	671
496	36.54%	923.2	764	82.81	1,197	1,218	1,607	671
497	36.62%	923.0	764	82.82	1,197	1,217	1,606	671
498	36.69%	920.7	764	82.93	1,196	1,216	1,605	670
499	36.76%	918.5	763	83.05	1,195	1,215	1,603	669
500	36.84%	918.5	763	83.05	1,195	1,215	1,603	669
501	36.91%	918.5	763	83.05	1,195	1,215	1,603	669
502	36.98%	914.7	761	83.23	1,193	1,213	1,600	668
503	37.06%	913.6	761	83.29	1,192	1,212	1,599	668
504	37.13%	911.4	760	83.40	1,191	1,211	1,597	667
505	37.21%	911.3	760	83.41	1,191	1,211	1,597	667
506	37.28%	911.0	760	83.42	1,190	1,210	1,597	667
507	37.35%	911.0	760	83.42	1,190	1,210	1,597	667
508	37.43%	910.5	760	83.45	1,190	1,210	1,597	667
509	37.50%	910.5	760	83.45	1,190	1,210	1,597	667
510	37.57%	909.4	759	83.50	1,189	1,209	1,596	666
511	37.65%	909.0	759	83.52	1,189	1,209	1,596	666
512	37.72%	908.0	759	83.57	1,189	1,209	1,595	666
513	37.79%	907.8	759	83.58	1,188	1,209	1,595	666
514	37.87%	906.9	758	83.63	1,188	1,208	1,594	666
515	37.94%	906.6	758	83.64	1,188	1,208	1,594	665
516	38.02%	906.6	758	83.64	1,188	1,208	1,594	665
517	38.09%	904.3	757	83.76	1,186	1,206	1,592	665
518	38.16%	904.3	757	83.76	1,186	1,206	1,592	665
519	38.24%	901.3	756	83.91	1,185	1,205	1,589	664
520	38.31%	900.0	756	83.98	1,184	1,204	1,588	663
521	38.38%	899.8	756	83.99	1,184	1,204	1,588	663
522	38.46%	898.9	755	84.03	1,183	1,203	1,587	663
523	38.53%	897.6	755	84.10	1,182	1,202	1,586	662
524	38.61%	896.1	754	84.18	1,181	1,201	1,585	662
525	38.68%	894.9	754	84.24	1,181	1,201	1,584	661
526	38.75%	894.0	753	84.28	1,180	1,200	1,584	661
527	38.83%	894.0	753	84.28	1,180	1,200	1,584	661
528	38.90%	894.0	753	84.28	1,180	1,200	1,584	661
529	38.97%	892.7	753	84.35	1,179	1,199	1,582	661
530	39.05%	892.7	753	84.35	1,179	1,199	1,582	661
531	39.12%	892.7	753	84.35	1,179	1,199	1,582	661
532	39.20%	892.0	753	84.39	1,179	1,199	1,582	660
533	39.27%	890.5	752	84.46	1,178	1,198	1,581	660
534	39.34%	890.5	752	84.46	1,178	1,198	1,581	660
535	39.42%	888.9	751	84.54	1,177	1,197	1,579	659
536	39.49%	888.6	751	84.56	1,177	1,197	1,579	659
537	39.56%	888.6	751	84.56	1,177	1,197	1,579	659
538	39.64%	888.1	751	84.58	1,177	1,196	1,579	659
539	39.71%	888.0	751	84.59	1,177	1,196	1,579	659
540	39.79%	884.9	750	84.75	1,175	1,194	1,576	658
541	39.86%	884.2	750	84.78	1,174	1,194	1,575	658
542	39.93%	883.5	749	84.82	1,174	1,194	1,575	658
543	40.01%	883.4	749	84.82	1,174	1,193	1,575	657
544	40.08%	881.9	749	84.90	1,173	1,193	1,573	657
545	40.15%	881.2	748	84.93	1,172	1,192	1,573	657
546	40.23%	881.2	748	84.93	1,172	1,192	1,573	657
547	40.30%	881.1	748	84.94	1,172	1,192	1,573	657
548	40.38%	881.1	748	84.94	1,172	1,192	1,573	657
549	40.45%	881.1	748	84.94	1,172	1,192	1,573	657
550	40.52%	879.6	748	85.01	1,171	1,191	1,572	656
551	40.60%	878.9	747	85.05	1,171	1,191	1,571	656
552	40.67%	878.8	747	85.05	1,171	1,191	1,571	656
553	40.74%	877.7	747	85.11	1,170	1,190	1,570	655
554	40.82%	877.0	747	85.15	1,170	1,189	1,569	655
555	40.89%	876.8	747	85.15	1,169	1,189	1,569	655
556	40.97%	876.6	747	85.16	1,169	1,189	1,569	655
557	41.04%	876.3	746	85.18	1,169	1,189	1,569	655
558	41.11%	875.1	746	85.24	1,168	1,188	1,568	655
559	41.19%	874.4	746	85.28	1,168	1,188	1,567	654
560	41.26%	874.4	746	85.28	1,168	1,188	1,567	654

Victoria Lake Monthly Outflow			Annual Average Power Discharge (m^3/s)	Energy Calculation for MP				
Duration (Month)	Probability	Flow / Maximum Power Discharge (m^3/s)		Plant Factor (%)	Annual Energy Production (GWh)			
					Owen Falls	Bujagali	Kalagala	Isimba
561	41.33%	872.2	745	85.39	1,166	1,186	1,565	653
562	41.41%	872.1	745	85.39	1,166	1,186	1,565	653
563	41.48%	871.9	745	85.40	1,166	1,186	1,565	653
564	41.56%	869.9	744	85.50	1,165	1,185	1,563	653
565	41.63%	869.6	744	85.52	1,165	1,184	1,563	653
566	41.70%	869.5	744	85.52	1,165	1,184	1,563	653
567	41.78%	869.5	744	85.52	1,165	1,184	1,563	653
568	41.85%	869.2	743	85.54	1,165	1,184	1,562	652
569	41.92%	868.9	743	85.55	1,164	1,184	1,562	652
570	42.00%	866.5	742	85.68	1,163	1,182	1,560	651
571	42.07%	866.2	742	85.69	1,163	1,182	1,560	651
572	42.15%	865.1	742	85.75	1,162	1,181	1,559	651
573	42.22%	865.1	742	85.75	1,162	1,181	1,559	651
574	42.29%	865.0	742	85.75	1,162	1,181	1,559	651
575	42.37%	862.5	741	85.88	1,160	1,180	1,557	650
576	42.44%	862.1	741	85.90	1,160	1,179	1,556	650
577	42.51%	860.3	740	85.98	1,159	1,178	1,555	649
578	42.59%	859.2	739	86.04	1,158	1,177	1,554	649
579	42.66%	858.8	739	86.06	1,158	1,177	1,553	649
580	42.74%	858.7	739	86.07	1,158	1,177	1,553	649
581	42.81%	857.6	739	86.12	1,157	1,176	1,552	648
582	42.88%	857.6	739	86.12	1,157	1,176	1,552	648
583	42.96%	857.0	738	86.15	1,156	1,176	1,552	648
584	43.03%	856.5	738	86.18	1,156	1,176	1,551	648
585	43.10%	856.1	738	86.20	1,156	1,175	1,551	648
586	43.18%	856.1	738	86.20	1,156	1,175	1,551	648
587	43.25%	855.4	738	86.24	1,155	1,175	1,550	647
588	43.33%	854.2	737	86.29	1,155	1,174	1,549	647
589	43.40%	853.1	737	86.35	1,154	1,173	1,548	646
590	43.47%	852.7	736	86.37	1,154	1,173	1,548	646
591	43.55%	852.6	736	86.37	1,153	1,173	1,548	646
592	43.62%	852.6	736	86.37	1,153	1,173	1,548	646
593	43.69%	852.0	736	86.40	1,153	1,173	1,547	646
594	43.77%	851.3	736	86.44	1,153	1,172	1,546	646
595	43.84%	850.3	735	86.49	1,152	1,171	1,546	645
596	43.92%	850.3	735	86.49	1,152	1,171	1,546	645
597	43.99%	850.1	735	86.50	1,152	1,171	1,545	645
598	44.06%	850.1	735	86.50	1,152	1,171	1,545	645
599	44.14%	848.8	735	86.57	1,151	1,170	1,544	645
600	44.21%	848.8	735	86.57	1,151	1,170	1,544	645
601	44.28%	848.8	735	86.57	1,151	1,170	1,544	645
602	44.36%	847.6	734	86.62	1,150	1,169	1,543	644
603	44.43%	845.3	733	86.74	1,148	1,168	1,541	643
604	44.51%	845.3	733	86.74	1,148	1,168	1,541	643
605	44.58%	845.3	733	86.74	1,148	1,168	1,541	643
606	44.65%	844.1	733	86.80	1,148	1,167	1,540	643
607	44.73%	843.8	733	86.82	1,147	1,167	1,539	643
608	44.80%	843.3	732	86.84	1,147	1,166	1,539	643
609	44.87%	842.7	732	86.87	1,147	1,166	1,538	642
610	44.95%	842.7	732	86.87	1,147	1,166	1,538	642
611	45.02%	842.7	732	86.87	1,147	1,166	1,538	642
612	45.10%	840.7	731	86.97	1,145	1,164	1,537	642
613	45.17%	840.4	731	86.98	1,145	1,164	1,536	641
614	45.24%	838.0	730	87.11	1,143	1,163	1,534	640
615	45.32%	837.8	730	87.11	1,143	1,162	1,534	640
616	45.39%	837.8	730	87.11	1,143	1,162	1,534	640
617	45.46%	837.2	730	87.14	1,143	1,162	1,533	640
618	45.54%	835.6	729	87.22	1,142	1,161	1,532	640
619	45.61%	835.6	729	87.22	1,142	1,161	1,532	640
620	45.69%	835.0	729	87.25	1,141	1,160	1,531	639
621	45.76%	834.4	728	87.28	1,141	1,160	1,531	639
622	45.83%	834.4	728	87.28	1,141	1,160	1,530	639
623	45.91%	833.5	728	87.33	1,140	1,159	1,530	639
624	45.98%	833.3	728	87.34	1,140	1,159	1,529	639
625	46.05%	833.0	728	87.35	1,140	1,159	1,529	638
626	46.13%	833.0	728	87.35	1,140	1,159	1,529	638
627	46.20%	833.0	728	87.35	1,140	1,159	1,529	638
628	46.28%	832.9	728	87.35	1,140	1,159	1,529	638
629	46.35%	832.9	728	87.35	1,140	1,159	1,529	638
630	46.42%	832.9	728	87.35	1,140	1,159	1,529	638
631	46.50%	831.1	727	87.45	1,138	1,158	1,527	638
632	46.57%	830.7	727	87.46	1,138	1,157	1,527	638
633	46.64%	829.6	726	87.52	1,137	1,156	1,526	637
634	46.72%	829.2	726	87.54	1,137	1,156	1,525	637
635	46.79%	828.7	726	87.56	1,137	1,156	1,525	637
636	46.87%	828.3	725	87.58	1,136	1,155	1,525	637
637	46.94%	828.1	725	87.59	1,136	1,155	1,524	636
638	47.01%	828.1	725	87.59	1,136	1,155	1,524	636
639	47.09%	828.1	725	87.59	1,136	1,155	1,524	636
640	47.16%	825.6	724	87.72	1,134	1,153	1,522	635

Victoria Lake Monthly Outflow			Annual Average Power Discharge (m^3/s)	Energy Calculation for MP				
Duration (Month)	Probability	Flow / Maximum Power Discharge (m^3/s)		Plant Factor (%)	Annual Energy Production (GWh)			
					Owen Falls	Bujagali	Kalagala	Isimba
641	47.23%	825.5	724	87.72	1,134	1,153	1,522	635
642	47.31%	823.3	723	87.83	1,133	1,152	1,520	635
643	47.38%	823.3	723	87.83	1,133	1,152	1,520	635
644	47.46%	823.3	723	87.83	1,133	1,152	1,520	635
645	47.53%	823.3	723	87.83	1,133	1,152	1,520	634
646	47.60%	823.3	723	87.83	1,133	1,152	1,520	634
647	47.68%	821.8	722	87.90	1,131	1,151	1,518	634
648	47.75%	821.5	722	87.92	1,131	1,150	1,518	634
649	47.82%	821.0	722	87.94	1,131	1,150	1,517	634
650	47.90%	820.6	722	87.96	1,131	1,150	1,517	633
651	47.97%	818.5	721	88.07	1,129	1,148	1,515	632
652	48.05%	818.5	721	88.07	1,129	1,148	1,515	632
653	48.12%	818.4	721	88.07	1,129	1,148	1,515	632
654	48.19%	818.4	721	88.07	1,129	1,148	1,515	632
655	48.27%	818.4	721	88.07	1,129	1,148	1,515	632
656	48.34%	818.3	721	88.07	1,129	1,148	1,515	632
657	48.41%	817.0	720	88.14	1,128	1,147	1,513	632
658	48.49%	816.2	720	88.18	1,127	1,146	1,512	631
659	48.56%	815.8	719	88.20	1,127	1,146	1,512	631
660	48.64%	814.7	719	88.25	1,126	1,145	1,511	631
661	48.71%	814.1	719	88.28	1,126	1,145	1,510	631
662	48.78%	813.5	718	88.30	1,125	1,144	1,510	630
663	48.86%	813.5	718	88.31	1,125	1,144	1,510	630
664	48.93%	812.9	718	88.34	1,125	1,144	1,509	630
665	49.00%	812.4	718	88.36	1,124	1,143	1,509	630
666	49.08%	812.2	718	88.37	1,124	1,143	1,508	630
667	49.15%	811.3	717	88.41	1,124	1,142	1,507	629
668	49.23%	811.0	717	88.43	1,123	1,142	1,507	629
669	49.30%	810.2	717	88.47	1,123	1,142	1,506	629
670	49.37%	808.7	716	88.54	1,121	1,140	1,505	628
671	49.45%	808.7	716	88.54	1,121	1,140	1,505	628
672	49.52%	808.5	716	88.55	1,121	1,140	1,505	628
673	49.59%	808.0	716	88.57	1,121	1,140	1,504	628
674	49.67%	807.6	715	88.59	1,121	1,140	1,504	628
675	49.74%	806.5	715	88.65	1,120	1,139	1,502	627
676	49.82%	806.5	715	88.65	1,120	1,139	1,502	627
677	49.89%	806.5	715	88.65	1,120	1,139	1,502	627
678	49.96%	806.3	715	88.65	1,120	1,139	1,502	627
679	50.04%	803.8	714	88.77	1,118	1,137	1,500	626
680	50.11%	803.8	714	88.77	1,118	1,137	1,500	626
681	50.18%	803.8	714	88.77	1,118	1,137	1,500	626
682	50.26%	803.8	714	88.77	1,118	1,137	1,500	626
683	50.33%	803.5	713	88.79	1,117	1,136	1,499	626
684	50.41%	802.5	713	88.84	1,117	1,135	1,498	626
685	50.48%	801.7	713	88.88	1,116	1,135	1,497	625
686	50.55%	801.6	712	88.88	1,116	1,135	1,497	625
687	50.63%	801.6	712	88.88	1,116	1,135	1,497	625
688	50.70%	800.2	712	88.95	1,115	1,134	1,496	625
689	50.77%	799.0	711	89.00	1,114	1,133	1,495	624
690	50.85%	799.0	711	89.00	1,114	1,133	1,495	624
691	50.92%	799.0	711	89.00	1,114	1,133	1,495	624
692	51.00%	798.7	711	89.02	1,114	1,132	1,494	624
693	51.07%	797.1	710	89.10	1,112	1,131	1,492	623
694	51.14%	796.7	710	89.12	1,112	1,131	1,492	623
695	51.22%	794.5	709	89.22	1,110	1,129	1,490	622
696	51.29%	794.5	709	89.22	1,110	1,129	1,490	622
697	51.36%	794.4	709	89.23	1,110	1,129	1,490	622
698	51.44%	794.4	709	89.23	1,110	1,129	1,490	622
699	51.51%	794.0	709	89.24	1,110	1,129	1,489	622
700	51.59%	792.4	708	89.32	1,109	1,127	1,487	621
701	51.66%	792.1	708	89.34	1,108	1,127	1,487	621
702	51.73%	791.9	708	89.34	1,108	1,127	1,487	621
703	51.81%	791.9	708	89.34	1,108	1,127	1,487	621
704	51.88%	791.9	708	89.34	1,108	1,127	1,487	621
705	51.95%	789.7	706	89.45	1,106	1,125	1,484	620
706	52.03%	789.7	706	89.45	1,106	1,125	1,484	620
707	52.10%	789.7	706	89.45	1,106	1,125	1,484	620
708	52.18%	789.3	706	89.47	1,106	1,125	1,484	620
709	52.25%	787.4	705	89.55	1,105	1,123	1,482	619
710	52.32%	787.4	705	89.56	1,105	1,123	1,482	619
711	52.40%	787.4	705	89.56	1,105	1,123	1,482	619
712	52.47%	784.8	704	89.68	1,102	1,121	1,479	618
713	52.54%	784.8	704	89.68	1,102	1,121	1,479	618
714	52.62%	784.8	704	89.68	1,102	1,121	1,479	618
715	52.69%	784.7	704	89.68	1,102	1,121	1,479	618
716	52.77%	784.7	704	89.68	1,102	1,121	1,479	618
717	52.84%	782.4	703	89.79	1,100	1,119	1,476	616
718	52.91%	781.6	702	89.83	1,100	1,118	1,476	616
719	52.99%	780.7	702	89.87	1,099	1,118	1,475	616
720	53.06%	780.3	701	89.89	1,099	1,117	1,474	615

Victoria Lake Monthly Outflow			Annual Average Power Discharge (m^3/s)	Energy Calculation for MP				
Duration (Month)	Probability	Flow / Maximum Power Discharge (m^3/s)		Plant Factor (%)	Annual Energy Production (GWh)			
					Owen Falls	Bujagali	Kalagala	Isimba
721	53.13%	780.1	701	89.90	1,098	1,117	1,474	615
722	53.21%	780.1	701	89.90	1,098	1,117	1,474	615
723	53.28%	779.4	701	89.93	1,098	1,116	1,473	615
724	53.36%	777.7	700	90.01	1,096	1,115	1,471	614
725	53.43%	775.5	699	90.12	1,095	1,113	1,469	613
726	53.50%	775.5	699	90.12	1,095	1,113	1,469	613
727	53.58%	775.5	699	90.12	1,095	1,113	1,469	613
728	53.65%	773.9	698	90.19	1,093	1,112	1,467	612
729	53.72%	773.2	698	90.23	1,093	1,111	1,466	612
730	53.80%	773.2	698	90.23	1,093	1,111	1,466	612
731	53.87%	773.2	698	90.23	1,093	1,111	1,466	612
732	53.95%	773.2	698	90.23	1,093	1,111	1,466	612
733	54.02%	773.2	698	90.23	1,093	1,111	1,466	612
734	54.09%	773.1	698	90.23	1,093	1,111	1,466	612
735	54.17%	773.0	698	90.24	1,093	1,111	1,466	612
736	54.24%	770.8	696	90.34	1,091	1,109	1,463	611
737	54.31%	770.6	696	90.35	1,090	1,109	1,463	611
738	54.39%	768.5	695	90.45	1,089	1,107	1,461	610
739	54.46%	768.5	695	90.45	1,089	1,107	1,461	610
740	54.54%	768.5	695	90.45	1,089	1,107	1,461	610
741	54.61%	768.4	695	90.45	1,089	1,107	1,461	610
742	54.68%	768.4	695	90.45	1,089	1,107	1,461	610
743	54.76%	767.6	695	90.49	1,088	1,106	1,460	609
744	54.83%	766.9	694	90.52	1,087	1,106	1,459	609
745	54.90%	766.2	694	90.55	1,087	1,105	1,458	609
746	54.98%	766.2	694	90.55	1,087	1,105	1,458	609
747	55.05%	763.9	693	90.66	1,085	1,103	1,455	608
748	55.13%	761.6	691	90.77	1,083	1,101	1,453	607
749	55.20%	761.6	691	90.77	1,083	1,101	1,453	607
750	55.27%	761.6	691	90.77	1,083	1,101	1,453	607
751	55.35%	761.4	691	90.78	1,083	1,101	1,453	606
752	55.42%	761.3	691	90.78	1,082	1,101	1,452	606
753	55.49%	761.3	691	90.78	1,082	1,101	1,452	606
754	55.57%	761.3	691	90.78	1,082	1,101	1,452	606
755	55.64%	761.3	691	90.78	1,082	1,101	1,452	606
756	55.72%	759.9	690	90.85	1,081	1,100	1,451	606
757	55.79%	759.8	690	90.85	1,081	1,099	1,451	606
758	55.86%	759.3	690	90.88	1,081	1,099	1,450	605
759	55.94%	759.0	690	90.89	1,081	1,099	1,450	605
760	56.01%	759.0	690	90.89	1,081	1,099	1,450	605
761	56.08%	756.8	689	90.99	1,079	1,097	1,447	604
762	56.16%	756.6	688	91.00	1,078	1,097	1,447	604
763	56.23%	756.6	688	91.00	1,078	1,097	1,447	604
764	56.31%	754.6	687	91.09	1,077	1,095	1,444	603
765	56.38%	754.6	687.3	91.09	1,077	1,095	1,444	603
766	56.45%	754.2	687	91.11	1,076	1,094	1,444	603
767	56.53%	753.4	687	91.14	1,076	1,094	1,443	603
768	56.60%	751.9	686	91.21	1,074	1,092	1,441	602
769	56.67%	751.9	686	91.21	1,074	1,092	1,441	602
770	56.75%	750.8	685	91.27	1,073	1,091	1,440	601
771	56.82%	749.7	685	91.32	1,072	1,090	1,439	601
772	56.90%	749.6	685	91.32	1,072	1,090	1,439	601
773	56.97%	748.1	684	91.39	1,071	1,089	1,437	600
774	57.04%	747.7	683	91.41	1,070	1,089	1,436	600
775	57.12%	747.7	683	91.41	1,070	1,089	1,436	600
776	57.19%	747.5	683	91.42	1,070	1,088	1,436	600
777	57.26%	747.5	683	91.42	1,070	1,088	1,436	600
778	57.34%	747.5	683	91.42	1,070	1,088	1,436	600
779	57.41%	746.9	683	91.44	1,070	1,088	1,435	599
780	57.49%	745.2	682	91.52	1,068	1,086	1,433	598
781	57.56%	743.1	681	91.62	1,066	1,084	1,431	597
782	57.63%	743.0	681	91.62	1,066	1,084	1,431	597
783	57.71%	743.0	681	91.62	1,066	1,084	1,431	597
784	57.78%	743.0	681	91.62	1,066	1,084	1,431	597
785	57.85%	743.0	681	91.62	1,066	1,084	1,431	597
786	57.93%	743.0	681	91.62	1,066	1,084	1,431	597
787	58.00%	740.7	679	91.72	1,064	1,082	1,428	596
788	58.08%	740.7	679	91.72	1,064	1,082	1,428	596
789	58.15%	740.7	679	91.72	1,064	1,082	1,428	596
790	58.22%	740.0	679	91.76	1,064	1,081	1,427	596
791	58.30%	739.5	679	91.78	1,063	1,081	1,426	596
792	58.37%	738.9	678	91.81	1,063	1,080	1,426	595
793	58.44%	738.4	678	91.83	1,062	1,080	1,425	595
794	58.52%	736.1	677	91.93	1,060	1,078	1,422	594
795	58.59%	735.9	677	91.94	1,060	1,078	1,422	594
796	58.67%	735.9	677	91.94	1,060	1,078	1,422	594
797	58.74%	734.1	676	92.02	1,058	1,076	1,420	593
798	58.81%	733.8	675	92.04	1,058	1,076	1,419	593
799	58.89%	733.8	675	92.04	1,058	1,076	1,419	593
800	58.96%	733.6	675	92.05	1,058	1,076	1,419	593

Victoria Lake Monthly Outflow			Annual Average Power Discharge (m^3/s)	Energy Calculation for MP				
Duration (Month)	Probability	Flow / Maximum Power Discharge (m^3/s)		Plant Factor (%)	Annual Energy Production (GWh)			
					Owen Falls	Bujagali	Kalagala	Isimba
801	59.03%	732.9	675	92.08	1,057	1,075	1,418	592
802	59.11%	731.6	674	92.14	1,056	1,074	1,417	592
803	59.18%	731.5	674	92.14	1,056	1,074	1,416	591
804	59.26%	731.4	674	92.15	1,056	1,073	1,416	591
805	59.33%	731.4	674	92.15	1,056	1,073	1,416	591
806	59.40%	731.4	674	92.15	1,056	1,073	1,416	591
807	59.48%	729.9	673	92.21	1,054	1,072	1,415	591
808	59.55%	729.2	673	92.25	1,054	1,071	1,414	590
809	59.62%	729.2	673	92.25	1,054	1,071	1,414	590
810	59.70%	728.4	672	92.28	1,053	1,071	1,413	590
811	59.77%	727.7	672	92.31	1,052	1,070	1,412	589
812	59.85%	727.2	671	92.33	1,052	1,069	1,411	589
813	59.92%	726.9	671	92.35	1,051	1,069	1,411	589
814	59.99%	726.9	671	92.35	1,051	1,069	1,411	589
815	60.07%	726.9	671	92.35	1,051	1,069	1,411	589
816	60.14%	726.9	671	92.35	1,051	1,069	1,411	589
817	60.21%	724.7	670	92.45	1,049	1,067	1,408	588
818	60.29%	722.9	669	92.53	1,048	1,065	1,406	587
819	60.36%	722.4	669	92.55	1,047	1,065	1,405	587
820	60.44%	722.4	669	92.55	1,047	1,065	1,405	587
821	60.51%	722.4	669	92.55	1,047	1,065	1,405	587
822	60.58%	722.2	668	92.56	1,047	1,065	1,405	587
823	60.66%	721.3	668	92.60	1,046	1,064	1,404	586
824	60.73%	721.1	668	92.61	1,046	1,064	1,403	586
825	60.80%	720.3	667	92.64	1,045	1,063	1,402	586
826	60.88%	720.3	667	92.64	1,045	1,063	1,402	586
827	60.95%	720.2	667	92.65	1,045	1,063	1,402	585
828	61.03%	720.1	667	92.65	1,045	1,063	1,402	585
829	61.10%	720.0	667	92.66	1,045	1,063	1,402	585
830	61.17%	719.9	667	92.66	1,045	1,062	1,402	585
831	61.25%	718.0	666	92.74	1,043	1,061	1,399	584
832	61.32%	718.0	666	92.74	1,043	1,061	1,399	584
833	61.39%	718.0	666	92.74	1,043	1,061	1,399	584
834	61.47%	717.2	665	92.78	1,042	1,060	1,398	584
835	61.54%	715.7	664	92.84	1,041	1,058	1,396	583
836	61.62%	715.7	664	92.84	1,041	1,058	1,396	583
837	61.69%	715.7	664	92.84	1,041	1,058	1,396	583
838	61.76%	715.7	664	92.84	1,041	1,058	1,396	583
839	61.84%	713.5	663	92.94	1,039	1,056	1,394	582
840	61.91%	713.5	663	92.94	1,039	1,056	1,394	582
841	61.98%	712.7	663	92.97	1,038	1,055	1,393	581
842	62.06%	711.2	662	93.04	1,036	1,054	1,391	581
843	62.13%	711.2	662	93.04	1,036	1,054	1,391	581
844	62.21%	711.2	662	93.04	1,036	1,054	1,391	581
845	62.28%	711.0	662	93.05	1,036	1,054	1,390	581
846	62.35%	709.9	661	93.10	1,035	1,053	1,389	580
847	62.43%	709.0	660	93.13	1,034	1,052	1,388	579
848	62.50%	706.8	659	93.23	1,032	1,049	1,385	578
849	62.57%	706.8	659	93.23	1,032	1,049	1,385	578
850	62.65%	706.4	659	93.25	1,032	1,049	1,384	578
851	62.72%	704.5	658	93.33	1,030	1,047	1,382	577
852	62.79%	704.5	658	93.33	1,030	1,047	1,382	577
853	62.87%	704.5	658	93.33	1,030	1,047	1,382	577
854	62.94%	704.5	658	93.33	1,030	1,047	1,382	577
855	63.02%	704.4	657	93.33	1,030	1,047	1,382	577
856	63.09%	703.0	657	93.39	1,028	1,046	1,380	576
857	63.16%	702.4	656	93.42	1,028	1,045	1,379	576
858	63.24%	702.3	656	93.42	1,028	1,045	1,379	576
859	63.31%	702.3	656	93.42	1,028	1,045	1,379	576
860	63.38%	702.2	656	93.43	1,028	1,045	1,379	576
861	63.46%	700.6	655	93.50	1,026	1,043	1,377	575
862	63.53%	699.8	655	93.53	1,025	1,043	1,376	574
863	63.61%	697.8	653	93.62	1,023	1,040	1,373	573
864	63.68%	697.8	653	93.62	1,023	1,040	1,373	573
865	63.75%	697.8	653	93.62	1,023	1,040	1,373	573
866	63.83%	696.0	652	93.69	1,021	1,039	1,370	572
867	63.90%	695.6	652	93.71	1,021	1,038	1,370	572
868	63.97%	695.6	652	93.71	1,021	1,038	1,370	572
869	64.05%	693.3	650	93.81	1,019	1,036	1,367	571
870	64.12%	693.3	650	93.81	1,019	1,036	1,367	571
871	64.20%	691.1	649	93.91	1,016	1,034	1,364	569
872	64.27%	691.1	649	93.91	1,016	1,034	1,364	569
873	64.34%	691.0	649	93.91	1,016	1,034	1,364	569
874	64.42%	691.0	649	93.91	1,016	1,034	1,364	569
875	64.49%	690.3	648	93.94	1,016	1,033	1,363	569
876	64.56%	689.0	648	93.99	1,014	1,032	1,361	568
877	64.64%	688.8	648	94.00	1,014	1,031	1,361	568
878	64.71%	688.8	648	94.00	1,014	1,031	1,361	568
879	64.79%	687.4	647	94.06	1,013	1,030	1,359	567
880	64.86%	686.7	646	94.09	1,012	1,029	1,358	567

Victoria Lake Monthly Outflow			Annual Average Power Discharge (m^3/s)	Energy Calculation for MP				
Duration (Month)	Probability	Flow / Maximum Power Discharge (m^3/s)		Plant Factor (%)	Annual Energy Production (GWh)			
					Owen Falls	Bujagali	Kalagala	Isimba
881	64.93%	686.6	646	94.10	1,012	1,029	1,358	567
882	65.01%	686.6	646	94.10	1,012	1,029	1,358	567
883	65.08%	686.2	646	94.11	1,012	1,029	1,357	567
884	65.15%	685.1	645	94.16	1,010	1,027	1,356	566
885	65.23%	684.4	645	94.19	1,010	1,027	1,355	566
886	65.30%	683.2	644	94.24	1,009	1,026	1,353	565
887	65.38%	682.9	644	94.25	1,008	1,025	1,353	565
888	65.45%	682.5	643	94.27	1,008	1,025	1,352	565
889	65.52%	682.5	643	94.27	1,008	1,025	1,352	565
890	65.60%	682.5	643	94.27	1,008	1,025	1,352	565
891	65.67%	682.5	643	94.27	1,008	1,025	1,352	565
892	65.74%	680.3	642	94.36	1,005	1,022	1,349	563
893	65.82%	680.2	642	94.37	1,005	1,022	1,349	563
894	65.89%	680.2	642	94.37	1,005	1,022	1,349	563
895	65.97%	678.0	640	94.46	1,003	1,020	1,346	562
896	66.04%	678.0	640	94.46	1,003	1,020	1,346	562
897	66.11%	677.9	640	94.46	1,003	1,020	1,346	562
898	66.19%	677.9	640	94.46	1,003	1,020	1,346	562
899	66.26%	677.5	640	94.48	1,003	1,019	1,345	562
900	66.33%	676.5	639	94.52	1,002	1,018	1,344	561
901	66.41%	675.9	639	94.55	1,001	1,018	1,343	561
902	66.48%	675.9	639	94.55	1,001	1,018	1,343	561
903	66.56%	675.8	639	94.55	1,001	1,018	1,343	561
904	66.63%	675.8	639	94.55	1,001	1,018	1,343	561
905	66.70%	674.3	638	94.61	999	1,016	1,341	560
906	66.78%	673.6	638	94.64	999	1,015	1,340	559
907	66.85%	673.5	637	94.64	998	1,015	1,340	559
908	66.92%	673.5	637	94.64	998	1,015	1,340	559
909	67.00%	673.5	637	94.64	998	1,015	1,340	559
910	67.07%	673.5	637	94.64	998	1,015	1,340	559
911	67.15%	669.4	635	94.82	994	1,011	1,334	557
912	67.22%	669.4	635	94.82	994	1,011	1,334	557
913	67.29%	668.3	634	94.86	993	1,010	1,332	556
914	67.37%	667.9	634	94.87	993	1,009	1,332	556
915	67.44%	667.2	633	94.91	992	1,009	1,331	556
916	67.51%	667.2	633	94.91	992	1,009	1,331	556
917	67.59%	667.1	633	94.91	992	1,008	1,330	556
918	67.66%	665.3	632	94.98	990	1,007	1,328	555
919	67.74%	664.9	632	95.00	989	1,006	1,328	554
920	67.81%	664.9	632	95.00	989	1,006	1,328	554
921	67.88%	664.9	632	95.00	989	1,006	1,328	554
922	67.96%	664.9	632	95.00	989	1,006	1,328	554
923	68.03%	662.8	630	95.08	987	1,004	1,324	553
924	68.10%	662.7	630	95.09	987	1,004	1,324	553
925	68.18%	660.5	629	95.18	985	1,001	1,321	552
926	68.25%	660.5	629	95.18	985	1,001	1,321	552
927	68.33%	660.5	629	95.18	985	1,001	1,321	552
928	68.40%	660.5	629	95.18	985	1,001	1,321	552
929	68.47%	659.3	628	95.23	983	1,000	1,319	551
930	68.55%	658.6	627	95.26	983	999	1,318	550
931	68.62%	658.5	627	95.26	982	999	1,318	550
932	68.69%	657.8	627	95.29	982	998	1,317	550
933	68.77%	656.4	626	95.35	980	997	1,315	549
934	68.84%	656.3	626	95.35	980	997	1,315	549
935	68.92%	655.2	625	95.39	979	996	1,314	548
936	68.99%	652.0	623	95.52	976	992	1,309	547
937	69.06%	651.9	623	95.53	975	992	1,309	546
938	69.14%	651.9	623	95.53	975	992	1,309	546
939	69.21%	651.9	623	95.53	975	992	1,309	546
940	69.28%	651.2	622	95.55	975	991	1,308	546
941	69.36%	650.4	622	95.59	974	990	1,307	546
942	69.43%	650.1	621	95.60	973	990	1,306	545
943	69.51%	650.0	621	95.60	973	990	1,306	545
944	69.58%	649.7	621	95.61	973	989	1,306	545
945	69.65%	648.9	621	95.65	972	989	1,304	545
946	69.73%	648.5	620	95.66	972	988	1,304	544
947	69.80%	647.8	620	95.69	971	987	1,303	544
948	69.87%	645.4	618	95.79	968	985	1,299	543
949	69.95%	645.2	618	95.80	968	984	1,299	542
950	70.02%	645.2	618	95.80	968	984	1,299	542
951	70.10%	643.8	617	95.85	967	983	1,297	541
952	70.17%	643.7	617	95.86	966	983	1,297	541
953	70.24%	643.7	617	95.86	966	983	1,297	541
954	70.32%	641.4	615	95.95	964	980	1,293	540
955	70.39%	641.4	615	95.95	964	980	1,293	540
956	70.46%	639.5	614	96.02	962	978	1,290	539
957	70.54%	638.9	614	96.05	961	977	1,290	538
958	70.61%	638.5	613	96.06	961	977	1,289	538
959	70.69%	637.3	613	96.11	959	976	1,287	538
960	70.76%	637.3	613	96.11	959	976	1,287	537

Victoria Lake Monthly Outflow			Annual Average Power Discharge (m³/s)	Energy Calculation for MP				
Duration (Month)	Probability	Flow / Maximum Power Discharge (m³/s)		Plant Factor (%)	Annual Energy Production (GWh)			
					Owen Falls	Bujagali	Kalagala	Isimba
961	70.83%	637.0	612	96.12	959	975	1,287	537
962	70.91%	636.9	612	96.13	959	975	1,287	537
963	70.98%	635.1	611	96.20	957	973	1,284	536
964	71.05%	635.0	611	96.20	957	973	1,284	536
965	71.13%	635.0	611	96.20	957	973	1,284	536
966	71.20%	635.0	611	96.20	957	973	1,284	536
967	71.28%	634.9	611	96.21	957	973	1,284	536
968	71.35%	634.3	610	96.23	956	972	1,283	536
969	71.42%	633.5	610	96.26	955	971	1,282	535
970	71.50%	632.8	609	96.29	954	971	1,281	535
971	71.57%	631.9	609	96.32	953	969	1,279	534
972	71.64%	631.7	609	96.33	953	969	1,279	534
973	71.72%	631.0	608	96.36	952	968	1,278	534
974	71.79%	630.0	607	96.40	951	967	1,276	533
975	71.87%	629.9	607	96.40	951	967	1,276	533
976	71.94%	629.1	607	96.43	950	966	1,275	532
977	72.01%	628.9	606	96.44	950	966	1,275	532
978	72.09%	628.4	606	96.46	949	965	1,274	532
979	72.16%	625.4	604	96.58	946	962	1,269	530
980	72.23%	625.0	604	96.59	946	962	1,269	530
981	72.31%	625.0	604	96.59	946	962	1,269	530
982	72.38%	624.3	603	96.62	945	961	1,268	529
983	72.46%	624.2	603	96.62	945	961	1,267	529
984	72.53%	623.8	603	96.64	944	960	1,267	529
985	72.60%	623.8	603	96.64	944	960	1,267	529
986	72.68%	623.5	603	96.65	944	960	1,266	529
987	72.75%	623.1	602	96.66	943	959	1,266	529
988	72.82%	623.1	602	96.67	943	959	1,266	529
989	72.90%	623.1	602	96.67	943	959	1,266	529
990	72.97%	621.9	601	96.71	942	958	1,264	528
991	73.05%	621.5	601	96.73	942	958	1,263	528
992	73.12%	621.3	601	96.74	941	957	1,263	527
993	73.19%	620.5	600	96.76	940	956	1,262	527
994	73.27%	620.0	600	96.78	940	956	1,261	527
995	73.34%	619.8	600	96.79	940	955	1,261	526
996	73.41%	619.4	600	96.81	939	955	1,260	526
997	73.49%	619.0	599	96.82	939	955	1,260	526
998	73.56%	618.8	599	96.83	939	954	1,259	526
999	73.64%	618.8	599	96.83	939	954	1,259	526
1,000	73.71%	617.2	598	96.89	937	952	1,257	525
1,001	73.78%	617.2	598	96.89	937	952	1,257	525
1,002	73.86%	617.2	598	96.89	937	952	1,257	525
1,003	73.93%	616.9	598	96.90	936	952	1,256	525
1,004	74.00%	615.3	597	96.96	934	950	1,254	523
1,005	74.08%	614.9	596	96.97	934	950	1,253	523
1,006	74.15%	614.9	596	96.97	934	950	1,253	523
1,007	74.23%	613.4	595	97.03	932	948	1,251	522
1,008	74.30%	613.1	595	97.04	932	948	1,250	522
1,009	74.37%	613.0	595	97.04	932	948	1,250	522
1,010	74.45%	611.5	594	97.10	930	946	1,248	521
1,011	74.52%	611.2	594	97.11	930	945	1,247	521
1,012	74.59%	611.2	594	97.11	930	945	1,247	521
1,013	74.67%	611.2	594	97.11	930	945	1,247	521
1,014	74.74%	610.4	593	97.14	929	944	1,246	520
1,015	74.82%	610.4	593	97.14	929	944	1,246	520
1,016	74.89%	610.3	593	97.14	929	944	1,246	520
1,017	74.96%	610.1	593	97.15	928	944	1,246	520
1,018	75.04%	608.9	592	97.19	927	943	1,244	519
1,019	75.11%	608.9	592	97.19	927	943	1,244	519
1,020	75.18%	607.6	591	97.24	925	941	1,242	518
1,021	75.26%	607.1	590	97.26	925	940	1,241	518
1,022	75.33%	606.9	590	97.27	925	940	1,241	518
1,023	75.41%	606.9	590	97.27	925	940	1,241	518
1,024	75.48%	605.7	589	97.31	923	939	1,239	517
1,025	75.55%	605.2	589	97.33	923	938	1,238	517
1,026	75.63%	604.9	589	97.34	922	938	1,237	517
1,027	75.70%	604.8	589	97.34	922	938	1,237	517
1,028	75.77%	604.8	589	97.34	922	938	1,237	517
1,029	75.85%	604.8	589	97.34	922	938	1,237	517
1,030	75.92%	604.6	589	97.35	922	937	1,237	516
1,031	76.00%	603.7	588	97.38	921	936	1,236	516
1,032	76.07%	603.3	588	97.40	920	936	1,235	516
1,033	76.14%	603.3	588	97.40	920	936	1,235	516
1,034	76.22%	603.0	587	97.41	920	936	1,234	515
1,035	76.29%	603.0	587	97.41	920	936	1,234	515
1,036	76.36%	603.0	587	97.41	920	935	1,234	515
1,037	76.44%	602.6	587	97.42	920	935	1,234	515
1,038	76.51%	601.5	586	97.46	918	934	1,232	514
1,039	76.59%	601.1	586	97.47	918	933	1,231	514
1,040	76.66%	601.1	586	97.47	918	933	1,231	514

Victoria Lake Monthly Outflow			Annual Average Power Discharge (m^3/s)	Energy Calculation for MP				
Duration (Month)	Probability	Flow / Maximum Power Discharge (m^3/s)		Plant Factor (%)	Annual Energy Production (GWh)			
					Owen Falls	Bujagali	Kalagala	Isimba
1,041	76.73%	601.1	586	97.47	918	933	1,231	514
1,042	76.81%	601.1	586	97.47	918	933	1,231	514
1,043	76.88%	601.1	586	97.47	918	933	1,231	514
1,044	76.95%	601.1	586	97.47	918	933	1,231	514
1,045	77.03%	601.1	586	97.47	918	933	1,231	514
1,046	77.10%	600.7	586	97.49	917	933	1,231	514
1,047	77.18%	600.7	586	97.49	917	933	1,231	514
1,048	77.25%	599.2	584	97.54	915	931	1,228	513
1,049	77.32%	598.9	584	97.55	915	930	1,228	513
1,050	77.40%	598.4	584	97.57	914	930	1,227	512
1,051	77.47%	598.1	584	97.58	914	930	1,226	512
1,052	77.54%	597.0	583	97.61	913	928	1,225	511
1,053	77.62%	597.0	583	97.61	913	928	1,225	511
1,054	77.69%	597.0	583	97.61	913	928	1,225	511
1,055	77.77%	597.0	583	97.61	913	928	1,225	511
1,056	77.84%	597.0	583	97.61	913	928	1,225	511
1,057	77.91%	596.8	583	97.62	913	928	1,224	511
1,058	77.99%	596.8	583	97.62	913	928	1,224	511
1,059	78.06%	596.8	583	97.62	913	928	1,224	511
1,060	78.13%	595.1	581	97.67	910	926	1,222	510
1,061	78.21%	595.1	581	97.67	910	926	1,222	510
1,062	78.28%	595.1	581	97.67	910	926	1,222	510
1,063	78.36%	595.1	581	97.67	910	926	1,222	510
1,064	78.43%	594.9	581	97.68	910	926	1,221	510
1,065	78.50%	594.9	581	97.68	910	926	1,221	510
1,066	78.58%	593.6	580	97.72	909	924	1,219	509
1,067	78.65%	593.4	580	97.73	908	924	1,219	509
1,068	78.72%	593.3	580	97.73	908	923	1,219	509
1,069	78.80%	593.2	580	97.74	908	923	1,218	509
1,070	78.87%	592.9	580	97.75	908	923	1,218	509
1,071	78.95%	592.9	580	97.75	908	923	1,218	509
1,072	79.02%	592.9	580	97.75	908	923	1,218	509
1,073	79.09%	592.5	579	97.76	907	923	1,217	508
1,074	79.17%	592.5	579	97.76	907	923	1,217	508
1,075	79.24%	592.1	579	97.77	907	922	1,217	508
1,076	79.31%	591.8	579	97.78	906	922	1,216	508
1,077	79.39%	591.8	579	97.78	906	922	1,216	508
1,078	79.46%	591.5	578	97.79	906	921	1,216	508
1,079	79.54%	591.1	578	97.80	905	921	1,215	507
1,080	79.61%	591.1	578	97.80	905	921	1,215	507
1,081	79.68%	591.0	578	97.80	905	921	1,215	507
1,082	79.76%	591.0	578	97.80	905	921	1,215	507
1,083	79.83%	589.5	577	97.85	904	919	1,212	506
1,084	79.90%	589.5	577	97.85	904	919	1,212	506
1,085	79.98%	589.2	577	97.86	903	918	1,212	506
1,086	80.05%	589.2	577	97.86	903	918	1,212	506
1,087	80.13%	589.1	577	97.86	903	918	1,212	506
1,088	80.20%	589.0	576	97.87	903	918	1,211	506
1,089	80.27%	587.3	575	97.92	901	916	1,209	505
1,090	80.35%	587.2	575	97.92	901	916	1,208	505
1,091	80.42%	587.2	575	97.92	901	916	1,208	505
1,092	80.49%	586.8	575	97.93	900	915	1,208	504
1,093	80.57%	586.2	574	97.95	899	914	1,207	504
1,094	80.64%	586.0	574	97.95	899	914	1,206	504
1,095	80.72%	585.3	573	97.98	898	913	1,205	503
1,096	80.79%	585.1	573	97.98	898	913	1,205	503
1,097	80.86%	585.1	573	97.98	898	913	1,205	503
1,098	80.94%	585.1	573	97.98	898	913	1,205	503
1,099	81.01%	585.1	573	97.98	898	913	1,205	503
1,100	81.08%	584.9	573	97.99	898	913	1,204	503
1,101	81.16%	584.3	573	98.01	897	912	1,203	502
1,102	81.23%	584.3	573	98.01	897	912	1,203	502
1,103	81.31%	583.6	572	98.03	896	911	1,202	502
1,104	81.38%	583.1	572	98.04	895	911	1,201	502
1,105	81.45%	582.9	572	98.04	895	910	1,201	502
1,106	81.53%	582.8	571	98.05	895	910	1,201	501
1,107	81.60%	582.1	571	98.07	894	909	1,200	501
1,108	81.67%	581.3	570	98.09	893	908	1,198	500
1,109	81.75%	581.2	570	98.09	893	908	1,198	500
1,110	81.82%	580.9	570	98.10	893	908	1,198	500
1,111	81.90%	580.9	570	98.10	893	908	1,198	500
1,112	81.97%	580.9	570	98.10	893	908	1,198	500
1,113	82.04%	580.6	570	98.11	892	907	1,197	500
1,114	82.12%	579.8	569	98.13	891	906	1,196	499
1,115	82.19%	579.5	569	98.14	891	906	1,195	499
1,116	82.26%	579.1	568	98.15	890	905	1,194	499
1,117	82.34%	579.1	568	98.15	890	905	1,194	499
1,118	82.41%	579.1	568	98.15	890	905	1,194	499
1,119	82.49%	578.7	568	98.16	890	905	1,194	498
1,120	82.56%	578.3	568	98.17	889	904	1,193	498

Victoria Lake Monthly Outflow			Annual Average Power Discharge (m^3/s)	Energy Calculation for MP				
Duration (Month)	Probability	Flow / Maximum Power Discharge (m^3/s)		Plant Factor (%)	Annual Energy Production (GWh)			
					Owen Falls	Bujagali	Kalagala	Isimba
1,121	82.63%	577.9	567	98.18	889	904	1,192	498
1,122	82.71%	577.2	567	98.20	888	903	1,191	497
1,123	82.78%	577.2	567	98.20	888	903	1,191	497
1,124	82.85%	577.1	567	98.21	888	903	1,191	497
1,125	82.93%	576.8	567	98.21	887	902	1,191	497
1,126	83.00%	576.8	567	98.21	887	902	1,191	497
1,127	83.08%	576.8	567	98.21	887	902	1,191	497
1,128	83.15%	576.8	567	98.21	887	902	1,191	497
1,129	83.22%	576.8	567	98.21	887	902	1,191	497
1,130	83.30%	576.8	567	98.21	887	902	1,191	497
1,131	83.37%	576.1	566	98.23	886	901	1,189	497
1,132	83.44%	575.5	565	98.25	886	901	1,188	496
1,133	83.52%	575.3	565	98.25	885	900	1,188	496
1,134	83.59%	575.0	565	98.26	885	900	1,187	496
1,135	83.67%	573.9	564	98.29	883	898	1,185	495
1,136	83.74%	573.5	564	98.30	883	898	1,185	495
1,137	83.81%	573.1	563	98.31	882	897	1,184	494
1,138	83.89%	573.1	563	98.31	882	897	1,184	494
1,139	83.96%	573.1	563	98.31	882	897	1,184	494
1,140	84.03%	572.7	563	98.32	882	897	1,183	494
1,141	84.11%	571.2	562	98.35	880	895	1,181	493
1,142	84.18%	571.1	562	98.36	880	895	1,181	493
1,143	84.26%	571.0	562	98.36	880	895	1,180	493
1,144	84.33%	570.9	562	98.36	880	894	1,180	493
1,145	84.40%	569.8	561	98.39	878	893	1,178	492
1,146	84.48%	569.2	560	98.41	877	892	1,177	491
1,147	84.55%	569.1	560	98.41	877	892	1,177	491
1,148	84.62%	569.0	560	98.41	877	892	1,177	491
1,149	84.70%	569.0	560	98.41	877	892	1,177	491
1,150	84.77%	568.6	560	98.42	877	891	1,176	491
1,151	84.85%	568.6	560	98.42	877	891	1,176	491
1,152	84.92%	567.1	558	98.45	875	889	1,173	490
1,153	84.99%	566.4	558	98.47	874	888	1,172	489
1,154	85.07%	565.1	557	98.50	872	887	1,170	488
1,155	85.14%	564.9	556	98.51	872	886	1,169	488
1,156	85.21%	564.9	556	98.51	872	886	1,169	488
1,157	85.29%	564.2	556	98.52	871	885	1,168	488
1,158	85.36%	564.1	556	98.53	871	885	1,168	488
1,159	85.44%	564.0	556	98.53	870	885	1,168	488
1,160	85.51%	563.0	555	98.55	869	884	1,166	487
1,161	85.58%	563.0	555	98.55	869	884	1,166	487
1,162	85.66%	563.0	555	98.55	869	884	1,166	487
1,163	85.73%	563.0	555	98.55	869	884	1,166	487
1,164	85.80%	562.9	555	98.55	869	884	1,166	487
1,165	85.88%	562.9	555	98.55	869	884	1,166	487
1,166	85.95%	562.9	555	98.55	869	884	1,166	487
1,167	86.03%	562.3	554	98.57	868	883	1,165	486
1,168	86.10%	561.2	553	98.59	867	881	1,163	485
1,169	86.17%	561.2	553	98.59	867	881	1,163	485
1,170	86.25%	561.2	553	98.59	867	881	1,163	485
1,171	86.32%	561.0	553	98.60	866	881	1,162	485
1,172	86.39%	561.0	553	98.60	866	881	1,162	485
1,173	86.47%	561.0	553	98.60	866	881	1,162	485
1,174	86.54%	559.7	552	98.63	865	879	1,160	484
1,175	86.62%	559.0	551	98.64	864	878	1,159	484
1,176	86.69%	558.9	551	98.64	864	878	1,159	484
1,177	86.76%	558.9	551	98.64	864	878	1,159	484
1,178	86.84%	557.2	550	98.68	861	876	1,156	482
1,179	86.91%	557.1	550	98.68	861	876	1,155	482
1,180	86.98%	557.1	550	98.68	861	876	1,155	482
1,181	87.06%	557.0	550	98.68	861	876	1,155	482
1,182	87.13%	557.0	550	98.68	861	876	1,155	482
1,183	87.21%	557.0	550	98.68	861	876	1,155	482
1,184	87.28%	556.7	549	98.69	861	875	1,155	482
1,185	87.35%	555.9	549	98.70	859	874	1,153	481
1,186	87.43%	555.2	548	98.72	858	873	1,152	481
1,187	87.50%	555.2	548	98.72	858	873	1,152	481
1,188	87.57%	555.2	548	98.72	858	873	1,152	481
1,189	87.65%	554.8	548	98.73	858	872	1,151	481
1,190	87.72%	552.9	546	98.77	855	870	1,148	479
1,191	87.79%	552.9	546	98.77	855	870	1,148	479
1,192	87.87%	551.7	545	98.79	854	868	1,145	478
1,193	87.94%	551.1	544	98.80	853	867	1,144	478
1,194	88.02%	550.9	544	98.80	853	867	1,144	478
1,195	88.09%	550.9	544	98.80	853	867	1,144	478
1,196	88.16%	550.9	544	98.80	853	867	1,144	478
1,197	88.24%	550.7	544	98.81	852	867	1,144	477
1,198	88.31%	549.4	543	98.83	850	865	1,141	476
1,199	88.38%	547.0	541	98.88	847	861	1,137	475
1,200	88.46%	545.5	540	98.91	845	859	1,134	473

Victoria Lake Monthly Outflow			Annual Average Power Discharge (m^3/s)	Energy Calculation for MP				
Duration (Month)	Probability	Flow / Maximum Power Discharge (m^3/s)		Plant Factor (%)	Annual Energy Production (GWh)			
					Owen Falls	Bujagali	Kalagala	Isimba
1,201	88.53%	545.1	539	98.91	845	859	1,133	473
1,202	88.61%	545.1	539	98.92	845	859	1,133	473
1,203	88.68%	545.1	539	98.92	845	859	1,133	473
1,204	88.75%	545.1	539	98.92	845	859	1,133	473
1,205	88.83%	544.7	539	98.92	844	858	1,132	473
1,206	88.90%	541.7	536	98.98	840	854	1,127	470
1,207	88.97%	541.0	536	98.99	839	853	1,125	470
1,208	89.05%	539.1	534	99.03	836	850	1,122	468
1,209	89.12%	539.1	534	99.03	836	850	1,122	468
1,210	89.20%	539.1	534	99.03	836	850	1,122	468
1,211	89.27%	539.0	534	99.03	836	850	1,122	468
1,212	89.34%	538.6	533	99.04	835	850	1,121	468
1,213	89.42%	538.0	533	99.05	835	849	1,120	468
1,214	89.49%	537.0	532	99.06	833	847	1,118	467
1,215	89.56%	536.9	532	99.07	833	847	1,118	467
1,216	89.64%	536.9	532	99.07	833	847	1,118	467
1,217	89.71%	535.2	530	99.10	831	845	1,115	465
1,218	89.79%	535.1	530	99.10	831	845	1,114	465
1,219	89.86%	535.1	530	99.10	831	845	1,114	465
1,220	89.93%	535.0	530	99.10	830	844	1,114	465
1,221	90.01%	535.0	530	99.10	830	844	1,114	465
1,222	90.08%	534.9	530	99.10	830	844	1,114	465
1,223	90.15%	534.3	530	99.11	829	843	1,113	465
1,224	90.23%	533.2	529	99.13	828	842	1,111	464
1,225	90.30%	533.2	529	99.13	828	842	1,111	464
1,226	90.38%	533.2	529	99.13	828	842	1,111	464
1,227	90.45%	533.2	529	99.13	828	842	1,111	464
1,228	90.52%	533.2	529	99.13	828	842	1,111	464
1,229	90.60%	531.6	527	99.16	826	840	1,108	463
1,230	90.67%	530.9	526	99.17	825	839	1,106	462
1,231	90.74%	529.8	525	99.18	823	837	1,104	461
1,232	90.82%	529.0	525	99.20	822	836	1,103	461
1,233	90.89%	527.2	523	99.23	819	833	1,099	459
1,234	90.97%	527.2	523	99.23	819	833	1,099	459
1,235	91.04%	527.2	523	99.23	819	833	1,099	459
1,236	91.11%	527.2	523	99.23	819	833	1,099	459
1,237	91.19%	526.1	522	99.24	818	832	1,097	458
1,238	91.26%	525.7	522	99.25	817	831	1,096	458
1,239	91.33%	525.1	521	99.26	816	830	1,095	457
1,240	91.41%	525.0	521	99.26	816	830	1,095	457
1,241	91.48%	524.9	521	99.26	816	830	1,095	457
1,242	91.56%	524.9	521	99.26	816	830	1,095	457
1,243	91.63%	523.1	519	99.29	814	827	1,092	456
1,244	91.70%	523.1	519	99.29	813	827	1,091	456
1,245	91.78%	522.9	519	99.29	813	827	1,091	456
1,246	91.85%	520.8	517	99.32	810	824	1,087	454
1,247	91.92%	520.8	517	99.32	810	824	1,087	454
1,248	92.00%	520.8	517	99.32	810	824	1,087	454
1,249	92.07%	520.8	517	99.32	810	824	1,087	454
1,250	92.15%	519.0	516	99.35	808	821	1,083	452
1,251	92.22%	518.9	516	99.35	807	821	1,083	452
1,252	92.29%	517.5	514	99.37	805	819	1,081	451
1,253	92.37%	517.1	514	99.37	805	818	1,080	451
1,254	92.44%	517.1	514	99.37	805	818	1,080	451
1,255	92.51%	517.1	514	99.37	805	818	1,080	451
1,256	92.59%	517.0	514	99.37	805	818	1,080	451
1,257	92.66%	515.0	512	99.40	802	815	1,076	449
1,258	92.74%	514.9	512	99.40	802	815	1,076	449
1,259	92.81%	514.3	511	99.41	801	814	1,074	449
1,260	92.88%	513.4	510	99.42	799	813	1,073	448
1,261	92.96%	513.0	510	99.42	799	812	1,072	448
1,262	93.03%	513.0	510	99.42	799	812	1,072	448
1,263	93.10%	513.0	510	99.42	799	812	1,072	448
1,264	93.18%	510.0	507	99.46	795	808	1,066	445
1,265	93.25%	509.7	507	99.47	794	807	1,065	445
1,266	93.33%	509.6	507	99.47	794	807	1,065	445
1,267	93.40%	508.9	506	99.47	793	806	1,064	444
1,268	93.47%	508.9	506	99.47	793	806	1,064	444
1,269	93.55%	508.9	506	99.47	793	806	1,064	444
1,270	93.62%	508.9	506	99.47	793	806	1,064	444
1,271	93.69%	508.1	506	99.48	792	805	1,062	444
1,272	93.77%	507.8	505	99.49	791	805	1,062	443
1,273	93.84%	507.8	505	99.49	791	805	1,062	443
1,274	93.92%	507.2	505	99.49	790	804	1,060	443
1,275	93.99%	507.0	504	99.50	790	803	1,060	443
1,276	94.06%	507.0	504	99.50	790	803	1,060	443
1,277	94.14%	503.1	501	99.54	784	798	1,052	439
1,278	94.21%	502.9	501	99.54	784	797	1,052	439
1,279	94.28%	502.5	500	99.54	784	797	1,051	439
1,280	94.36%	502.3	500	99.55	783	796	1,051	439

Victoria Lake Monthly Outflow			Annual Average Power Discharge (m^3/s)	Energy Calculation for MP				
Duration (Month)	Probability	Flow / Maximum Power Discharge (m^3/s)		Plant Factor (%)	Annual Energy Production (GWh)			
					Owen Falls	Bujagali	Kalagala	Isimba
1,281	94.43%	501.2	499	99.56	781	795	1,049	438
1,282	94.51%	501.0	499	99.56	781	795	1,048	438
1,283	94.58%	501.0	499	99.56	781	795	1,048	438
1,284	94.65%	500.8	499	99.56	781	794	1,048	437
1,285	94.73%	499.2	497	99.58	779	792	1,045	436
1,286	94.80%	499.2	497	99.58	779	792	1,045	436
1,287	94.87%	498.8	497	99.58	778	791	1,044	436
1,288	94.95%	498.8	497	99.58	778	791	1,044	436
1,289	95.02%	498.1	496	99.59	777	790	1,042	435
1,290	95.10%	497.7	496	99.59	776	789	1,042	435
1,291	95.17%	497.3	495	99.59	776	789	1,041	435
1,292	95.24%	496.9	495	99.60	775	788	1,040	434
1,293	95.32%	496.9	495	99.60	775	788	1,040	434
1,294	95.39%	495.1	493	99.61	772	785	1,036	433
1,295	95.46%	495.1	493	99.61	772	785	1,036	433
1,296	95.54%	495.1	493	99.61	772	785	1,036	433
1,297	95.61%	494.7	493	99.62	772	785	1,036	432
1,298	95.69%	493.2	491	99.63	770	783	1,033	431
1,299	95.76%	493.1	491	99.63	769	782	1,032	431
1,300	95.83%	493.1	491	99.63	769	782	1,032	431
1,301	95.91%	493.1	491	99.63	769	782	1,032	431
1,302	95.98%	491.1	489	99.64	766	779	1,028	429
1,303	96.05%	489.2	488	99.66	764	776	1,025	428
1,304	96.13%	489.1	487	99.66	763	776	1,024	428
1,305	96.20%	486.9	485	99.68	760	773	1,020	426
1,306	96.28%	486.9	485	99.68	760	773	1,020	426
1,307	96.35%	486.9	485	99.68	760	773	1,020	426
1,308	96.42%	486.9	485	99.68	760	773	1,020	426
1,309	96.50%	486.1	485	99.68	759	772	1,018	425
1,310	96.57%	485.0	483	99.69	757	770	1,016	424
1,311	96.64%	485.0	483	99.69	757	770	1,016	424
1,312	96.72%	485.0	483	99.69	757	770	1,016	424
1,313	96.79%	483.2	482	99.70	755	767	1,012	423
1,314	96.87%	480.9	480	99.71	751	764	1,008	421
1,315	96.94%	480.9	480	99.71	751	764	1,008	421
1,316	97.01%	479.2	478	99.72	748	761	1,004	419
1,317	97.09%	479.0	478	99.72	748	761	1,004	419
1,318	97.16%	476.9	476	99.73	745	757	999	417
1,319	97.23%	476.9	476	99.73	745	757	999	417
1,320	97.31%	475.4	474	99.74	743	755	996	416
1,321	97.38%	474.9	474	99.74	742	754	996	416
1,322	97.46%	471.2	470	99.76	736	749	988	412
1,323	97.53%	469.1	468	99.77	733	746	984	411
1,324	97.60%	469.1	468	99.77	733	746	984	411
1,325	97.68%	467.1	466	99.78	730	742	979	409
1,326	97.75%	465.2	464	99.79	727	739	976	407
1,327	97.82%	463.7	463	99.80	725	737	973	406
1,328	97.90%	463.0	462	99.80	724	736	971	405
1,329	97.97%	461.1	460	99.81	721	733	967	404
1,330	98.05%	461.1	460	99.81	721	733	967	404
1,331	98.12%	461.0	460	99.81	721	733	967	404
1,332	98.19%	461.0	460	99.81	721	733	967	404
1,333	98.27%	452.9	452	99.84	708	720	950	397
1,334	98.34%	451.8	451	99.84	706	718	948	396
1,335	98.41%	446.9	446	99.86	699	711	938	392
1,336	98.49%	444.8	444	99.86	696	708	934	390
1,337	98.56%	439.1	439	99.88	687	698	922	385
1,338	98.64%	435.0	434	99.89	681	692	913	381
1,339	98.71%	433.0	433	99.90	678	689	909	380
1,340	98.78%	432.9	432	99.90	677	689	909	379
1,341	98.86%	429.0	429	99.91	671	683	901	376
1,342	98.93%	427.1	427	99.91	668	680	897	374
1,343	99.00%	427.1	427	99.91	668	680	897	374
1,344	99.08%	423.0	423	99.92	662	673	888	371
1,345	99.15%	421.2	421	99.92	659	670	885	369
1,346	99.23%	417.1	417	99.93	653	664	876	366
1,347	99.30%	412.9	413	99.94	646	657	867	362
1,348	99.37%	405.1	405	99.95	634	645	851	355
1,349	99.45%	401.0	401	99.96	628	638	842	352
1,350	99.52%	398.9	399	99.96	625	635	838	350
1,351	99.59%	371.1	371	99.99	581	591	780	326
1,352	99.67%	368.9	369	99.99	578	587	775	324
1,353	99.74%	368.9	369	99.99	578	587	775	324
1,354	99.82%	368.8	369	99.99	578	587	775	324
1,355	99.89%	345.2	345	100.00	541	550	725	303
1,356	99.96%	345.0	345	100.00	540	549	725	303

Appendix I-2

Energy Calculation for hydropower in Lower Nile River

Victoria Lake Monthly Outflow			After Amenity Flow / Maximum Power Discharge	Annual Average Power Discharge	Energy Calculation for MP						Energy Calculation for Pre FS
Duration	Probability	Flow			Plant Factor	Annual Energy Production (GWh)					
(Month)		(m^3/s)	(m^3/s)	(m^3/s)	(%)	Karuma	Oriang	Ayago	Kiba	Murchison	Ayago
1	0.04%	1991	1941	816	42.07	4,994	3,335	5,247	2,489	5,573	5,102
2	0.11%	1956	1906	816	42.83	4,994	3,335	5,247	2,489	5,573	5,101
3	0.18%	1867	1817	816	44.93	4,993	3,334	5,246	2,489	5,572	5,101
4	0.26%	1843	1793	816	45.53	4,992	3,334	5,245	2,488	5,572	5,100
5	0.33%	1765	1715	816	47.58	4,991	3,333	5,244	2,488	5,570	5,099
6	0.41%	1757	1707	816	47.79	4,991	3,333	5,244	2,488	5,570	5,099
7	0.48%	1750	1700	816	47.99	4,991	3,333	5,244	2,488	5,570	5,098
8	0.55%	1740	1690	816	48.28	4,990	3,332	5,243	2,487	5,570	5,098
9	0.63%	1736	1686	816	48.38	4,990	3,332	5,243	2,487	5,569	5,098
10	0.70%	1721	1671	816	48.82	4,990	3,332	5,243	2,487	5,569	5,097
11	0.77%	1721	1671	816	48.83	4,990	3,332	5,242	2,487	5,569	5,097
12	0.85%	1716	1666	816	48.97	4,989	3,332	5,242	2,487	5,569	5,097
13	0.92%	1710	1660	816	49.15	4,989	3,332	5,242	2,487	5,568	5,097
14	1.00%	1705	1655	816	49.28	4,989	3,331	5,242	2,487	5,568	5,096
15	1.07%	1702	1652	816	49.37	4,989	3,331	5,241	2,486	5,568	5,096
16	1.14%	1699	1649	816	49.47	4,988	3,331	5,241	2,486	5,567	5,096
17	1.22%	1697	1647	816	49.53	4,988	3,331	5,241	2,486	5,567	5,096
18	1.29%	1695	1645	816	49.58	4,988	3,331	5,241	2,486	5,567	5,096
19	1.36%	1695	1645	816	49.58	4,988	3,331	5,241	2,486	5,567	5,096
20	1.44%	1690	1640	815	49.73	4,988	3,331	5,240	2,486	5,567	5,095
21	1.51%	1679	1629	815	50.04	4,987	3,330	5,239	2,486	5,566	5,094
22	1.59%	1674	1624	815	50.21	4,986	3,330	5,239	2,485	5,565	5,094
23	1.66%	1667	1617	815	50.41	4,985	3,329	5,238	2,485	5,564	5,093
24	1.73%	1658	1608	815	50.67	4,985	3,329	5,237	2,484	5,563	5,092
25	1.81%	1652	1602	815	50.85	4,984	3,328	5,237	2,484	5,562	5,092
26	1.88%	1652	1602	815	50.86	4,984	3,328	5,236	2,484	5,562	5,092
27	1.95%	1649	1599	815	50.96	4,983	3,328	5,236	2,484	5,562	5,091
28	2.03%	1647	1597	815	51.02	4,983	3,328	5,236	2,484	5,562	5,091
29	2.10%	1642	1592	815	51.18	4,983	3,327	5,235	2,483	5,561	5,090
30	2.18%	1638	1588	815	51.31	4,982	3,327	5,235	2,483	5,560	5,090
31	2.25%	1633	1583	814	51.44	4,982	3,327	5,234	2,483	5,560	5,089
32	2.32%	1632	1582	814	51.48	4,981	3,326	5,234	2,483	5,560	5,089
33	2.40%	1630	1580	814	51.54	4,981	3,326	5,233	2,483	5,559	5,089
34	2.47%	1611	1561	814	52.14	4,978	3,324	5,231	2,481	5,556	5,086
35	2.54%	1602	1552	814	52.42	4,977	3,323	5,229	2,481	5,555	5,084
36	2.62%	1602	1552	814	52.44	4,977	3,323	5,229	2,481	5,554	5,084
37	2.69%	1601	1551	814	52.46	4,977	3,323	5,229	2,481	5,554	5,084
38	2.77%	1599	1549	814	52.54	4,976	3,323	5,228	2,480	5,554	5,084
39	2.84%	1587	1537	813	52.92	4,974	3,322	5,226	2,479	5,552	5,082
40	2.91%	1579	1529	813	53.17	4,973	3,321	5,225	2,479	5,550	5,080
41	2.99%	1576	1526	813	53.29	4,972	3,320	5,224	2,478	5,549	5,080
42	3.06%	1575	1525	813	53.31	4,972	3,320	5,224	2,478	5,549	5,079
43	3.13%	1574	1524	813	53.34	4,972	3,320	5,224	2,478	5,549	5,079
44	3.21%	1571	1521	813	53.45	4,971	3,320	5,223	2,478	5,548	5,079
45	3.28%	1569	1519	813	53.50	4,971	3,319	5,223	2,478	5,548	5,078
46	3.36%	1566	1516	813	53.60	4,970	3,319	5,222	2,477	5,547	5,078
47	3.43%	1565	1515	813	53.63	4,970	3,319	5,222	2,477	5,547	5,078
48	3.50%	1564	1514	813	53.66	4,970	3,319	5,222	2,477	5,547	5,077
49	3.58%	1563	1513	813	53.71	4,970	3,319	5,222	2,477	5,547	5,077
50	3.65%	1563	1513	813	53.72	4,970	3,319	5,221	2,477	5,546	5,077
51	3.72%	1557	1507	812	53.89	4,968	3,318	5,220	2,476	5,545	5,076
52	3.80%	1556	1506	812	53.95	4,968	3,318	5,220	2,476	5,545	5,075
53	3.87%	1554	1504	812	54.02	4,968	3,317	5,219	2,476	5,544	5,075
54	3.95%	1553	1503	812	54.05	4,967	3,317	5,219	2,476	5,544	5,075
55	4.02%	1551	1501	812	54.11	4,967	3,317	5,219	2,476	5,543	5,074
56	4.09%	1549	1499	812	54.16	4,967	3,317	5,218	2,475	5,543	5,074
57	4.17%	1547	1497	812	54.24	4,966	3,316	5,218	2,475	5,542	5,073
58	4.24%	1546	1496	812	54.26	4,966	3,316	5,217	2,475	5,542	5,073
59	4.31%	1542	1492	812	54.41	4,965	3,315	5,216	2,475	5,541	5,072
60	4.39%	1538	1488	812	54.53	4,964	3,315	5,215	2,474	5,540	5,071
61	4.46%	1535	1485	811	54.64	4,963	3,314	5,214	2,474	5,539	5,070
62	4.54%	1535	1485	811	54.65	4,963	3,314	5,214	2,474	5,539	5,070
63	4.61%	1533	1483	811	54.72	4,962	3,314	5,214	2,473	5,538	5,069
64	4.68%	1527	1477	811	54.90	4,961	3,313	5,212	2,473	5,536	5,068
65	4.76%	1522	1472	811	55.10	4,959	3,311	5,210	2,472	5,535	5,066
66	4.83%	1512	1462	810	55.42	4,956	3,310	5,207	2,470	5,531	5,063
67	4.90%	1512	1462	810	55.44	4,956	3,310	5,207	2,470	5,531	5,063
68	4.98%	1509	1459	810	55.52	4,955	3,309	5,206	2,470	5,530	5,062
69	5.05%	1506	1456	810	55.63	4,954	3,308	5,205	2,469	5,529	5,061
70	5.13%	1504	1454	810	55.69	4,954	3,308	5,205	2,469	5,529	5,061
71	5.20%	1503	1453	810	55.75	4,953	3,308	5,204	2,469	5,528	5,060
72	5.27%	1501	1451	810	55.82	4,953	3,307	5,204	2,469	5,528	5,060
73	5.35%	1499	1449	810	55.87	4,952	3,307	5,203	2,468	5,527	5,059
74	5.42%	1499	1449	810	55.87	4,952	3,307	5,203	2,468	5,527	5,059
75	5.49%	1495	1445	809	56.01	4,951	3,306	5,202	2,468	5,526	5,058
76	5.57%	1495	1445	809	56.02	4,951	3,306	5,202	2,468	5,525	5,058
77	5.64%	1490	1440	809	56.20	4,949	3,305	5,200	2,467	5,523	5,056
78	5.72%	1484	1434	809	56.41	4,947	3,303	5,198	2,466	5,521	5,054
79	5.79%	1481	1431	809	56.51	4,946	3,303	5,197	2,465	5,520	5,053
80	5.86%	1480	1430	809	56.56	4,945	3,302	5,196	2,465	5,519	5,052

Victoria Lake Monthly Outflow			After Amenity Flow / Maximum Power Discharge (m^3/s)	Annual Average Power Discharge (m^3/s)	Energy Calculation for MP						Energy Calculation for Pre FS
Duration (Month)	Probability	Flow (m^3/s)			Plant Factor (%)	Annual Energy Production (GWh)					
						Karuma	Oriang	Ayago	Kiba	Murchison	Ayago
81	5.94%	1473	1423	808	56.81	4,943	3,301	5,193	2,464	5,517	5,050
82	6.01%	1467	1417	808	57.00	4,941	3,299	5,191	2,463	5,514	5,048
83	6.08%	1467	1417	808	57.03	4,941	3,299	5,191	2,463	5,514	5,047
84	6.16%	1465	1415	808	57.09	4,940	3,299	5,190	2,462	5,513	5,047
85	6.23%	1459	1409	807	57.28	4,938	3,297	5,188	2,461	5,511	5,045
86	6.31%	1458	1408	807	57.35	4,937	3,297	5,187	2,461	5,510	5,044
87	6.38%	1457	1407	807	57.35	4,937	3,297	5,187	2,461	5,510	5,044
88	6.45%	1456	1406	807	57.39	4,937	3,297	5,187	2,461	5,510	5,043
89	6.53%	1456	1406	807	57.39	4,937	3,297	5,187	2,461	5,510	5,043
90	6.60%	1456	1406	807	57.42	4,936	3,296	5,187	2,460	5,509	5,043
91	6.67%	1452	1402	807	57.57	4,935	3,295	5,185	2,460	5,508	5,041
92	6.75%	1450	1400	807	57.62	4,934	3,295	5,184	2,459	5,507	5,041
93	6.82%	1447	1397	807	57.74	4,933	3,294	5,183	2,459	5,505	5,039
94	6.90%	1444	1394	806	57.83	4,932	3,293	5,182	2,458	5,504	5,038
95	6.97%	1443	1393	806	57.89	4,931	3,293	5,181	2,458	5,503	5,038
96	7.04%	1443	1393	806	57.90	4,931	3,293	5,181	2,458	5,503	5,038
97	7.12%	1442	1392	806	57.92	4,931	3,293	5,181	2,458	5,503	5,037
98	7.19%	1440	1390	806	57.97	4,930	3,292	5,180	2,457	5,502	5,037
99	7.26%	1437	1387	806	58.08	4,929	3,291	5,179	2,457	5,501	5,035
100	7.34%	1437	1387	806	58.08	4,929	3,291	5,179	2,457	5,501	5,035
101	7.41%	1437	1387	806	58.09	4,929	3,291	5,178	2,457	5,501	5,035
102	7.49%	1433	1383	806	58.24	4,927	3,290	5,177	2,456	5,499	5,033
103	7.56%	1431	1381	805	58.32	4,926	3,289	5,176	2,455	5,498	5,032
104	7.63%	1429	1379	805	58.39	4,925	3,289	5,175	2,455	5,497	5,031
105	7.71%	1428	1378	805	58.43	4,924	3,288	5,174	2,454	5,496	5,031
106	7.78%	1428	1378	805	58.44	4,924	3,288	5,174	2,454	5,496	5,031
107	7.85%	1427	1377	805	58.46	4,924	3,288	5,174	2,454	5,496	5,030
108	7.93%	1427	1377	805	58.48	4,924	3,288	5,173	2,454	5,495	5,030
109	8.00%	1425	1375	805	58.55	4,923	3,287	5,172	2,454	5,494	5,029
110	8.08%	1424	1374	805	58.58	4,923	3,287	5,172	2,454	5,494	5,029
111	8.15%	1424	1374	805	58.58	4,923	3,287	5,172	2,454	5,494	5,029
112	8.22%	1422	1372	805	58.63	4,922	3,287	5,171	2,453	5,493	5,028
113	8.30%	1422	1372	805	58.66	4,921	3,286	5,171	2,453	5,493	5,028
114	8.37%	1421	1371	805	58.70	4,921	3,286	5,170	2,453	5,492	5,027
115	8.44%	1419	1369	804	58.75	4,920	3,286	5,170	2,452	5,491	5,026
116	8.52%	1419	1369	804	58.75	4,920	3,285	5,169	2,452	5,491	5,026
117	8.59%	1419	1369	804	58.77	4,920	3,285	5,169	2,452	5,491	5,026
118	8.67%	1415	1365	804	58.89	4,918	3,284	5,167	2,451	5,489	5,024
119	8.74%	1412	1362	804	59.02	4,916	3,283	5,165	2,450	5,487	5,022
120	8.81%	1410	1360	804	59.08	4,915	3,282	5,164	2,450	5,486	5,021
121	8.89%	1409	1359	804	59.14	4,914	3,282	5,164	2,450	5,485	5,021
122	8.96%	1407	1357	803	59.20	4,914	3,281	5,163	2,449	5,484	5,020
123	9.03%	1407	1357	803	59.21	4,913	3,281	5,163	2,449	5,484	5,020
124	9.11%	1406	1356	803	59.24	4,913	3,281	5,162	2,449	5,483	5,019
125	9.18%	1402	1352	803	59.37	4,911	3,279	5,160	2,448	5,481	5,017
126	9.26%	1401	1351	803	59.43	4,910	3,279	5,159	2,447	5,480	5,016
127	9.33%	1400	1350	803	59.46	4,910	3,279	5,159	2,447	5,480	5,016
128	9.40%	1397	1347	802	59.57	4,908	3,277	5,157	2,446	5,478	5,014
129	9.48%	1397	1347	802	59.58	4,908	3,277	5,157	2,446	5,477	5,014
130	9.55%	1396	1346	802	59.61	4,907	3,277	5,156	2,446	5,477	5,013
131	9.62%	1395	1345	802	59.64	4,907	3,277	5,156	2,446	5,476	5,013
132	9.70%	1392	1342	802	59.75	4,905	3,276	5,154	2,445	5,475	5,011
133	9.77%	1392	1342	802	59.76	4,905	3,275	5,154	2,445	5,474	5,011
134	9.85%	1390	1340	802	59.83	4,904	3,275	5,152	2,444	5,473	5,010
135	9.92%	1386	1336	801	60.00	4,901	3,273	5,150	2,443	5,470	5,007
136	9.99%	1379	1329	801	60.24	4,897	3,270	5,145	2,441	5,466	5,003
137	10.07%	1378	1328	801	60.27	4,897	3,270	5,145	2,441	5,465	5,003
138	10.14%	1377	1327	801	60.31	4,896	3,269	5,144	2,440	5,464	5,002
139	10.21%	1373	1323	800	60.48	4,893	3,268	5,141	2,439	5,461	4,999
140	10.29%	1372	1322	800	60.50	4,893	3,267	5,141	2,439	5,461	4,999
141	10.36%	1372	1322	800	60.53	4,892	3,267	5,140	2,439	5,460	4,998
142	10.44%	1371	1321	800	60.54	4,892	3,267	5,140	2,438	5,460	4,998
143	10.51%	1368	1318	800	60.66	4,890	3,266	5,138	2,437	5,458	4,996
144	10.58%	1368	1318	800	60.66	4,890	3,266	5,138	2,437	5,458	4,996
145	10.66%	1368	1318	800	60.67	4,890	3,265	5,138	2,437	5,458	4,996
146	10.73%	1367	1317	799	60.71	4,889	3,265	5,137	2,437	5,457	4,995
147	10.80%	1367	1317	799	60.71	4,889	3,265	5,137	2,437	5,457	4,995
148	10.88%	1366	1316	799	60.72	4,889	3,265	5,137	2,437	5,457	4,995
149	10.95%	1362	1312	799	60.90	4,886	3,263	5,134	2,435	5,453	4,992
150	11.03%	1355	1305	798	61.18	4,881	3,260	5,129	2,433	5,448	4,987
151	11.10%	1353	1303	798	61.22	4,880	3,259	5,128	2,433	5,447	4,986
152	11.17%	1352	1302	798	61.28	4,879	3,258	5,127	2,432	5,446	4,985
153	11.25%	1350	1300	798	61.36	4,878	3,257	5,125	2,431	5,444	4,983
154	11.32%	1349	1299	797	61.38	4,878	3,257	5,125	2,431	5,444	4,983
155	11.39%	1346	1296	797	61.49	4,876	3,256	5,123	2,430	5,442	4,981
156	11.47%	1346	1296	797	61.52	4,875	3,255	5,122	2,430	5,441	4,980
157	11.54%	1345	1295	797	61.54	4,875	3,255	5,122	2,430	5,441	4,980
158	11.62%	1345	1295	797	61.54	4,875	3,255	5,122	2,430	5,441	4,980
159	11.69%	1345	1295	797	61.55	4,874	3,255	5,122	2,430	5,440	4,980
160	11.76%	1344	1294	797	61.59	4,874	3,255	5,121	2,429	5,439	4,979

Victoria Lake Monthly Outflow			After Amenity Flow / Maximum Power Discharge (m^3/s)	Annual Average Power Discharge (m^3/s)	Energy Calculation for MP						Energy Calculation for Pre FS
Duration (Month)	Probability	Flow (m^3/s)			Plant Factor (%)	Annual Energy Production (GWh)					
						Karuma	Oriang	Ayago	Kiba	Murchison	Ayago
161	11.84%	1340	1290	796	61.74	4,871	3,253	5,118	2,428	5,436	4,976
162	11.91%	1340	1290	796	61.74	4,871	3,253	5,118	2,428	5,436	4,976
163	11.98%	1338	1288	796	61.81	4,870	3,252	5,116	2,427	5,435	4,975
164	12.06%	1337	1287	796	61.85	4,869	3,251	5,116	2,427	5,434	4,974
165	12.13%	1337	1287	796	61.86	4,869	3,251	5,116	2,427	5,434	4,974
166	12.21%	1329	1279	795	62.17	4,863	3,247	5,109	2,424	5,427	4,968
167	12.28%	1328	1278	795	62.19	4,862	3,247	5,109	2,424	5,427	4,967
168	12.35%	1323	1273	794	62.39	4,859	3,244	5,105	2,422	5,423	4,964
169	12.43%	1322	1272	794	62.42	4,858	3,244	5,104	2,421	5,422	4,963
170	12.50%	1322	1272	794	62.44	4,858	3,244	5,104	2,421	5,422	4,963
171	12.57%	1320	1270	794	62.51	4,856	3,243	5,102	2,420	5,420	4,961
172	12.65%	1318	1268	794	62.58	4,855	3,242	5,101	2,420	5,418	4,960
173	12.72%	1317	1267	794	62.63	4,854	3,241	5,100	2,419	5,417	4,959
174	12.79%	1316	1266	794	62.66	4,853	3,241	5,099	2,419	5,417	4,958
175	12.87%	1315	1265	793	62.72	4,852	3,240	5,098	2,418	5,415	4,957
176	12.94%	1314	1264	793	62.75	4,851	3,240	5,097	2,418	5,415	4,956
177	13.02%	1314	1264	793	62.75	4,851	3,240	5,097	2,418	5,415	4,956
178	13.09%	1312	1262	793	62.82	4,850	3,239	5,096	2,417	5,413	4,955
179	13.16%	1311	1261	793	62.89	4,849	3,238	5,094	2,417	5,411	4,953
180	13.24%	1310	1260	793	62.91	4,848	3,238	5,094	2,417	5,411	4,953
181	13.31%	1310	1260	793	62.91	4,848	3,238	5,094	2,417	5,411	4,953
182	13.38%	1309	1259	792	62.97	4,847	3,237	5,093	2,416	5,410	4,952
183	13.46%	1307	1257	792	63.04	4,845	3,236	5,091	2,415	5,408	4,950
184	13.53%	1306	1256	792	63.07	4,845	3,235	5,090	2,415	5,407	4,949
185	13.61%	1306	1256	792	63.09	4,845	3,235	5,090	2,415	5,407	4,949
186	13.68%	1301	1251	791	63.27	4,841	3,232	5,086	2,413	5,402	4,945
187	13.75%	1298	1248	791	63.39	4,838	3,231	5,083	2,411	5,400	4,943
188	13.83%	1297	1247	791	63.44	4,837	3,230	5,082	2,411	5,399	4,942
189	13.90%	1296	1246	791	63.47	4,836	3,230	5,082	2,411	5,398	4,941
190	13.97%	1295	1245	791	63.52	4,835	3,229	5,080	2,410	5,397	4,940
191	14.05%	1295	1245	791	63.52	4,835	3,229	5,080	2,410	5,397	4,940
192	14.12%	1293	1243	790	63.57	4,834	3,228	5,079	2,410	5,395	4,939
193	14.20%	1293	1243	790	63.59	4,834	3,228	5,079	2,409	5,395	4,938
194	14.27%	1292	1242	790	63.62	4,833	3,227	5,078	2,409	5,394	4,938
195	14.34%	1291	1241	790	63.68	4,832	3,227	5,077	2,408	5,393	4,936
196	14.42%	1290	1240	790	63.69	4,832	3,226	5,076	2,408	5,392	4,936
197	14.49%	1290	1240	790	63.71	4,831	3,226	5,076	2,408	5,392	4,936
198	14.56%	1288	1238	790	63.77	4,830	3,225	5,075	2,407	5,390	4,934
199	14.64%	1287	1237	789	63.84	4,828	3,224	5,073	2,407	5,389	4,933
200	14.71%	1286	1236	789	63.85	4,828	3,224	5,073	2,406	5,388	4,932
201	14.79%	1286	1236	789	63.87	4,828	3,224	5,072	2,406	5,388	4,932
202	14.86%	1282	1232	789	64.02	4,824	3,221	5,069	2,405	5,384	4,928
203	14.93%	1281	1231	789	64.08	4,823	3,221	5,067	2,404	5,383	4,927
204	15.01%	1280	1230	788	64.11	4,822	3,220	5,067	2,404	5,382	4,926
205	15.08%	1279	1229	788	64.14	4,821	3,220	5,066	2,403	5,381	4,925
206	15.15%	1276	1226	788	64.27	4,818	3,218	5,063	2,402	5,378	4,922
207	15.23%	1270	1220	787	64.52	4,813	3,214	5,057	2,399	5,371	4,917
208	15.30%	1268	1218	787	64.58	4,811	3,213	5,055	2,398	5,370	4,915
209	15.38%	1267	1217	786	64.62	4,810	3,212	5,054	2,398	5,369	4,914
210	15.45%	1266	1216	786	64.66	4,809	3,212	5,053	2,397	5,368	4,913
211	15.52%	1265	1215	786	64.70	4,808	3,211	5,052	2,397	5,367	4,912
212	15.60%	1264	1214	786	64.76	4,807	3,210	5,051	2,396	5,365	4,911
213	15.67%	1263	1213	786	64.78	4,807	3,210	5,050	2,396	5,364	4,910
214	15.74%	1263	1213	786	64.79	4,806	3,210	5,050	2,396	5,364	4,910
215	15.82%	1263	1213	786	64.80	4,806	3,209	5,050	2,395	5,364	4,910
216	15.89%	1262	1212	786	64.83	4,805	3,209	5,049	2,395	5,363	4,909
217	15.97%	1262	1212	786	64.84	4,805	3,209	5,049	2,395	5,363	4,909
218	16.04%	1261	1211	786	64.85	4,805	3,209	5,048	2,395	5,363	4,909
219	16.11%	1260	1210	785	64.89	4,804	3,208	5,047	2,394	5,362	4,908
220	16.19%	1260	1210	785	64.91	4,803	3,208	5,047	2,394	5,361	4,907
221	16.26%	1259	1209	785	64.94	4,803	3,207	5,046	2,394	5,360	4,906
222	16.33%	1259	1209	785	64.94	4,803	3,207	5,046	2,394	5,360	4,906
223	16.41%	1258	1208	785	64.97	4,802	3,207	5,045	2,393	5,359	4,906
224	16.48%	1258	1208	785	64.97	4,802	3,207	5,045	2,393	5,359	4,906
225	16.56%	1258	1208	785	64.98	4,802	3,206	5,045	2,393	5,359	4,905
226	16.63%	1258	1208	785	65.01	4,801	3,206	5,044	2,393	5,358	4,905
227	16.70%	1257	1207	785	65.04	4,800	3,205	5,043	2,393	5,357	4,904
228	16.78%	1256	1206	785	65.08	4,799	3,205	5,042	2,392	5,356	4,903
229	16.85%	1255	1205	785	65.11	4,798	3,204	5,042	2,392	5,355	4,902
230	16.92%	1253	1203	784	65.20	4,796	3,203	5,039	2,390	5,353	4,900
231	17.00%	1252	1202	784	65.21	4,796	3,202	5,039	2,390	5,352	4,899
232	17.07%	1252	1202	784	65.23	4,795	3,202	5,038	2,390	5,352	4,899
233	17.15%	1251	1201	784	65.25	4,795	3,202	5,038	2,390	5,351	4,898
234	17.22%	1251	1201	784	65.26	4,795	3,202	5,038	2,390	5,351	4,898
235	17.29%	1251	1201	784	65.26	4,794	3,202	5,037	2,390	5,351	4,898
236	17.37%	1250	1200	784	65.30	4,793	3,201	5,036	2,389	5,350	4,897
237	17.44%	1250	1200	784	65.30	4,793	3,201	5,036	2,389	5,350	4,897
238	17.51%	1250	1200	784	65.31	4,793	3,201	5,036	2,389	5,350	4,897
239	17.59%	1250	1200	784	65.32	4,793	3,201	5,036	2,389	5,349	4,896
240	17.66%	1249	1199	783	65.37	4,792	3,200	5,034	2,388	5,348	4,895

Victoria Lake Monthly Outflow			After Amenity Flow / Maximum Power Discharge	Annual Average Power Discharge	Energy Calculation for MP						Energy Calculation for Pre FS
Duration	Probability	Flow			Plant Factor	Annual Energy Production (GWh)					
(Month)		(m^3/s)	(m^3/s)	(m^3/s)	(%)	Karuma	Oriang	Ayago	Kiba	Murchison	Ayago
241	17.74%	1248	1198	783	65.40	4,791	3,199	5,034	2,388	5,347	4,894
242	17.81%	1247	1197	783	65.43	4,790	3,199	5,033	2,387	5,346	4,893
243	17.88%	1243	1193	782	65.59	4,785	3,196	5,028	2,385	5,341	4,889
244	17.96%	1241	1191	782	65.65	4,784	3,195	5,026	2,384	5,339	4,887
245	18.03%	1238	1188	782	65.77	4,781	3,192	5,023	2,383	5,336	4,884
246	18.10%	1238	1188	782	65.78	4,780	3,192	5,022	2,383	5,335	4,883
247	18.18%	1237	1187	781	65.81	4,779	3,192	5,022	2,382	5,334	4,883
248	18.25%	1235	1185	781	65.89	4,777	3,190	5,019	2,381	5,332	4,880
249	18.33%	1235	1185	781	65.91	4,777	3,190	5,019	2,381	5,331	4,880
250	18.40%	1234	1184	781	65.94	4,776	3,189	5,018	2,381	5,330	4,879
251	18.47%	1234	1184	781	65.94	4,776	3,189	5,018	2,380	5,330	4,879
252	18.55%	1233	1183	781	65.98	4,775	3,188	5,017	2,380	5,329	4,878
253	18.62%	1231	1181	780	66.08	4,772	3,187	5,014	2,378	5,326	4,875
254	18.69%	1230	1180	780	66.12	4,771	3,186	5,013	2,378	5,325	4,874
255	18.77%	1229	1179	780	66.14	4,770	3,185	5,012	2,378	5,324	4,873
256	18.84%	1229	1179	780	66.15	4,770	3,185	5,012	2,377	5,324	4,873
257	18.92%	1226	1176	779	66.28	4,766	3,183	5,008	2,376	5,319	4,869
258	18.99%	1223	1173	779	66.37	4,764	3,181	5,005	2,374	5,317	4,866
259	19.06%	1222	1172	779	66.42	4,762	3,180	5,004	2,374	5,315	4,865
260	19.14%	1221	1171	778	66.45	4,761	3,179	5,003	2,373	5,314	4,864
261	19.21%	1221	1171	778	66.48	4,760	3,179	5,002	2,373	5,313	4,863
262	19.28%	1221	1171	778	66.49	4,760	3,179	5,001	2,373	5,313	4,863
263	19.36%	1221	1171	778	66.49	4,760	3,179	5,001	2,373	5,313	4,863
264	19.43%	1219	1169	778	66.56	4,758	3,177	4,999	2,372	5,310	4,861
265	19.51%	1216	1166	777	66.66	4,755	3,175	4,996	2,370	5,307	4,858
266	19.58%	1213	1163	777	66.81	4,751	3,172	4,991	2,368	5,302	4,853
267	19.65%	1212	1162	777	66.82	4,750	3,172	4,991	2,368	5,302	4,853
268	19.73%	1212	1162	777	66.84	4,750	3,172	4,990	2,367	5,301	4,852
269	19.80%	1211	1161	776	66.86	4,749	3,171	4,990	2,367	5,300	4,852
270	19.87%	1211	1161	776	66.87	4,749	3,171	4,989	2,367	5,300	4,851
271	19.95%	1209	1159	776	66.95	4,746	3,170	4,987	2,366	5,297	4,849
272	20.02%	1209	1159	776	66.97	4,746	3,169	4,986	2,365	5,297	4,848
273	20.10%	1208	1158	776	66.98	4,746	3,169	4,986	2,365	5,296	4,848
274	20.17%	1207	1157	776	67.03	4,744	3,168	4,984	2,365	5,295	4,846
275	20.24%	1207	1157	776	67.05	4,743	3,168	4,984	2,364	5,294	4,846
276	20.32%	1205	1155	775	67.11	4,742	3,166	4,982	2,363	5,292	4,844
277	20.39%	1203	1153	775	67.21	4,738	3,164	4,979	2,362	5,288	4,841
278	20.46%	1202	1152	775	67.23	4,738	3,164	4,978	2,361	5,288	4,840
279	20.54%	1202	1152	775	67.25	4,737	3,164	4,978	2,361	5,287	4,840
280	20.61%	1199	1149	774	67.36	4,734	3,161	4,974	2,360	5,283	4,836
281	20.69%	1199	1149	774	67.37	4,734	3,161	4,974	2,359	5,283	4,836
282	20.76%	1198	1148	774	67.40	4,733	3,160	4,973	2,359	5,282	4,835
283	20.83%	1198	1148	774	67.41	4,732	3,160	4,972	2,359	5,282	4,834
284	20.91%	1197	1147	774	67.43	4,732	3,160	4,972	2,358	5,281	4,834
285	20.98%	1196	1146	773	67.48	4,730	3,159	4,970	2,358	5,279	4,832
286	21.05%	1195	1145	773	67.52	4,729	3,158	4,969	2,357	5,278	4,831
287	21.13%	1195	1145	773	67.52	4,729	3,158	4,969	2,357	5,278	4,831
288	21.20%	1193	1143	773	67.59	4,726	3,156	4,966	2,356	5,275	4,829
289	21.28%	1193	1143	773	67.61	4,726	3,156	4,966	2,356	5,275	4,828
290	21.35%	1192	1142	773	67.64	4,725	3,155	4,965	2,355	5,273	4,827
291	21.42%	1191	1141	772	67.69	4,724	3,154	4,963	2,354	5,272	4,826
292	21.50%	1191	1141	772	67.70	4,723	3,154	4,962	2,354	5,271	4,825
293	21.57%	1188	1138	772	67.79	4,720	3,152	4,959	2,353	5,268	4,822
294	21.64%	1187	1137	771	67.84	4,719	3,151	4,958	2,352	5,266	4,821
295	21.72%	1187	1137	771	67.85	4,718	3,151	4,957	2,352	5,266	4,820
296	21.79%	1187	1137	771	67.87	4,718	3,150	4,957	2,351	5,265	4,820
297	21.87%	1184	1134	771	67.97	4,714	3,148	4,953	2,350	5,262	4,816
298	21.94%	1184	1134	771	67.98	4,714	3,148	4,953	2,350	5,261	4,816
299	22.01%	1184	1134	771	67.98	4,714	3,148	4,953	2,349	5,261	4,816
300	22.09%	1183	1133	771	68.02	4,713	3,147	4,952	2,349	5,260	4,814
301	22.16%	1183	1133	771	68.02	4,713	3,147	4,951	2,349	5,260	4,814
302	22.23%	1181	1131	770	68.11	4,710	3,145	4,948	2,347	5,256	4,811
303	22.31%	1180	1130	770	68.13	4,709	3,145	4,948	2,347	5,256	4,811
304	22.38%	1180	1130	770	68.14	4,709	3,144	4,947	2,347	5,255	4,810
305	22.46%	1179	1129	770	68.16	4,708	3,144	4,947	2,347	5,255	4,810
306	22.53%	1178	1128	770	68.20	4,707	3,143	4,945	2,346	5,253	4,808
307	22.60%	1178	1128	769	68.22	4,706	3,143	4,945	2,346	5,252	4,808
308	22.68%	1178	1128	769	68.22	4,706	3,142	4,944	2,346	5,252	4,808
309	22.75%	1177	1127	769	68.23	4,705	3,142	4,944	2,345	5,252	4,807
310	22.82%	1177	1127	769	68.27	4,704	3,141	4,943	2,345	5,250	4,806
311	22.90%	1176	1126	769	68.31	4,703	3,140	4,941	2,344	5,249	4,804
312	22.97%	1172	1122	768	68.44	4,698	3,137	4,936	2,342	5,244	4,800
313	23.05%	1170	1120.5	768	68.52	4,696	3,136	4,934	2,340	5,241	4,797
314	23.12%	1170	1119.6	768	68.55	4,694	3,135	4,932	2,340	5,239	4,796
315	23.19%	1169	1119	767	68.59	4,693	3,134	4,931	2,339	5,238	4,794
316	23.27%	1168	1118	767	68.61	4,692	3,133	4,930	2,339	5,237	4,794
317	23.34%	1165	1115	767	68.73	4,688	3,131	4,926	2,337	5,232	4,789
318	23.41%	1164	1114	766	68.76	4,687	3,130	4,925	2,336	5,231	4,788
319	23.49%	1164	1114	766	68.77	4,687	3,130	4,924	2,336	5,231	4,788
320	23.56%	1164	1114	766	68.79	4,686	3,129	4,923	2,336	5,230	4,787

Victoria Lake Monthly Outflow			After Amenity Flow / Maximum Power Discharge	Annual Average Power Discharge	Energy Calculation for MP						Energy Calculation for Pre FS
Duration	Probability	Flow			Plant Factor	Annual Energy Production (GWh)					
(Month)		(m^3/s)	(m^3/s)	(m^3/s)	(%)	Karuma	Oriang	Ayago	Kiba	Murchison	Ayago
321	23.64%	1164	1114	766	68.79	4,686	3,129	4,923	2,336	5,230	4,787
322	23.71%	1161	1111	766	68.89	4,682	3,127	4,920	2,334	5,226	4,784
323	23.78%	1160	1110	765	68.94	4,681	3,126	4,918	2,333	5,224	4,782
324	23.86%	1159	1109	765	69.00	4,678	3,124	4,916	2,332	5,222	4,779
325	23.93%	1157	1107	765	69.06	4,676	3,123	4,913	2,331	5,219	4,777
326	24.00%	1156	1106	764	69.09	4,675	3,122	4,912	2,330	5,218	4,776
327	24.08%	1153	1103	764	69.22	4,671	3,119	4,907	2,328	5,213	4,772
328	24.15%	1152	1102	763	69.25	4,669	3,118	4,906	2,327	5,211	4,770
329	24.23%	1151	1101	763	69.32	4,667	3,117	4,904	2,326	5,209	4,768
330	24.30%	1150	1100	763	69.34	4,666	3,116	4,903	2,326	5,208	4,767
331	24.37%	1149	1099	763	69.38	4,665	3,115	4,901	2,325	5,206	4,765
332	24.45%	1149	1099	763	69.40	4,664	3,115	4,900	2,325	5,205	4,765
333	24.52%	1148	1098	762	69.43	4,663	3,114	4,899	2,324	5,204	4,764
334	24.59%	1147	1097	762	69.46	4,662	3,113	4,898	2,324	5,203	4,763
335	24.67%	1146	1096	762	69.52	4,660	3,112	4,896	2,322	5,200	4,760
336	24.74%	1144	1094	761	69.62	4,656	3,109	4,892	2,321	5,197	4,757
337	24.82%	1138	1088	760	69.84	4,648	3,104	4,883	2,317	5,187	4,748
338	24.89%	1136	1086	759	69.92	4,645	3,102	4,880	2,315	5,184	4,745
339	24.96%	1136	1086	759	69.92	4,645	3,102	4,880	2,315	5,184	4,745
340	25.04%	1136	1086	759	69.92	4,645	3,102	4,880	2,315	5,184	4,745
341	25.11%	1136	1086	759	69.94	4,644	3,101	4,880	2,315	5,183	4,745
342	25.18%	1136	1086	759	69.94	4,644	3,101	4,880	2,315	5,183	4,745
343	25.26%	1135	1085	759	69.98	4,643	3,100	4,878	2,314	5,181	4,743
344	25.33%	1134	1084	759	70.02	4,641	3,099	4,877	2,313	5,180	4,742
345	25.41%	1132	1082	758	70.10	4,638	3,097	4,873	2,312	5,176	4,738
346	25.48%	1132	1082	758	70.11	4,638	3,097	4,873	2,312	5,176	4,738
347	25.55%	1131	1081	758	70.13	4,637	3,097	4,872	2,311	5,175	4,737
348	25.63%	1131	1081	758	70.14	4,637	3,096	4,872	2,311	5,175	4,737
349	25.70%	1129	1079	758	70.21	4,634	3,095	4,869	2,310	5,172	4,734
350	25.77%	1129	1079	758	70.23	4,633	3,094	4,868	2,309	5,171	4,733
351	25.85%	1128	1078	757	70.25	4,633	3,094	4,867	2,309	5,170	4,733
352	25.92%	1128	1078	757	70.26	4,632	3,093	4,867	2,309	5,170	4,732
353	26.00%	1127	1077	757	70.29	4,631	3,092	4,866	2,308	5,168	4,731
354	26.07%	1127	1077	757	70.32	4,630	3,092	4,865	2,308	5,167	4,730
355	26.14%	1124	1074	756	70.43	4,626	3,089	4,860	2,306	5,163	4,726
356	26.22%	1123	1073	756	70.47	4,624	3,088	4,858	2,305	5,161	4,724
357	26.29%	1123	1073	756	70.48	4,624	3,088	4,858	2,305	5,160	4,724
358	26.36%	1121	1071	756	70.54	4,621	3,086	4,856	2,303	5,158	4,721
359	26.44%	1120	1070	755	70.57	4,620	3,085	4,854	2,303	5,156	4,720
360	26.51%	1120	1070	755	70.60	4,619	3,084	4,853	2,302	5,155	4,719
361	26.59%	1119	1069	755	70.63	4,618	3,084	4,852	2,302	5,154	4,718
362	26.66%	1119	1069	755	70.63	4,618	3,084	4,852	2,302	5,154	4,717
363	26.73%	1119	1069	755	70.63	4,618	3,084	4,852	2,302	5,154	4,717
364	26.81%	1119	1069	755	70.63	4,617	3,083	4,852	2,302	5,154	4,717
365	26.88%	1119	1069	755	70.64	4,617	3,083	4,851	2,301	5,153	4,717
366	26.95%	1118	1068	755	70.65	4,617	3,083	4,851	2,301	5,153	4,717
367	27.03%	1117	1067	754	70.72	4,614	3,081	4,848	2,300	5,150	4,714
368	27.10%	1115	1065	754	70.79	4,611	3,079	4,845	2,298	5,146	4,711
369	27.18%	1113	1063	753	70.88	4,608	3,077	4,841	2,297	5,142	4,707
370	27.25%	1113	1063	753	70.89	4,607	3,077	4,841	2,296	5,142	4,707
371	27.32%	1111	1061	753	70.94	4,605	3,075	4,839	2,295	5,140	4,705
372	27.40%	1111	1061	753	70.96	4,604	3,075	4,838	2,295	5,139	4,704
373	27.47%	1108	1058	752	71.09	4,599	3,071	4,832	2,292	5,133	4,698
374	27.54%	1107	1057	752	71.11	4,598	3,071	4,831	2,292	5,132	4,698
375	27.62%	1107	1057	752	71.12	4,598	3,070	4,831	2,292	5,132	4,697
376	27.69%	1106	1056	752	71.14	4,597	3,070	4,830	2,291	5,130	4,696
377	27.77%	1105	1055	751	71.19	4,595	3,068	4,828	2,290	5,128	4,694
378	27.84%	1105	1055	751	71.19	4,595	3,068	4,828	2,290	5,128	4,694
379	27.91%	1105	1055	751	71.20	4,595	3,068	4,828	2,290	5,128	4,694
380	27.99%	1102	1052	750	71.31	4,590	3,065	4,823	2,288	5,123	4,689
381	28.06%	1101	1051	750	71.35	4,588	3,064	4,821	2,287	5,121	4,687
382	28.13%	1101	1051	750	71.35	4,588	3,064	4,821	2,287	5,121	4,687
383	28.21%	1101	1051	750	71.35	4,588	3,064	4,821	2,287	5,121	4,687
384	28.28%	1098	1048	749	71.50	4,582	3,060	4,814	2,284	5,114	4,681
385	28.36%	1097	1047	749	71.52	4,581	3,059	4,813	2,283	5,113	4,680
386	28.43%	1097	1047	749	71.52	4,581	3,059	4,813	2,283	5,113	4,680
387	28.50%	1093	1043	748	71.68	4,574	3,055	4,806	2,280	5,105	4,673
388	28.58%	1093	1043	748	71.69	4,574	3,054	4,806	2,280	5,105	4,673
389	28.65%	1092	1042	748	71.72	4,573	3,054	4,804	2,279	5,103	4,671
390	28.72%	1092	1042	748	71.74	4,572	3,053	4,804	2,279	5,103	4,671
391	28.80%	1092	1042	747	71.75	4,571	3,053	4,803	2,279	5,102	4,670
392	28.87%	1092	1042	747	71.75	4,571	3,053	4,803	2,279	5,102	4,670
393	28.95%	1086	1036	746	71.98	4,561	3,046	4,793	2,274	5,091	4,660
394	29.02%	1084	1034	745	72.06	4,558	3,044	4,789	2,272	5,087	4,657
395	29.09%	1084	1034	745	72.08	4,558	3,043	4,789	2,272	5,087	4,656
396	29.17%	1081	1031	744	72.20	4,552	3,040	4,783	2,269	5,081	4,651
397	29.24%	1079	1029	744	72.28	4,549	3,038	4,779	2,267	5,077	4,647
398	29.31%	1079	1029	744	72.29	4,548	3,037	4,779	2,267	5,076	4,646
399	29.39%	1078	1028	744	72.31	4,548	3,037	4,778	2,267	5,075	4,646
400	29.46%	1078	1028	743	72.34	4,546	3,036	4,777	2,266	5,074	4,644

Victoria Lake Monthly Outflow			After Amenity Flow / Maximum Power Discharge (m^3/s)	Annual Average Power Discharge (m^3/s)	Energy Calculation for MP						Energy Calculation for Pre FS
Duration (Month)	Probability	Flow (m^3/s)			Plant Factor (%)	Annual Energy Production (GWh)					
						Karuma	Oriang	Ayago	Kiba	Murchison	Ayago
401	29.54%	1077	1027	743	72.35	4,546	3,035	4,776	2,266	5,073	4,644
402	29.61%	1077	1027	743	72.36	4,545	3,035	4,776	2,265	5,073	4,643
403	29.68%	1076	1026	743	72.40	4,543	3,034	4,774	2,265	5,071	4,642
404	29.76%	1076	1026	743	72.42	4,543	3,034	4,773	2,264	5,070	4,641
405	29.83%	1076	1026	743	72.42	4,543	3,033	4,773	2,264	5,070	4,641
406	29.90%	1074	1024	742	72.48	4,540	3,032	4,770	2,263	5,067	4,638
407	29.98%	1073	1023	742	72.51	4,539	3,031	4,769	2,262	5,066	4,637
408	30.05%	1072	1022	742	72.58	4,536	3,029	4,766	2,261	5,062	4,634
409	30.13%	1068	1018	740	72.74	4,529	3,024	4,758	2,257	5,054	4,626
410	30.20%	1068	1018	740	72.74	4,528	3,024	4,758	2,257	5,054	4,626
411	30.27%	1068	1018	740	72.76	4,528	3,024	4,757	2,257	5,053	4,626
412	30.35%	1067	1017	740	72.79	4,526	3,023	4,756	2,256	5,052	4,624
413	30.42%	1067	1017	740	72.79	4,526	3,023	4,756	2,256	5,052	4,624
414	30.49%	1066	1016	740	72.84	4,524	3,021	4,754	2,255	5,049	4,622
415	30.57%	1066	1016	740	72.84	4,524	3,021	4,754	2,255	5,049	4,622
416	30.64%	1065	1015	739	72.87	4,523	3,020	4,752	2,254	5,048	4,621
417	30.72%	1064	1014	739	72.88	4,522	3,020	4,751	2,254	5,047	4,620
418	30.79%	1063	1013	739	72.96	4,519	3,017	4,748	2,252	5,043	4,616
419	30.86%	1058	1008	737	73.14	4,510	3,012	4,739	2,248	5,034	4,608
420	30.94%	1056	1006	737	73.24	4,506	3,009	4,734	2,246	5,029	4,603
421	31.01%	1052	1002	736	73.40	4,499	3,004	4,727	2,242	5,021	4,596
422	31.08%	1052	1002	735	73.42	4,498	3,004	4,726	2,242	5,020	4,595
423	31.16%	1051	1001	735	73.45	4,497	3,003	4,725	2,241	5,019	4,594
424	31.23%	1051	1001	735	73.47	4,496	3,002	4,724	2,241	5,018	4,593
425	31.31%	1049	999	735	73.53	4,493	3,000	4,721	2,240	5,015	4,590
426	31.38%	1048	998	734	73.57	4,491	2,999	4,719	2,238	5,012	4,588
427	31.45%	1048	998	734	73.59	4,490	2,999	4,718	2,238	5,012	4,587
428	31.53%	1045	995	733	73.72	4,484	2,995	4,712	2,235	5,005	4,581
429	31.60%	1042	992	732	73.83	4,480	2,991	4,707	2,233	5,000	4,576
430	31.67%	1040	990	732	73.91	4,476	2,989	4,703	2,231	4,995	4,572
431	31.75%	1037	987	731	74.06	4,469	2,984	4,696	2,228	4,988	4,566
432	31.82%	1036	986	730	74.09	4,468	2,983	4,694	2,227	4,986	4,564
433	31.90%	1030	980	729	74.32	4,457	2,976	4,683	2,222	4,974	4,553
434	31.97%	1029	979	728	74.37	4,455	2,975	4,681	2,220	4,972	4,551
435	32.04%	1028	978	728	74.42	4,453	2,973	4,678	2,219	4,970	4,549
436	32.12%	1027	977	728	74.45	4,451	2,972	4,677	2,219	4,968	4,547
437	32.19%	1027	977	728	74.47	4,450	2,972	4,676	2,218	4,967	4,547
438	32.26%	1027	977	728	74.47	4,450	2,972	4,676	2,218	4,967	4,547
439	32.34%	1027	977	728	74.47	4,450	2,972	4,676	2,218	4,967	4,546
440	32.41%	1027	977	727	74.49	4,449	2,971	4,675	2,218	4,966	4,546
441	32.49%	1026	976	727	74.52	4,448	2,970	4,674	2,217	4,964	4,544
442	32.56%	1025	975	727	74.55	4,447	2,969	4,672	2,216	4,963	4,543
443	32.63%	1025	975	727	74.56	4,446	2,969	4,672	2,216	4,963	4,542
444	32.71%	1024	974	727	74.59	4,445	2,968	4,670	2,215	4,961	4,541
445	32.78%	1020	970	725	74.77	4,436	2,962	4,661	2,211	4,951	4,532
446	32.85%	1019	969	725	74.82	4,434	2,961	4,659	2,210	4,949	4,530
447	32.93%	1017	967	724	74.89	4,431	2,959	4,655	2,208	4,945	4,527
448	33.00%	1017	967	724	74.92	4,430	2,958	4,654	2,208	4,944	4,525
449	33.08%	1017	967	724	74.92	4,430	2,958	4,654	2,208	4,944	4,525
450	33.15%	1017	967	724	74.92	4,429	2,958	4,654	2,208	4,944	4,525
451	33.22%	1016	966	724	74.95	4,428	2,957	4,652	2,207	4,942	4,524
452	33.30%	1016	966	724	74.97	4,427	2,956	4,652	2,207	4,941	4,523
453	33.37%	1015	965	724	74.99	4,426	2,956	4,651	2,206	4,940	4,522
454	33.44%	1008	958	721	75.31	4,411	2,946	4,635	2,199	4,923	4,507
455	33.52%	1007	957	721	75.36	4,409	2,944	4,632	2,198	4,921	4,504
456	33.59%	1004	954	720	75.46	4,404	2,941	4,628	2,195	4,916	4,499
457	33.67%	1004	954	720	75.49	4,403	2,940	4,626	2,194	4,914	4,498
458	33.74%	1001	951	719	75.62	4,396	2,936	4,619	2,191	4,907	4,491
459	33.81%	999	949	718	75.70	4,393	2,933	4,616	2,190	4,903	4,488
460	33.89%	999	949	718	75.70	4,393	2,933	4,615	2,190	4,903	4,488
461	33.96%	996	946	717	75.82	4,387	2,930	4,610	2,187	4,897	4,482
462	34.03%	995	945	717	75.88	4,384	2,928	4,606	2,185	4,893	4,479
463	34.11%	993	943	716	75.94	4,382	2,926	4,604	2,184	4,890	4,476
464	34.18%	991	941	716	76.03	4,377	2,923	4,599	2,182	4,885	4,472
465	34.26%	990	940	715	76.10	4,374	2,921	4,596	2,180	4,882	4,469
466	34.33%	988	938	715	76.16	4,371	2,919	4,593	2,179	4,879	4,466
467	34.40%	988	938	714	76.20	4,369	2,918	4,591	2,178	4,877	4,464
468	34.48%	982	932	713	76.43	4,359	2,911	4,580	2,172	4,865	4,453
469	34.55%	982	932	712	76.45	4,358	2,910	4,578	2,172	4,863	4,452
470	34.62%	982	932	712	76.46	4,357	2,910	4,578	2,172	4,863	4,451
471	34.70%	977	927	711	76.66	4,348	2,903	4,568	2,167	4,852	4,442
472	34.77%	971	921	709	76.96	4,334	2,894	4,554	2,160	4,837	4,427
473	34.85%	967	917	707	77.14	4,326	2,888	4,545	2,156	4,828	4,419
474	34.92%	966	916	707	77.18	4,324	2,887	4,543	2,155	4,825	4,417
475	34.99%	965	915	707	77.21	4,322	2,886	4,541	2,154	4,824	4,416
476	35.07%	962	912	705	77.37	4,315	2,881	4,533	2,151	4,816	4,408
477	35.14%	960	910	705	77.46	4,311	2,879	4,529	2,149	4,811	4,404
478	35.21%	960	910	705	77.46	4,310	2,878	4,529	2,148	4,811	4,404
479	35.29%	957	907	704	77.60	4,304	2,874	4,522	2,145	4,804	4,397
480	35.36%	957	907	704	77.60	4,304	2,874	4,522	2,145	4,804	4,397

Victoria Lake Monthly Outflow			After Amenity Flow / Maximum Power Discharge	Annual Average Power Discharge	Energy Calculation for MP						Energy Calculation for Pre FS
Duration	Probability	Flow			Plant Factor	Annual Energy Production (GWh)					
(Month)		(m^3/s)	(m^3/s)	(m^3/s)	(%)	Karuma	Oriang	Ayago	Kiba	Murchison	Ayago
481	35.44%	955	905	703	77.70	4,300	2,871	4,517	2,143	4,799	4,392
482	35.51%	954	904	703	77.72	4,299	2,870	4,516	2,143	4,798	4,391
483	35.58%	954	904	703	77.74	4,298	2,870	4,516	2,142	4,797	4,391
484	35.66%	953	903	702	77.76	4,297	2,869	4,514	2,142	4,795	4,389
485	35.73%	952	902	702	77.83	4,293	2,867	4,511	2,140	4,792	4,386
486	35.80%	951	901	702	77.87	4,291	2,866	4,509	2,139	4,790	4,384
487	35.88%	948	898	701	77.99	4,286	2,862	4,503	2,136	4,783	4,378
488	35.95%	948	898	701	78.00	4,286	2,862	4,503	2,136	4,783	4,378
489	36.03%	948	898	701	78.00	4,285	2,862	4,503	2,136	4,783	4,378
490	36.10%	948	898	701	78.00	4,285	2,862	4,503	2,136	4,783	4,378
491	36.17%	948	898	701	78.01	4,285	2,861	4,502	2,136	4,782	4,378
492	36.25%	947	897	700	78.08	4,282	2,859	4,499	2,134	4,779	4,374
493	36.32%	944	894	699	78.19	4,276	2,856	4,493	2,132	4,773	4,369
494	36.39%	944	894	699	78.20	4,276	2,855	4,493	2,131	4,772	4,368
495	36.47%	941	891	698	78.33	4,270	2,851	4,486	2,128	4,765	4,362
496	36.54%	941	891	698	78.35	4,269	2,851	4,485	2,128	4,765	4,361
497	36.62%	940	890	698	78.40	4,267	2,849	4,483	2,127	4,762	4,359
498	36.69%	939	889	697	78.42	4,266	2,848	4,482	2,126	4,761	4,358
499	36.76%	938	888	697	78.47	4,263	2,847	4,479	2,125	4,758	4,355
500	36.84%	938	888	697	78.47	4,263	2,847	4,479	2,125	4,758	4,355
501	36.91%	937	887	697	78.52	4,261	2,845	4,477	2,124	4,755	4,353
502	36.98%	936	886	696	78.56	4,259	2,844	4,475	2,123	4,753	4,351
503	37.06%	935	885	696	78.63	4,255	2,842	4,471	2,121	4,749	4,347
504	37.13%	935	885	696	78.63	4,255	2,842	4,471	2,121	4,749	4,347
505	37.21%	934	884	695	78.68	4,253	2,840	4,469	2,120	4,747	4,345
506	37.28%	933	883	695	78.73	4,250	2,838	4,466	2,119	4,744	4,342
507	37.35%	932	882	695	78.75	4,250	2,838	4,465	2,118	4,743	4,341
508	37.43%	932	882	695	78.75	4,250	2,838	4,465	2,118	4,743	4,341
509	37.50%	932	882	695	78.78	4,248	2,837	4,464	2,117	4,741	4,340
510	37.57%	930	880	694	78.85	4,245	2,834	4,460	2,116	4,737	4,336
511	37.65%	928	878	693	78.96	4,239	2,831	4,454	2,113	4,732	4,331
512	37.72%	927	877	693	79.00	4,238	2,830	4,452	2,112	4,729	4,329
513	37.79%	927	877	693	79.00	4,237	2,830	4,452	2,112	4,729	4,329
514	37.87%	926	876	693	79.03	4,236	2,829	4,450	2,111	4,727	4,327
515	37.94%	925	875	692	79.11	4,232	2,826	4,447	2,109	4,723	4,323
516	38.02%	923	873	691	79.19	4,228	2,823	4,442	2,107	4,719	4,319
517	38.09%	922	872	691	79.24	4,225	2,822	4,440	2,106	4,716	4,317
518	38.16%	921	871	690	79.30	4,223	2,820	4,437	2,105	4,713	4,314
519	38.24%	920	870	690	79.35	4,220	2,818	4,434	2,103	4,710	4,311
520	38.31%	919	869	690	79.37	4,219	2,818	4,433	2,103	4,709	4,310
521	38.38%	919	869	690	79.38	4,219	2,817	4,433	2,103	4,708	4,310
522	38.46%	918	868	689	79.41	4,217	2,816	4,431	2,102	4,706	4,308
523	38.53%	918	868	689	79.41	4,217	2,816	4,431	2,102	4,706	4,308
524	38.61%	918	868	689	79.44	4,216	2,815	4,429	2,101	4,705	4,307
525	38.68%	917	867	689	79.49	4,213	2,814	4,427	2,100	4,702	4,304
526	38.75%	917	867	689	79.49	4,213	2,813	4,427	2,100	4,702	4,304
527	38.83%	916	866	689	79.51	4,212	2,813	4,425	2,099	4,701	4,303
528	38.90%	915	865	688	79.58	4,209	2,810	4,422	2,098	4,697	4,300
529	38.97%	914	864	688	79.59	4,208	2,810	4,421	2,097	4,697	4,299
530	39.05%	914	864	688	79.59	4,208	2,810	4,421	2,097	4,696	4,299
531	39.12%	914	864	688	79.59	4,208	2,810	4,421	2,097	4,696	4,299
532	39.20%	911	861	687	79.77	4,199	2,804	4,412	2,093	4,686	4,290
533	39.27%	910	860	686	79.79	4,198	2,803	4,410	2,092	4,685	4,288
534	39.34%	909	859	686	79.86	4,194	2,801	4,407	2,091	4,681	4,285
535	39.42%	909	859	686	79.87	4,194	2,801	4,407	2,090	4,681	4,285
536	39.49%	908	858	685	79.90	4,192	2,799	4,405	2,089	4,679	4,283
537	39.56%	907	857	685	79.95	4,190	2,798	4,402	2,088	4,676	4,280
538	39.64%	906	856	685	79.98	4,188	2,797	4,400	2,087	4,674	4,279
539	39.71%	906	856	685	79.98	4,188	2,797	4,400	2,087	4,674	4,278
540	39.79%	906	856	685	79.99	4,187	2,796	4,400	2,087	4,673	4,278
541	39.86%	906	856	685	79.99	4,187	2,796	4,400	2,087	4,673	4,278
542	39.93%	905	855	684	80.02	4,186	2,795	4,398	2,086	4,672	4,276
543	40.01%	904	854	684	80.07	4,184	2,794	4,396	2,085	4,669	4,274
544	40.08%	904	854	684	80.10	4,182	2,792	4,394	2,084	4,667	4,272
545	40.15%	903	853	684	80.12	4,181	2,792	4,393	2,084	4,666	4,271
546	40.23%	901	851	683	80.23	4,175	2,788	4,387	2,081	4,660	4,265
547	40.30%	900	850	682	80.25	4,174	2,787	4,386	2,081	4,659	4,264
548	40.38%	899	849	682	80.31	4,171	2,785	4,382	2,079	4,655	4,261
549	40.45%	898	848	682	80.35	4,169	2,784	4,380	2,078	4,653	4,259
550	40.52%	896	846	681	80.47	4,162	2,779	4,373	2,075	4,645	4,252
551	40.60%	895	845	680	80.49	4,161	2,779	4,372	2,074	4,644	4,251
552	40.67%	895	845	680	80.50	4,161	2,778	4,372	2,074	4,644	4,251
553	40.74%	893	843	680	80.59	4,156	2,775	4,367	2,072	4,639	4,246
554	40.82%	893	843	680	80.59	4,156	2,775	4,367	2,072	4,639	4,246
555	40.89%	893	843	679	80.61	4,155	2,775	4,366	2,071	4,638	4,245
556	40.97%	893	843	679	80.61	4,155	2,775	4,365	2,071	4,637	4,245
557	41.04%	892	842.4	679	80.63	4,154	2,774	4,365	2,071	4,636	4,244
558	41.11%	892	842	679	80.65	4,153	2,773	4,364	2,070	4,635	4,243
559	41.19%	889	839	678	80.79	4,145	2,768	4,357	2,066	4,627	4,235
560	41.26%	888	838	677	80.85	4,142	2,766	4,352	2,065	4,623	4,232

Victoria Lake Monthly Outflow			After Amenity Flow / Maximum Power Discharge	Annual Average Power Discharge	Energy Calculation for MP						Energy Calculation for Pre FS
Duration	Probability	Flow			Plant Factor	Annual Energy Production (GWh)					
(Month)		(m^3/s)	(m^3/s)	(m^3/s)	(%)	Karuma	Oriang	Ayago	Kiba	Murchison	Ayago
561	41.33%	887	837	677	80.86	4,142	2,766	4,352	2,064	4,623	4,231
562	41.41%	886	836	676	80.94	4,138	2,763	4,347	2,062	4,618	4,227
563	41.48%	884	834	676	81.01	4,134	2,760	4,343	2,060	4,613	4,223
564	41.56%	882	832	675	81.11	4,128	2,757	4,338	2,058	4,608	4,218
565	41.63%	881	831	675	81.16	4,126	2,755	4,335	2,056	4,605	4,215
566	41.70%	881	831	675	81.16	4,126	2,755	4,335	2,056	4,605	4,215
567	41.78%	880	830	674	81.19	4,124	2,754	4,333	2,055	4,603	4,213
568	41.85%	880	830	674	81.19	4,124	2,754	4,333	2,055	4,602	4,213
569	41.92%	880	830	674	81.19	4,124	2,754	4,333	2,055	4,602	4,213
570	42.00%	878	828	673	81.32	4,117	2,749	4,326	2,052	4,595	4,206
571	42.07%	877	827	673	81.34	4,116	2,749	4,325	2,052	4,594	4,205
572	42.15%	877	827	673	81.34	4,116	2,749	4,325	2,052	4,594	4,205
573	42.22%	877	827	673	81.38	4,114	2,747	4,322	2,050	4,591	4,203
574	42.29%	875	825	672	81.44	4,110	2,745	4,319	2,049	4,587	4,199
575	42.37%	875	825	672	81.45	4,110	2,745	4,318	2,049	4,587	4,199
576	42.44%	875	825	672	81.47	4,109	2,744	4,317	2,048	4,586	4,197
577	42.51%	874	824	672	81.49	4,108	2,743	4,316	2,047	4,585	4,197
578	42.59%	874	824	671	81.51	4,106	2,742	4,315	2,047	4,583	4,195
579	42.66%	873	823	671	81.52	4,106	2,742	4,314	2,046	4,582	4,195
580	42.74%	873	823	671	81.56	4,104	2,740	4,312	2,045	4,580	4,193
581	42.81%	872	822	671	81.60	4,102	2,739	4,310	2,044	4,578	4,190
582	42.88%	871	821	670	81.66	4,099	2,737	4,306	2,043	4,574	4,187
583	42.96%	869	819	669	81.73	4,095	2,734	4,302	2,041	4,570	4,183
584	43.03%	869	819	669	81.73	4,095	2,734	4,302	2,041	4,570	4,183
585	43.10%	869	819	669	81.73	4,095	2,734	4,302	2,041	4,570	4,183
586	43.18%	869	819	669	81.75	4,093	2,734	4,301	2,040	4,569	4,182
587	43.25%	868	818	669	81.78	4,092	2,732	4,299	2,039	4,567	4,180
588	43.33%	867	817	669	81.81	4,090	2,731	4,297	2,038	4,564	4,178
589	43.40%	865	815	668	81.92	4,084	2,727	4,291	2,035	4,558	4,172
590	43.47%	865	815	668	81.92	4,084	2,727	4,291	2,035	4,558	4,172
591	43.55%	865	815	668	81.92	4,084	2,727	4,291	2,035	4,558	4,172
592	43.62%	864	814	667	81.97	4,081	2,725	4,288	2,034	4,555	4,169
593	43.69%	863	813	667	82.00	4,079	2,724	4,286	2,033	4,553	4,168
594	43.77%	863	813	667	82.02	4,078	2,723	4,284	2,033	4,551	4,166
595	43.84%	863	813	667	82.03	4,077	2,723	4,284	2,032	4,551	4,165
596	43.92%	862	812	666	82.05	4,076	2,722	4,283	2,032	4,549	4,164
597	43.99%	862	812	666	82.05	4,076	2,722	4,283	2,032	4,549	4,164
598	44.06%	862	812	666	82.06	4,076	2,722	4,282	2,032	4,549	4,164
599	44.14%	862	812	666	82.07	4,075	2,721	4,282	2,031	4,548	4,163
600	44.21%	860	810	665	82.16	4,070	2,718	4,276	2,028	4,542	4,158
601	44.28%	859	809	665	82.18	4,069	2,717	4,275	2,028	4,541	4,157
602	44.36%	857	807	664	82.30	4,062	2,712	4,268	2,024	4,533	4,149
603	44.43%	856	806	664	82.32	4,061	2,712	4,266	2,024	4,532	4,148
604	44.51%	856	806	664	82.36	4,059	2,710	4,264	2,023	4,530	4,146
605	44.58%	854	804	663	82.43	4,055	2,708	4,260	2,021	4,525	4,142
606	44.65%	854	804	663	82.43	4,054	2,707	4,260	2,021	4,525	4,142
607	44.73%	853	803	663	82.46	4,052	2,706	4,258	2,020	4,523	4,140
608	44.80%	851	801	662	82.56	4,047	2,702	4,252	2,017	4,517	4,134
609	44.87%	851	801	662	82.57	4,046	2,702	4,251	2,017	4,516	4,134
610	44.95%	851	801	661	82.59	4,045	2,701	4,250	2,016	4,515	4,133
611	45.02%	849	799	660	82.69	4,040	2,697	4,244	2,013	4,508	4,127
612	45.10%	849	799	660	82.69	4,039	2,697	4,244	2,013	4,508	4,126
613	45.17%	847	797	660	82.76	4,035	2,695	4,240	2,011	4,503	4,122
614	45.24%	847	797	660	82.78	4,034	2,694	4,238	2,011	4,502	4,121
615	45.32%	846	796	659	82.80	4,033	2,693	4,237	2,010	4,501	4,120
616	45.39%	840	790	657	83.10	4,015	2,681	4,219	2,001	4,481	4,102
617	45.46%	840	790	656	83.10	4,015	2,681	4,219	2,001	4,481	4,102
618	45.54%	838	788	656	83.20	4,010	2,677	4,213	1,998	4,475	4,096
619	45.61%	837	787	655	83.22	4,008	2,677	4,211	1,998	4,473	4,095
620	45.69%	837	787	655	83.23	4,007	2,676	4,211	1,997	4,473	4,094
621	45.76%	834	784	654	83.37	4,000	2,671	4,202	1,994	4,464	4,086
622	45.83%	834	784	654	83.37	3,999	2,671	4,202	1,993	4,464	4,086
623	45.91%	831	781	653	83.51	3,991	2,665	4,194	1,989	4,455	4,077
624	45.98%	829	779	652	83.62	3,985	2,661	4,187	1,986	4,448	4,071
625	46.05%	829	779	651	83.62	3,985	2,661	4,187	1,986	4,447	4,071
626	46.13%	829	779	651	83.63	3,984	2,660	4,186	1,986	4,446	4,070
627	46.20%	828	778	651	83.70	3,980	2,658	4,182	1,984	4,442	4,066
628	46.28%	827	777	651	83.72	3,979	2,657	4,181	1,983	4,441	4,065
629	46.35%	825	775	650	83.81	3,973	2,653	4,175	1,980	4,435	4,059
630	46.42%	825	775	650	83.81	3,973	2,653	4,175	1,980	4,435	4,059
631	46.50%	823	773.4	649	83.90	3,968	2,650	4,170	1,978	4,429	4,054
632	46.57%	823	773.3	649	83.90	3,968	2,650	4,169	1,978	4,429	4,054
633	46.64%	822	772.1	648	83.96	3,965	2,648	4,166	1,976	4,425	4,051
634	46.72%	822	771.8	648	83.98	3,964	2,647	4,165	1,976	4,424	4,050
635	46.79%	821	771	648	83.99	3,963	2,646	4,164	1,975	4,423	4,048
636	46.87%	821	771	648	84.02	3,962	2,645	4,162	1,975	4,421	4,047
637	46.94%	821	771	648	84.02	3,962	2,645	4,162	1,975	4,421	4,047
638	47.01%	821	771	648	84.03	3,961	2,645	4,161	1,974	4,420	4,046
639	47.09%	820	770	647	84.05	3,960	2,644	4,161	1,974	4,419	4,045
640	47.16%	818	768	646	84.14	3,954	2,640	4,154	1,971	4,413	4,039

Victoria Lake Monthly Outflow			After Amenity Flow / Maximum Power Discharge (m^3/s)	Annual Average Power Discharge (m^3/s)	Energy Calculation for MP						Energy Calculation for Pre FS
Duration (Month)	Probability	Flow (m^3/s)			Plant Factor (%)	Annual Energy Production (GWh)					
						Karuma	Oriang	Ayago	Kiba	Murchison	Ayago
641	47.23%	818	768	646	84.16	3,953	2,640	4,154	1,970	4,412	4,039
642	47.31%	818	768	646	84.16	3,953	2,640	4,153	1,970	4,412	4,038
643	47.38%	818	768	646	84.18	3,952	2,639	4,152	1,970	4,410	4,037
644	47.46%	818	768	646	84.18	3,952	2,639	4,152	1,970	4,410	4,037
645	47.53%	817	767	646	84.19	3,951	2,638	4,151	1,969	4,410	4,036
646	47.60%	816	766	645	84.25	3,948	2,636	4,148	1,968	4,406	4,033
647	47.68%	815	765	645	84.28	3,946	2,635	4,146	1,967	4,404	4,031
648	47.75%	815	765	645	84.28	3,946	2,635	4,146	1,967	4,404	4,031
649	47.82%	815	765	645	84.29	3,945	2,634	4,145	1,966	4,403	4,030
650	47.90%	814	764	644	84.37	3,940	2,631	4,140	1,964	4,397	4,025
651	47.97%	812	762	644	84.42	3,937	2,629	4,136	1,962	4,394	4,022
652	48.05%	808	758	642	84.62	3,925	2,621	4,123	1,956	4,380	4,009
653	48.12%	808	758	642	84.64	3,924	2,620	4,123	1,956	4,379	4,008
654	48.19%	807	757	641	84.68	3,921	2,619	4,120	1,955	4,377	4,006
655	48.27%	807	757	641	84.71	3,919	2,617	4,118	1,954	4,374	4,004
656	48.34%	806	756	641	84.72	3,919	2,617	4,118	1,953	4,374	4,004
657	48.41%	806	756	641	84.72	3,919	2,617	4,118	1,953	4,374	4,004
658	48.49%	805	755	640	84.80	3,914	2,613	4,112	1,951	4,368	3,998
659	48.56%	804	754	639	84.85	3,911	2,612	4,109	1,949	4,365	3,995
660	48.64%	803	753	639	84.87	3,909	2,611	4,107	1,949	4,363	3,994
661	48.71%	802	752	638	84.94	3,905	2,608	4,103	1,946	4,358	3,989
662	48.78%	799	749	637	85.07	3,897	2,602	4,095	1,942	4,349	3,981
663	48.86%	799	749	637	85.07	3,897	2,602	4,095	1,942	4,349	3,981
664	48.93%	796	746	636	85.20	3,889	2,597	4,086	1,938	4,340	3,973
665	49.00%	796	746	636	85.22	3,888	2,596	4,085	1,938	4,339	3,972
666	49.08%	795	745	635	85.25	3,886	2,595	4,083	1,937	4,337	3,970
667	49.15%	795	745	635	85.28	3,884	2,594	4,081	1,936	4,335	3,968
668	49.23%	794	744	635	85.31	3,883	2,593	4,079	1,935	4,333	3,966
669	49.30%	794	744	635	85.33	3,881	2,592	4,078	1,935	4,332	3,965
670	49.37%	793	743	634	85.34	3,880	2,591	4,077	1,934	4,331	3,964
671	49.45%	793	743	634	85.38	3,878	2,590	4,075	1,933	4,328	3,962
672	49.52%	792	742	634	85.40	3,877	2,589	4,073	1,932	4,327	3,960
673	49.59%	790	740	633	85.53	3,869	2,583	4,065	1,928	4,318	3,952
674	49.67%	788	738	632	85.59	3,865	2,581	4,061	1,926	4,313	3,948
675	49.74%	788	738	632	85.61	3,863	2,580	4,059	1,926	4,312	3,947
676	49.82%	784	734	630	85.80	3,852	2,572	4,047	1,920	4,299	3,935
677	49.89%	784	734	630	85.80	3,852	2,572	4,047	1,920	4,299	3,935
678	49.96%	783	733	629	85.84	3,849	2,570	4,044	1,919	4,296	3,932
679	50.04%	783	733	629	85.84	3,849	2,570	4,044	1,919	4,296	3,932
680	50.11%	783	733	629	85.85	3,848	2,570	4,044	1,918	4,295	3,932
681	50.18%	783	733	629	85.85	3,848	2,570	4,043	1,918	4,295	3,932
682	50.26%	781	731	628	85.93	3,843	2,566	4,038	1,916	4,289	3,926
683	50.33%	780	730	628	85.98	3,840	2,565	4,035	1,914	4,286	3,923
684	50.41%	778	728	627	86.11	3,832	2,559	4,027	1,910	4,277	3,915
685	50.48%	778	728	627	86.11	3,832	2,559	4,027	1,910	4,277	3,915
686	50.55%	777	727	626	86.12	3,831	2,558	4,025	1,910	4,276	3,914
687	50.63%	777	727	626	86.15	3,830	2,557	4,024	1,909	4,274	3,913
688	50.70%	777	727	626	86.16	3,829	2,557	4,023	1,908	4,273	3,912
689	50.77%	775	725	625	86.25	3,823	2,553	4,017	1,906	4,267	3,906
690	50.85%	774	724	625	86.27	3,822	2,552	4,016	1,905	4,266	3,904
691	50.92%	773	723	624	86.34	3,817	2,549	4,011	1,903	4,260	3,900
692	51.00%	772	722	624	86.41	3,813	2,547	4,007	1,901	4,256	3,896
693	51.07%	770	720	623	86.49	3,808	2,543	4,001	1,898	4,250	3,890
694	51.14%	769	719	622	86.51	3,807	2,542	4,000	1,897	4,249	3,889
695	51.22%	769	719	622	86.56	3,804	2,540	3,997	1,896	4,245	3,886
696	51.29%	767	717	621	86.62	3,800	2,537	3,992	1,894	4,241	3,882
697	51.36%	767	717	621	86.64	3,798	2,536	3,991	1,893	4,239	3,880
698	51.44%	767	717	621	86.66	3,797	2,536	3,990	1,893	4,238	3,880
699	51.51%	766	716	621	86.68	3,796	2,535	3,988	1,892	4,237	3,878
700	51.59%	765	715	620	86.71	3,794	2,534	3,986	1,891	4,234	3,876
701	51.66%	765	715	620	86.71	3,794	2,533	3,986	1,891	4,234	3,876
702	51.73%	764	714	620	86.77	3,790	2,531	3,983	1,889	4,230	3,872
703	51.81%	762	712	619	86.88	3,783	2,526	3,975	1,886	4,223	3,865
704	51.88%	762	712	619	86.88	3,783	2,526	3,975	1,886	4,222	3,865
705	51.95%	762	712	618	86.89	3,782	2,526	3,974	1,885	4,221	3,864
706	52.03%	760	710	618	86.96	3,778	2,523	3,969	1,883	4,216	3,859
707	52.10%	760	710	618	86.97	3,777	2,522	3,969	1,883	4,216	3,859
708	52.18%	760	710	618	86.97	3,777	2,522	3,968	1,883	4,215	3,859
709	52.25%	760	710	618	86.97	3,777	2,522	3,968	1,883	4,215	3,859
710	52.32%	760	710	617	86.99	3,776	2,522	3,967	1,882	4,214	3,858
711	52.40%	759	709	617	87.01	3,775	2,521	3,966	1,881	4,213	3,856
712	52.47%	759	709	617	87.04	3,773	2,519	3,964	1,880	4,211	3,854
713	52.54%	759	709	617	87.04	3,773	2,519	3,964	1,880	4,211	3,854
714	52.62%	758	708	616	87.08	3,770	2,518	3,961	1,879	4,208	3,852
715	52.69%	758	708	616	87.08	3,770	2,518	3,961	1,879	4,208	3,852
716	52.77%	758	708	616	87.08	3,770	2,518	3,961	1,879	4,208	3,852
717	52.84%	756	706	616	87.15	3,765	2,514	3,956	1,877	4,203	3,847
718	52.91%	756	706	616	87.16	3,765	2,514	3,955	1,876	4,202	3,846
719	52.99%	756	706	616	87.16	3,765	2,514	3,955	1,876	4,202	3,846
720	53.06%	755	705	615	87.20	3,762	2,512	3,952	1,875	4,198	3,843

Victoria Lake Monthly Outflow			After Amenity Flow / Maximum Power Discharge	Annual Average Power Discharge	Energy Calculation for MP						Energy Calculation for Pre FS
Duration	Probability	Flow			Plant Factor	Annual Energy Production (GWh)					
(Month)		(m^3/s)	(m^3/s)	(m^3/s)	(%)	Karuma	Oriang	Ayago	Kiba	Murchison	Ayago
721	53.13%	755	705	615	87.22	3,761	2,511	3,951	1,874	4,197	3,842
722	53.21%	754	704	614	87.26	3,758	2,509	3,948	1,873	4,194	3,839
723	53.28%	753	703.1	614	87.31	3,755	2,507	3,945	1,871	4,190	3,836
724	53.36%	752	702.3	613	87.35	3,752	2,506	3,942	1,870	4,188	3,833
725	53.43%	752	701.6	613	87.38	3,750	2,504	3,940	1,869	4,185	3,830
726	53.50%	750	700	612	87.44	3,746	2,501	3,936	1,867	4,181	3,827
727	53.58%	750	700	612	87.44	3,746	2,501	3,936	1,867	4,181	3,827
728	53.65%	749	699	611	87.53	3,740	2,497	3,929	1,864	4,174	3,821
729	53.72%	749	699	611	87.53	3,740	2,497	3,929	1,864	4,174	3,821
730	53.80%	748	698	611	87.54	3,739	2,497	3,929	1,864	4,173	3,820
731	53.87%	748	698	611	87.54	3,739	2,497	3,929	1,864	4,173	3,820
732	53.95%	748	698	611	87.57	3,737	2,495	3,926	1,863	4,171	3,818
733	54.02%	747	697	610	87.62	3,734	2,493	3,923	1,861	4,167	3,814
734	54.09%	746	696	610	87.65	3,732	2,492	3,921	1,860	4,165	3,812
735	54.17%	746	696	610	87.65	3,731	2,492	3,920	1,860	4,164	3,812
736	54.24%	745	695	609	87.72	3,727	2,489	3,916	1,857	4,159	3,807
737	54.31%	743	693	608	87.80	3,722	2,485	3,910	1,855	4,154	3,802
738	54.39%	743	693	608	87.80	3,721	2,485	3,910	1,855	4,153	3,802
739	54.46%	743	693	608	87.81	3,720	2,484	3,909	1,854	4,152	3,801
740	54.54%	743	693	608	87.82	3,720	2,484	3,909	1,854	4,152	3,800
741	54.61%	739	689	606	87.98	3,709	2,477	3,897	1,849	4,139	3,789
742	54.68%	739	689	606	87.98	3,709	2,477	3,897	1,849	4,139	3,789
743	54.76%	738	688	606	88.03	3,705	2,474	3,893	1,847	4,135	3,785
744	54.83%	738	688	606	88.03	3,705	2,474	3,893	1,847	4,135	3,785
745	54.90%	738	688	606	88.03	3,705	2,474	3,893	1,847	4,135	3,785
746	54.98%	737	687	605	88.09	3,701	2,472	3,889	1,845	4,131	3,781
747	55.05%	737	687	605	88.09	3,701	2,471	3,888	1,845	4,130	3,781
748	55.13%	736	686	605	88.11	3,700	2,470	3,887	1,844	4,129	3,779
749	55.20%	736	686	604	88.16	3,696	2,468	3,884	1,842	4,125	3,776
750	55.27%	733	683	603	88.26	3,689	2,464	3,876	1,839	4,117	3,769
751	55.35%	733	683	603	88.27	3,689	2,463	3,876	1,838	4,117	3,768
752	55.42%	733	683	603	88.28	3,688	2,463	3,875	1,838	4,116	3,768
753	55.49%	733	683	603	88.29	3,687	2,462	3,874	1,838	4,115	3,767
754	55.57%	732	682	602	88.34	3,684	2,460	3,870	1,836	4,111	3,763
755	55.64%	732	682	602	88.34	3,684	2,460	3,870	1,836	4,111	3,763
756	55.72%	730	680	601	88.41	3,679	2,456	3,865	1,834	4,106	3,758
757	55.79%	730	680	601	88.41	3,679	2,456	3,865	1,834	4,106	3,758
758	55.86%	730	680	601	88.43	3,677	2,455	3,863	1,833	4,104	3,756
759	55.94%	729	679	601	88.46	3,675	2,454	3,861	1,832	4,101	3,754
760	56.01%	729	679	601	88.46	3,675	2,454	3,861	1,832	4,101	3,754
761	56.08%	728	678	600	88.52	3,671	2,451	3,857	1,830	4,097	3,750
762	56.16%	726	676	599	88.59	3,665	2,448	3,851	1,827	4,091	3,745
763	56.23%	726	676	599	88.62	3,663	2,446	3,849	1,826	4,089	3,743
764	56.31%	726	676	599	88.63	3,663	2,446	3,848	1,826	4,088	3,742
765	56.38%	726	676	599	88.64	3,662	2,446	3,848	1,825	4,087	3,741
766	56.45%	725	675	599	88.65	3,661	2,445	3,847	1,825	4,087	3,741
767	56.53%	725	675	599	88.65	3,661	2,445	3,847	1,825	4,087	3,741
768	56.60%	725	675	599	88.65	3,661	2,445	3,847	1,825	4,086	3,740
769	56.67%	725	675	599	88.66	3,661	2,444	3,846	1,825	4,086	3,740
770	56.75%	724	674	598	88.70	3,658	2,443	3,843	1,823	4,083	3,737
771	56.82%	724	674	598	88.70	3,658	2,443	3,843	1,823	4,083	3,737
772	56.90%	724	674	598	88.73	3,655	2,441	3,841	1,822	4,080	3,734
773	56.97%	722	672	597	88.80	3,650	2,438	3,835	1,819	4,074	3,729
774	57.04%	721	671	596	88.83	3,648	2,436	3,833	1,818	4,072	3,727
775	57.12%	721	671	596	88.83	3,648	2,436	3,833	1,818	4,072	3,727
776	57.19%	721	671	596	88.83	3,648	2,436	3,833	1,818	4,072	3,727
777	57.26%	721	671	596	88.83	3,648	2,436	3,833	1,818	4,072	3,727
778	57.34%	721	671	596	88.87	3,645	2,434	3,830	1,817	4,068	3,724
779	57.41%	721	671	596	88.87	3,645	2,434	3,830	1,817	4,068	3,724
780	57.49%	721	671	596	88.87	3,645	2,434	3,830	1,817	4,068	3,724
781	57.56%	720	670	596	88.90	3,643	2,432	3,827	1,816	4,065	3,721
782	57.63%	718	668	594	89.01	3,634	2,427	3,819	1,812	4,056	3,713
783	57.71%	718	668	594	89.01	3,634	2,427	3,819	1,812	4,056	3,713
784	57.78%	717	667	594	89.03	3,633	2,426	3,817	1,811	4,055	3,711
785	57.85%	717	667	594	89.05	3,632	2,425	3,816	1,810	4,053	3,710
786	57.93%	717	667	594	89.05	3,632	2,425	3,816	1,810	4,053	3,710
787	58.00%	716	666	594	89.06	3,631	2,424	3,815	1,810	4,052	3,709
788	58.08%	716	666	593	89.10	3,628	2,423	3,812	1,808	4,049	3,706
789	58.15%	715	665	593	89.13	3,625	2,421	3,809	1,807	4,046	3,704
790	58.22%	714	664	592	89.19	3,621	2,418	3,804	1,805	4,041	3,699
791	58.30%	712	662	591	89.26	3,616	2,415	3,799	1,802	4,036	3,694
792	58.37%	711	661	591	89.31	3,612	2,412	3,795	1,800	4,031	3,690
793	58.44%	711	661	590	89.33	3,611	2,411	3,794	1,800	4,030	3,689
794	58.52%	709	659	589	89.40	3,605	2,407	3,788	1,797	4,024	3,683
795	58.59%	709	659	589	89.40	3,605	2,407	3,788	1,797	4,024	3,683
796	58.67%	709	659	589	89.40	3,605	2,407	3,788	1,797	4,024	3,683
797	58.74%	709	659	589	89.41	3,604	2,407	3,787	1,796	4,023	3,682
798	58.81%	709	659	589	89.41	3,604	2,407	3,787	1,796	4,022	3,682
799	58.89%	709	659	589	89.42	3,604	2,406	3,786	1,796	4,022	3,681
800	58.96%	708	658	589	89.45	3,601	2,405	3,784	1,795	4,019	3,679

Victoria Lake Monthly Outflow			After Amenity Flow / Maximum Power Discharge (m^3/s)	Annual Average Power Discharge (m^3/s)	Energy Calculation for MP						Energy Calculation for Pre FS
Duration (Month)	Probability	Flow (m^3/s)			Plant Factor (%)	Annual Energy Production (GWh)					
						Karuma	Oriang	Ayago	Kiba	Murchison	Ayago
801	59.03%	706	656	587	89.57	3,592	2,398	3,774	1,790	4,009	3,669
802	59.11%	706	656	587	89.57	3,592	2,398	3,774	1,790	4,009	3,669
803	59.18%	706	656	587	89.57	3,592	2,398	3,774	1,790	4,009	3,669
804	59.26%	706	656	587	89.57	3,592	2,398	3,774	1,790	4,009	3,669
805	59.33%	705	655	587	89.61	3,589	2,397	3,771	1,789	4,006	3,666
806	59.40%	705	655	587	89.62	3,588	2,396	3,770	1,788	4,004	3,665
807	59.48%	704	654	586	89.64	3,586	2,395	3,768	1,788	4,003	3,664
808	59.55%	704	654	586	89.66	3,585	2,394	3,766	1,787	4,001	3,662
809	59.62%	703	653	586	89.68	3,583	2,393	3,765	1,786	3,999	3,660
810	59.70%	703	653	585	89.71	3,581	2,391	3,762	1,785	3,997	3,658
811	59.77%	702	652	585	89.73	3,579	2,390	3,761	1,784	3,995	3,656
812	59.85%	702	652	585	89.74	3,578	2,389	3,760	1,783	3,994	3,655
813	59.92%	702	652	585	89.74	3,578	2,389	3,760	1,783	3,994	3,655
814	59.99%	700	650	584	89.82	3,572	2,385	3,753	1,780	3,987	3,649
815	60.07%	700	650	584	89.82	3,572	2,385	3,753	1,780	3,987	3,649
816	60.14%	699	649	583	89.88	3,567	2,382	3,748	1,778	3,981	3,644
817	60.21%	698	648	583	89.91	3,564	2,380	3,745	1,777	3,978	3,641
818	60.29%	698	648	583	89.93	3,563	2,379	3,744	1,776	3,977	3,640
819	60.36%	695	645	581	90.07	3,552	2,372	3,732	1,770	3,964	3,629
820	60.44%	694	644	581	90.08	3,551	2,371	3,731	1,770	3,963	3,627
821	60.51%	694	644	581	90.08	3,551	2,371	3,731	1,770	3,963	3,627
822	60.58%	694	644	581	90.08	3,551	2,371	3,731	1,770	3,963	3,627
823	60.66%	692	642	579	90.20	3,541	2,365	3,721	1,765	3,953	3,618
824	60.73%	691	641	579	90.24	3,538	2,363	3,718	1,764	3,949	3,615
825	60.80%	691	641	578	90.26	3,537	2,362	3,716	1,763	3,947	3,613
826	60.88%	690	640	578	90.29	3,534	2,360	3,713	1,761	3,944	3,610
827	60.95%	690	640	578	90.29	3,534	2,360	3,713	1,761	3,944	3,610
828	61.03%	688	638	576	90.40	3,525	2,354	3,704	1,757	3,934	3,601
829	61.10%	687	637	576	90.44	3,522	2,352	3,701	1,755	3,931	3,598
830	61.17%	686	636	576	90.46	3,521	2,351	3,699	1,755	3,929	3,597
831	61.25%	685	635	575	90.51	3,516	2,348	3,694	1,752	3,924	3,592
832	61.32%	683	633	574	90.60	3,509	2,343	3,687	1,749	3,916	3,585
833	61.39%	683	633	574	90.60	3,509	2,343	3,687	1,749	3,916	3,585
834	61.47%	683	633	573	90.62	3,508	2,342	3,685	1,748	3,915	3,583
835	61.54%	680	629.9	572	90.75	3,496	2,335	3,674	1,743	3,902	3,572
836	61.62%	678	628	570	90.85	3,489	2,330	3,666	1,739	3,894	3,564
837	61.69%	677	627	570	90.88	3,486	2,328	3,662	1,737	3,890	3,561
838	61.76%	677	627	570	90.88	3,486	2,328	3,662	1,737	3,890	3,561
839	61.84%	677	627	570	90.89	3,485	2,327	3,662	1,737	3,890	3,560
840	61.91%	677	627	570	90.89	3,485	2,327	3,662	1,737	3,890	3,560
841	61.98%	676	626	569	90.94	3,481	2,324	3,657	1,735	3,885	3,556
842	62.06%	675	625	569	90.97	3,478	2,323	3,655	1,734	3,882	3,554
843	62.13%	674	624	568	91.03	3,474	2,320	3,650	1,731	3,877	3,549
844	62.21%	674	624	568	91.03	3,474	2,320	3,650	1,731	3,877	3,549
845	62.28%	674	624	568	91.05	3,473	2,319	3,649	1,731	3,876	3,548
846	62.35%	674	624	568	91.05	3,472	2,319	3,648	1,731	3,875	3,547
847	62.43%	673	623	567	91.07	3,471	2,318	3,647	1,730	3,874	3,546
848	62.50%	672	622	567	91.12	3,467	2,315	3,642	1,728	3,869	3,541
849	62.57%	672	622	567	91.12	3,467	2,315	3,642	1,728	3,869	3,541
850	62.65%	671	621	566	91.15	3,464	2,313	3,639	1,726	3,866	3,539
851	62.72%	671	621	566	91.19	3,461	2,311	3,636	1,725	3,863	3,536
852	62.79%	670	620	566	91.19	3,461	2,311	3,636	1,725	3,862	3,535
853	62.87%	669	619	565	91.24	3,457	2,308	3,632	1,723	3,858	3,531
854	62.94%	667	617	564	91.33	3,449	2,303	3,624	1,719	3,849	3,523
855	63.02%	666	616	563	91.40	3,443	2,299	3,617	1,716	3,843	3,517
856	63.09%	665	615	562	91.44	3,439	2,297	3,614	1,714	3,839	3,514
857	63.16%	665	615	562	91.45	3,438	2,296	3,613	1,714	3,838	3,513
858	63.24%	665	615	562	91.46	3,438	2,296	3,612	1,714	3,837	3,512
859	63.31%	665	615	562	91.46	3,438	2,296	3,612	1,714	3,837	3,512
860	63.38%	665	615	562	91.46	3,438	2,296	3,612	1,714	3,837	3,512
861	63.46%	664	614	561	91.51	3,434	2,293	3,608	1,712	3,833	3,508
862	63.53%	664	614	561	91.51	3,434	2,293	3,608	1,712	3,833	3,508
863	63.61%	664	614	561	91.51	3,434	2,293	3,608	1,712	3,833	3,508
864	63.68%	662	612	560	91.58	3,428	2,289	3,601	1,708	3,826	3,502
865	63.75%	662	612	560	91.59	3,426	2,288	3,600	1,708	3,824	3,501
866	63.83%	662	612	560	91.60	3,426	2,288	3,600	1,708	3,824	3,500
867	63.90%	661	611	560	91.63	3,423	2,286	3,597	1,706	3,821	3,497
868	63.97%	661	611	560	91.63	3,423	2,286	3,597	1,706	3,821	3,497
869	64.05%	661	611	560	91.63	3,423	2,286	3,597	1,706	3,821	3,497
870	64.12%	660	610	559	91.68	3,419	2,283	3,592	1,704	3,816	3,493
871	64.20%	660	610	559	91.68	3,419	2,283	3,592	1,704	3,816	3,493
872	64.27%	659	609	559	91.70	3,417	2,282	3,591	1,703	3,814	3,491
873	64.34%	657	607	557	91.80	3,409	2,276	3,581	1,699	3,804	3,482
874	64.42%	655	605	556	91.90	3,400	2,270	3,572	1,695	3,795	3,473
875	64.49%	654	604	556	91.92	3,398	2,269	3,571	1,694	3,793	3,472
876	64.56%	654	604	556	91.92	3,398	2,269	3,571	1,694	3,793	3,472
877	64.64%	654	604	556	91.93	3,398	2,269	3,570	1,694	3,792	3,471
878	64.71%	653	603	555	91.97	3,394	2,266	3,566	1,692	3,788	3,467
879	64.79%	653	603	555	91.98	3,393	2,266	3,565	1,691	3,787	3,466
880	64.86%	653	603	554	92.00	3,391	2,264	3,563	1,690	3,785	3,464

Victoria Lake Monthly Outflow			After Amenity Flow / Maximum Power Discharge (m^3/s)	Annual Average Power Discharge (m^3/s)	Energy Calculation for MP						Energy Calculation for Pre FS
Duration (Month)	Probability	Flow (m^3/s)			Plant Factor (%)	Annual Energy Production (GWh) Karuma	Oriang	Ayago	Kiba	Murchison	Ayago
881	64.93%	652	602	554	92.03	3,389	2,263	3,560	1,689	3,782	3,462
882	65.01%	652	602	554	92.04	3,388	2,262	3,560	1,689	3,781	3,461
883	65.08%	651	601	553	92.09	3,384	2,259	3,555	1,686	3,776	3,457
884	65.15%	650	600	553	92.12	3,381	2,258	3,552	1,685	3,773	3,454
885	65.23%	650	600	552	92.14	3,379	2,256	3,550	1,684	3,771	3,452
886	65.30%	650	600	552	92.14	3,379	2,256	3,550	1,684	3,771	3,452
887	65.38%	648	598	552	92.20	3,373	2,252	3,544	1,681	3,765	3,446
888	65.45%	647	597	551	92.24	3,370	2,250	3,541	1,680	3,761	3,443
889	65.52%	646	596	550	92.30	3,364	2,247	3,535	1,677	3,755	3,437
890	65.60%	645	595	550	92.34	3,361	2,245	3,532	1,675	3,751	3,434
891	65.67%	645	595	549	92.36	3,359	2,243	3,529	1,674	3,749	3,432
892	65.74%	645	595	549	92.36	3,359	2,243	3,529	1,674	3,749	3,432
893	65.82%	644	594	548	92.41	3,355	2,240	3,525	1,672	3,744	3,427
894	65.89%	643	593	548	92.44	3,352	2,238	3,522	1,671	3,741	3,425
895	65.97%	642	592	547	92.50	3,347	2,235	3,516	1,668	3,735	3,419
896	66.04%	640	590	546	92.57	3,340	2,230	3,509	1,665	3,728	3,412
897	66.11%	638	588	545	92.64	3,334	2,226	3,503	1,662	3,721	3,406
898	66.19%	636	586	544	92.74	3,325	2,220	3,494	1,657	3,711	3,397
899	66.26%	635	585	543	92.78	3,322	2,218	3,490	1,656	3,707	3,394
900	66.33%	635	585	543	92.81	3,319	2,216	3,487	1,654	3,704	3,391
901	66.41%	635	585	543	92.81	3,319	2,216	3,487	1,654	3,704	3,391
902	66.48%	633	583	541	92.89	3,311	2,211	3,479	1,650	3,696	3,383
903	66.56%	632	582	541	92.93	3,308	2,209	3,476	1,649	3,692	3,380
904	66.63%	631	581	540	92.96	3,305	2,207	3,473	1,647	3,689	3,377
905	66.70%	631	581	540	92.98	3,304	2,206	3,471	1,647	3,687	3,375
906	66.78%	631	581	540	92.98	3,304	2,206	3,471	1,647	3,687	3,375
907	66.85%	629	579	539	93.07	3,295	2,200	3,462	1,642	3,678	3,366
908	66.92%	628	578	538	93.10	3,293	2,199	3,460	1,641	3,675	3,364
909	67.00%	626	576	537	93.20	3,284	2,193	3,450	1,637	3,665	3,355
910	67.07%	626	576	537	93.20	3,284	2,193	3,450	1,637	3,665	3,355
911	67.15%	626	576	537	93.21	3,282	2,192	3,449	1,636	3,663	3,353
912	67.22%	626	576	537	93.21	3,282	2,192	3,449	1,636	3,663	3,353
913	67.29%	625	575	536	93.25	3,279	2,190	3,446	1,635	3,660	3,350
914	67.37%	624	574	536	93.28	3,276	2,188	3,442	1,633	3,656	3,347
915	67.44%	624	574	535	93.31	3,273	2,186	3,439	1,631	3,653	3,344
916	67.51%	624	574	535	93.31	3,273	2,186	3,439	1,631	3,653	3,344
917	67.59%	624	574	535	93.31	3,273	2,186	3,439	1,631	3,653	3,344
918	67.66%	624	574	535	93.31	3,273	2,186	3,439	1,631	3,653	3,344
919	67.74%	623	573	535	93.35	3,270	2,184	3,436	1,630	3,650	3,341
920	67.81%	621	571	533	93.43	3,262	2,178	3,428	1,626	3,641	3,333
921	67.88%	621	571	533	93.45	3,261	2,177	3,426	1,625	3,639	3,331
922	67.96%	620	570	533	93.48	3,258	2,175	3,423	1,624	3,636	3,328
923	68.03%	620	570	533	93.48	3,258	2,175	3,423	1,624	3,636	3,328
924	68.10%	620	570	533	93.48	3,258	2,175	3,423	1,624	3,636	3,328
925	68.18%	619	569	532	93.51	3,255	2,173	3,420	1,622	3,632	3,325
926	68.25%	618	568	532	93.55	3,251	2,171	3,416	1,621	3,629	3,322
927	68.33%	617	567	531	93.59	3,247	2,168	3,412	1,619	3,624	3,317
928	68.40%	617	567	531	93.59	3,247	2,168	3,412	1,619	3,624	3,317
929	68.47%	617	567	531	93.59	3,247	2,168	3,412	1,619	3,624	3,317
930	68.55%	617	567	531	93.59	3,247	2,168	3,412	1,619	3,624	3,317
931	68.62%	617	567	531	93.61	3,245	2,167	3,410	1,618	3,622	3,315
932	68.69%	615	565	530	93.68	3,239	2,163	3,403	1,615	3,615	3,309
933	68.77%	613	563	528	93.76	3,231	2,158	3,395	1,610	3,606	3,301
934	68.84%	613	563	528	93.76	3,231	2,158	3,395	1,610	3,606	3,301
935	68.92%	613	563	528	93.78	3,230	2,157	3,393	1,610	3,604	3,299
936	68.99%	613	563	528	93.78	3,230	2,157	3,393	1,610	3,604	3,299
937	69.06%	613	563	528	93.78	3,229	2,157	3,393	1,610	3,604	3,299
938	69.14%	612	562.3	528	93.81	3,226	2,154	3,390	1,608	3,601	3,296
939	69.21%	610	559.7	526	93.93	3,215	2,147	3,378	1,603	3,589	3,285
940	69.28%	609	559	525	93.94	3,214	2,146	3,377	1,602	3,587	3,283
941	69.36%	606	556	523	94.10	3,198	2,136	3,361	1,594	3,570	3,267
942	69.43%	606	556	523	94.10	3,198	2,136	3,361	1,594	3,570	3,267
943	69.51%	605	555	523	94.12	3,197	2,135	3,359	1,593	3,568	3,266
944	69.58%	605	555	523	94.13	3,196	2,134	3,358	1,593	3,567	3,265
945	69.65%	605	555	523	94.13	3,196	2,134	3,358	1,593	3,567	3,265
946	69.73%	605	555	522	94.14	3,195	2,133	3,357	1,592	3,566	3,264
947	69.80%	605	555	522	94.14	3,195	2,133	3,357	1,592	3,566	3,264
948	69.87%	603	553	521	94.24	3,185	2,127	3,347	1,588	3,555	3,254
949	69.95%	602	552.2	521	94.26	3,184	2,126	3,345	1,587	3,553	3,252
950	70.02%	602	551.9	520	94.27	3,182	2,125	3,343	1,586	3,551	3,251
951	70.10%	602	551.9	520	94.27	3,182	2,125	3,343	1,586	3,551	3,251
952	70.17%	601	550.7	519	94.32	3,177	2,122	3,338	1,584	3,546	3,246
953	70.24%	600	550	519	94.34	3,176	2,121	3,336	1,583	3,544	3,244
954	70.32%	600	550	519	94.36	3,174	2,119	3,335	1,582	3,542	3,242
955	70.39%	600	550	519	94.36	3,173	2,119	3,334	1,582	3,541	3,242
956	70.46%	599	549	518	94.41	3,169	2,116	3,329	1,579	3,537	3,237
957	70.54%	598	548	518	94.42	3,167	2,115	3,328	1,579	3,535	3,236
958	70.61%	598	548	518	94.44	3,165	2,114	3,326	1,578	3,533	3,234
959	70.69%	597	547	517	94.47	3,163	2,112	3,323	1,576	3,530	3,231
960	70.76%	597	547	517	94.47	3,163	2,112	3,323	1,576	3,530	3,231

Victoria Lake Monthly Outflow			After Amenity Flow / Maximum Power Discharge (m^3/s)	Annual Average Power Discharge (m^3/s)	Energy Calculation for MP						Energy Calculation for Pre FS
Duration (Month)	Probability	Flow (m^3/s)			Plant Factor (%)	Annual Energy Production (GWh)					
						Karuma	Oriang	Ayago	Kiba	Murchison	Ayago
961	70.83%	597	547	517	94.47	3,163	2,112	3,323	1,576	3,530	3,231
962	70.91%	596	546	516	94.53	3,157	2,108	3,317	1,574	3,523	3,225
963	70.98%	596	546	516	94.54	3,155	2,107	3,315	1,573	3,522	3,223
964	71.05%	595	545	516	94.56	3,153	2,106	3,313	1,572	3,519	3,222
965	71.13%	595	545	516	94.57	3,153	2,105	3,313	1,572	3,519	3,221
966	71.20%	595	545	515	94.59	3,150	2,104	3,310	1,570	3,516	3,218
967	71.28%	594	544	515	94.61	3,149	2,103	3,308	1,569	3,514	3,217
968	71.35%	594	544	515	94.61	3,149	2,103	3,308	1,569	3,514	3,217
969	71.42%	594	544	515	94.61	3,149	2,103	3,308	1,569	3,514	3,217
970	71.50%	594	544	514	94.63	3,146	2,101	3,306	1,568	3,512	3,214
971	71.57%	594	544	514	94.63	3,146	2,101	3,306	1,568	3,512	3,214
972	71.64%	594	544	514	94.63	3,146	2,101	3,306	1,568	3,512	3,214
973	71.72%	594	544	514	94.63	3,146	2,101	3,306	1,568	3,512	3,214
974	71.79%	593	543	514	94.66	3,143	2,099	3,302	1,567	3,508	3,211
975	71.87%	593	543	514	94.66	3,143	2,099	3,302	1,567	3,508	3,211
976	71.94%	593	543	514	94.68	3,142	2,098	3,301	1,566	3,506	3,209
977	72.01%	592	542	513	94.69	3,140	2,097	3,299	1,565	3,504	3,208
978	72.09%	591	541	513	94.72	3,137	2,095	3,296	1,563	3,501	3,204
979	72.16%	591	541	513	94.72	3,137	2,095	3,296	1,563	3,501	3,204
980	72.23%	590	540	512	94.77	3,132	2,091	3,290	1,561	3,495	3,199
981	72.31%	590	540	512	94.79	3,130	2,090	3,289	1,560	3,493	3,198
982	72.38%	590	540	512	94.79	3,130	2,090	3,289	1,560	3,493	3,198
983	72.46%	590	540	512	94.79	3,130	2,090	3,289	1,560	3,493	3,198
984	72.53%	590	540	512	94.79	3,130	2,090	3,289	1,560	3,493	3,198
985	72.60%	590	540	512	94.79	3,130	2,090	3,289	1,560	3,493	3,198
986	72.68%	590	540	512	94.79	3,130	2,090	3,289	1,560	3,493	3,198
987	72.75%	587	537	510	94.91	3,117	2,081	3,275	1,554	3,479	3,184
988	72.82%	587	537	509	94.91	3,116	2,081	3,274	1,553	3,478	3,184
989	72.90%	586	536	509	94.93	3,114	2,080	3,272	1,552	3,476	3,182
990	72.97%	586	536	509	94.93	3,114	2,080	3,272	1,552	3,476	3,182
991	73.05%	586	536	509	94.94	3,113	2,079	3,271	1,552	3,475	3,181
992	73.12%	584	534	508	95.01	3,106	2,074	3,263	1,548	3,466	3,173
993	73.19%	583	533	506	95.09	3,097	2,068	3,254	1,544	3,457	3,164
994	73.27%	583	533	506	95.09	3,097	2,068	3,254	1,544	3,457	3,164
995	73.34%	582	532	506	95.09	3,097	2,068	3,254	1,543	3,456	3,164
996	73.41%	582	532	506	95.09	3,097	2,068	3,254	1,543	3,456	3,164
997	73.49%	582	532	506	95.09	3,097	2,068	3,254	1,543	3,456	3,164
998	73.56%	582	532	506	95.09	3,097	2,068	3,254	1,543	3,456	3,164
999	73.64%	582	532	506	95.09	3,097	2,068	3,254	1,543	3,456	3,164
1,000	73.71%	582	532	506	95.10	3,095	2,067	3,252	1,543	3,455	3,162
1,001	73.78%	582	532	506	95.10	3,095	2,067	3,252	1,543	3,455	3,162
1,002	73.86%	582	532	506	95.11	3,095	2,067	3,252	1,543	3,454	3,162
1,003	73.93%	581	531	505	95.15	3,090	2,063	3,247	1,540	3,449	3,157
1,004	74.00%	580	530	505	95.18	3,087	2,062	3,244	1,539	3,446	3,154
1,005	74.08%	580	530	505	95.18	3,087	2,061	3,243	1,539	3,445	3,153
1,006	74.15%	580	530	505	95.18	3,087	2,061	3,243	1,539	3,445	3,153
1,007	74.23%	580	530	504	95.20	3,085	2,060	3,241	1,538	3,443	3,151
1,008	74.30%	579	529	504	95.23	3,082	2,058	3,238	1,536	3,439	3,148
1,009	74.37%	579	529	504	95.24	3,080	2,057	3,236	1,535	3,437	3,146
1,010	74.45%	579	529	504	95.24	3,080	2,057	3,236	1,535	3,437	3,146
1,011	74.52%	579	529	504	95.24	3,080	2,057	3,236	1,535	3,437	3,146
1,012	74.59%	578	528	503	95.27	3,076	2,054	3,232	1,533	3,433	3,143
1,013	74.67%	578	528	503	95.28	3,075	2,053	3,230	1,533	3,432	3,141
1,014	74.74%	578	528	503	95.29	3,074	2,053	3,230	1,532	3,431	3,141
1,015	74.82%	576	526	502	95.33	3,070	2,050	3,225	1,530	3,426	3,136
1,016	74.89%	576	526	502	95.35	3,067	2,048	3,223	1,529	3,423	3,134
1,017	74.96%	576	526	502	95.35	3,067	2,048	3,223	1,529	3,423	3,134
1,018	75.04%	576	526	501	95.36	3,066	2,047	3,222	1,528	3,422	3,132
1,019	75.11%	576	526	501	95.36	3,066	2,047	3,221	1,528	3,422	3,132
1,020	75.18%	575	525	501	95.38	3,064	2,046	3,219	1,527	3,420	3,130
1,021	75.26%	575	525.2	501	95.38	3,064	2,046	3,219	1,527	3,420	3,130
1,022	75.33%	575	525.0	501	95.39	3,063	2,045	3,218	1,527	3,418	3,129
1,023	75.41%	575	525	501	95.39	3,062	2,045	3,217	1,526	3,418	3,128
1,024	75.48%	574	524	500	95.44	3,056	2,041	3,211	1,523	3,411	3,122
1,025	75.55%	573	523	500	95.44	3,056	2,041	3,211	1,523	3,411	3,122
1,026	75.63%	573	523	499	95.46	3,054	2,039	3,209	1,522	3,409	3,120
1,027	75.70%	573	523	499	95.47	3,052	2,038	3,207	1,521	3,407	3,118
1,028	75.77%	573	523	499	95.48	3,051	2,038	3,206	1,521	3,405	3,117
1,029	75.85%	571	521	498	95.53	3,045	2,034	3,200	1,518	3,399	3,111
1,030	75.92%	571	521	498	95.54	3,044	2,033	3,199	1,517	3,398	3,110
1,031	76.00%	569	519	496	95.63	3,033	2,026	3,187	1,512	3,385	3,099
1,032	76.07%	568	518	496	95.64	3,032	2,024	3,185	1,511	3,383	3,097
1,033	76.14%	567	517	494	95.70	3,024	2,020	3,178	1,507	3,375	3,090
1,034	76.22%	566	516	494	95.71	3,023	2,019	3,176	1,507	3,374	3,088
1,035	76.29%	566	516	494	95.73	3,021	2,017	3,174	1,506	3,372	3,086
1,036	76.36%	565	515	493	95.77	3,016	2,014	3,169	1,503	3,366	3,081
1,037	76.44%	564	514	492	95.81	3,011	2,010	3,163	1,501	3,360	3,076
1,038	76.51%	563	513	492	95.83	3,008	2,009	3,161	1,499	3,358	3,073
1,039	76.59%	563	513	492	95.83	3,008	2,009	3,161	1,499	3,358	3,073
1,040	76.66%	563	513	492	95.84	3,006	2,008	3,159	1,499	3,355	3,071

Victoria Lake Monthly Outflow			After Amenity Flow / Maximum Power Discharge (m^3/s)	Annual Average Power Discharge (m^3/s)	Energy Calculation for MP						Energy Calculation for Pre FS
Duration (Month)	Probability	Flow (m^3/s)			Plant Factor (%)	Annual Energy Production (GWh)					
						Karuma	Oriang	Ayago	Kiba	Murchison	Ayago
1,041	76.73%	563	513	491	95.86	3,005	2,006	3,157	1,498	3,353	3,070
1,042	76.81%	562	512	491	95.88	3,002	2,005	3,154	1,496	3,350	3,067
1,043	76.88%	562	512	491	95.89	3,000	2,003	3,152	1,495	3,348	3,065
1,044	76.95%	561	511	490	95.90	2,999	2,003	3,151	1,495	3,347	3,064
1,045	77.03%	560	510	490	95.93	2,995	2,000	3,147	1,493	3,343	3,060
1,046	77.10%	560	510	489	95.95	2,993	1,999	3,145	1,492	3,341	3,058
1,047	77.18%	560	510	489	95.95	2,993	1,999	3,145	1,492	3,341	3,058
1,048	77.25%	560	510	489	95.95	2,993	1,999	3,145	1,492	3,341	3,058
1,049	77.32%	560	510	489	95.96	2,991	1,998	3,143	1,491	3,339	3,056
1,050	77.40%	559	509	489	95.97	2,990	1,997	3,142	1,490	3,337	3,055
1,051	77.47%	559	509	489	95.98	2,989	1,996	3,141	1,490	3,337	3,054
1,052	77.54%	556	506	486	96.08	2,975	1,987	3,126	1,483	3,321	3,040
1,053	77.62%	556	506	486	96.08	2,975	1,987	3,126	1,483	3,321	3,040
1,054	77.69%	556	506	486	96.08	2,975	1,987	3,126	1,483	3,321	3,040
1,055	77.77%	556	506	486	96.10	2,974	1,986	3,124	1,482	3,319	3,038
1,056	77.84%	556	506	486	96.11	2,972	1,985	3,122	1,481	3,317	3,036
1,057	77.91%	555	505	486	96.13	2,970	1,983	3,121	1,480	3,315	3,034
1,058	77.99%	555	505	486	96.13	2,970	1,983	3,121	1,480	3,315	3,034
1,059	78.06%	555	505	486	96.13	2,970	1,983	3,121	1,480	3,315	3,034
1,060	78.13%	555	505	485	96.14	2,968	1,982	3,119	1,479	3,313	3,032
1,061	78.21%	555	505	485	96.14	2,968	1,982	3,119	1,479	3,313	3,032
1,062	78.28%	553	503	484	96.21	2,959	1,976	3,109	1,475	3,303	3,023
1,063	78.36%	553	503	484	96.22	2,958	1,975	3,107	1,474	3,301	3,021
1,064	78.43%	553	503	484	96.22	2,958	1,975	3,107	1,474	3,301	3,021
1,065	78.50%	553	503	484	96.22	2,958	1,975	3,107	1,474	3,301	3,021
1,066	78.58%	553	503	484	96.22	2,958	1,975	3,107	1,474	3,301	3,021
1,067	78.65%	552	502	483	96.24	2,954	1,973	3,104	1,472	3,297	3,018
1,068	78.72%	551	501	482	96.28	2,950	1,970	3,099	1,470	3,292	3,013
1,069	78.80%	550	500	482	96.30	2,947	1,968	3,096	1,469	3,289	3,010
1,070	78.87%	550	500	482	96.30	2,947	1,968	3,096	1,469	3,289	3,010
1,071	78.95%	550	500	482	96.31	2,945	1,967	3,094	1,468	3,287	3,009
1,072	79.02%	550	500	481	96.32	2,944	1,966	3,093	1,467	3,286	3,008
1,073	79.09%	550	500	481	96.32	2,943	1,965	3,092	1,467	3,285	3,007
1,074	79.17%	548	498	480	96.36	2,938	1,962	3,087	1,464	3,279	3,001
1,075	79.24%	548	498	480	96.39	2,934	1,959	3,083	1,462	3,275	2,997
1,076	79.31%	547	497	479	96.40	2,932	1,958	3,081	1,462	3,273	2,996
1,077	79.39%	547	497	479	96.41	2,931	1,957	3,079	1,461	3,271	2,994
1,078	79.46%	547	497	479	96.43	2,929	1,956	3,077	1,460	3,269	2,992
1,079	79.54%	545	495	478	96.48	2,921	1,951	3,070	1,456	3,261	2,985
1,080	79.61%	545	495	477	96.49	2,920	1,950	3,068	1,455	3,259	2,983
1,081	79.68%	544	494	477	96.51	2,916	1,947	3,064	1,453	3,254	2,979
1,082	79.76%	544	494	477	96.51	2,916	1,947	3,064	1,453	3,254	2,979
1,083	79.83%	544	494	476	96.53	2,914	1,946	3,062	1,453	3,252	2,977
1,084	79.90%	542	492	476	96.57	2,909	1,942	3,056	1,450	3,246	2,972
1,085	79.98%	542	492.1	475	96.58	2,907	1,941	3,054	1,449	3,244	2,970
1,086	80.05%	542	491.7	475	96.59	2,905	1,940	3,052	1,448	3,242	2,967
1,087	80.13%	541	491.0	474	96.62	2,901	1,937	3,048	1,446	3,238	2,964
1,088	80.20%	540	489.5	473	96.67	2,894	1,933	3,041	1,442	3,230	2,957
1,089	80.27%	540	490	473	96.67	2,894	1,933	3,041	1,442	3,230	2,957
1,090	80.35%	539	489	473	96.68	2,891	1,931	3,038	1,441	3,227	2,954
1,091	80.42%	539	489	472	96.70	2,890	1,930	3,036	1,440	3,225	2,952
1,092	80.49%	538	488	472	96.73	2,885	1,926	3,031	1,438	3,220	2,947
1,093	80.57%	537	487	471	96.75	2,882	1,924	3,028	1,436	3,216	2,944
1,094	80.64%	537	487	471	96.75	2,881	1,924	3,027	1,436	3,216	2,943
1,095	80.72%	536	486	471	96.77	2,878	1,922	3,024	1,435	3,212	2,940
1,096	80.79%	535	485	469	96.82	2,871	1,917	3,016	1,431	3,204	2,933
1,097	80.86%	534	484	469	96.85	2,866	1,914	3,012	1,429	3,199	2,928
1,098	80.94%	534	484	469	96.85	2,866	1,914	3,012	1,429	3,199	2,928
1,099	81.01%	533	483	468	96.87	2,863	1,912	3,008	1,427	3,196	2,925
1,100	81.08%	533	483	468	96.89	2,861	1,910	3,006	1,426	3,193	2,923
1,101	81.16%	532	482	467	96.90	2,859	1,909	3,004	1,425	3,191	2,921
1,102	81.23%	532	482	467	96.91	2,857	1,908	3,002	1,424	3,189	2,919
1,103	81.31%	532	482	467	96.91	2,857	1,908	3,002	1,424	3,189	2,919
1,104	81.38%	531	481	467	96.94	2,853	1,905	2,998	1,422	3,185	2,915
1,105	81.45%	531	481	466	96.96	2,850	1,903	2,994	1,420	3,181	2,911
1,106	81.53%	530	480	465	96.99	2,846	1,900	2,990	1,418	3,176	2,907
1,107	81.60%	529	479	464	97.02	2,840	1,897	2,984	1,416	3,170	2,902
1,108	81.67%	527	477	463	97.08	2,831	1,891	2,975	1,411	3,160	2,892
1,109	81.75%	526	476	463	97.09	2,829	1,889	2,973	1,410	3,158	2,890
1,110	81.82%	526	476	463	97.09	2,829	1,889	2,973	1,410	3,158	2,890
1,111	81.90%	526	476	463	97.09	2,829	1,889	2,973	1,410	3,158	2,890
1,112	81.97%	526	476	462	97.11	2,827	1,888	2,971	1,409	3,156	2,888
1,113	82.04%	526	476	462	97.11	2,827	1,888	2,971	1,409	3,156	2,888
1,114	82.12%	526	476	462	97.12	2,826	1,887	2,969	1,408	3,154	2,887
1,115	82.19%	526	476	462	97.12	2,826	1,887	2,969	1,408	3,154	2,887
1,116	82.26%	526	476	462	97.12	2,826	1,887	2,969	1,408	3,154	2,887
1,117	82.34%	525	475	461	97.15	2,821	1,883	2,963	1,406	3,148	2,881
1,118	82.41%	525	475	461	97.15	2,821	1,883	2,963	1,406	3,148	2,881
1,119	82.49%	524	474	460	97.18	2,816	1,881	2,959	1,404	3,143	2,877
1,120	82.56%	523	473	460	97.20	2,812	1,878	2,955	1,402	3,139	2,873

Victoria Lake Monthly Outflow			After Amenity Flow / Maximum Power Discharge (m^3/s)	Annual Average Power Discharge (m^3/s)	Energy Calculation for MP						Energy Calculation for Pre FS
Duration (Month)	Probability	Flow (m^3/s)			Plant Factor (%)	Annual Energy Production (GWh)					
						Karuma	Oriang	Ayago	Kiba	Murchison	Ayago
1,121	82.63%	523	473	460	97.20	2,812	1,878	2,955	1,402	3,139	2,873
1,122	82.71%	523	473	460	97.21	2,811	1,877	2,953	1,401	3,137	2,871
1,123	82.78%	523	473	460	97.21	2,810	1,877	2,953	1,401	3,137	2,871
1,124	82.85%	522	472	459	97.24	2,805	1,873	2,947	1,398	3,131	2,866
1,125	82.93%	521	471	458	97.27	2,801	1,870	2,943	1,396	3,126	2,862
1,126	83.00%	521	471	458	97.27	2,801	1,870	2,943	1,396	3,126	2,862
1,127	83.08%	519	469	456	97.32	2,792	1,864	2,933	1,391	3,116	2,852
1,128	83.15%	519	469	456	97.32	2,792	1,864	2,933	1,391	3,116	2,852
1,129	83.22%	519	469	456	97.33	2,791	1,864	2,933	1,391	3,115	2,851
1,130	83.30%	519	469	456	97.33	2,791	1,864	2,933	1,391	3,115	2,851
1,131	83.37%	519	469	456	97.33	2,791	1,864	2,933	1,391	3,115	2,851
1,132	83.44%	519	469	456	97.33	2,791	1,864	2,932	1,391	3,115	2,851
1,133	83.52%	518	468	455	97.36	2,786	1,860	2,927	1,389	3,109	2,846
1,134	83.59%	517	467	455	97.38	2,782	1,858	2,923	1,387	3,105	2,842
1,135	83.67%	516	466	454	97.42	2,775	1,853	2,916	1,383	3,098	2,835
1,136	83.74%	515	465	453	97.43	2,772	1,851	2,913	1,382	3,094	2,832
1,137	83.81%	515	465	453	97.45	2,770	1,850	2,911	1,381	3,092	2,830
1,138	83.89%	514	464	452	97.47	2,766	1,847	2,906	1,378	3,087	2,825
1,139	83.96%	513	463	452	97.50	2,762	1,844	2,902	1,376	3,082	2,821
1,140	84.03%	513	463	452	97.50	2,762	1,844	2,902	1,376	3,082	2,821
1,141	84.11%	513	463	451	97.51	2,759	1,842	2,899	1,375	3,079	2,819
1,142	84.18%	513	463	451	97.51	2,759	1,842	2,899	1,375	3,079	2,818
1,143	84.26%	512	462	451	97.52	2,757	1,841	2,897	1,374	3,077	2,817
1,144	84.33%	512	462	451	97.53	2,756	1,840	2,895	1,373	3,076	2,815
1,145	84.40%	512	462	450	97.53	2,755	1,840	2,895	1,373	3,075	2,815
1,146	84.48%	511	461	450	97.54	2,753	1,839	2,893	1,372	3,073	2,813
1,147	84.55%	511	461	450	97.54	2,753	1,839	2,893	1,372	3,073	2,813
1,148	84.62%	511	461	450	97.54	2,753	1,839	2,893	1,372	3,073	2,813
1,149	84.70%	511	461	450	97.56	2,749	1,836	2,889	1,370	3,069	2,809
1,150	84.77%	510	460	449	97.58	2,746	1,833	2,885	1,369	3,064	2,805
1,151	84.85%	509	459	448	97.60	2,742	1,831	2,881	1,367	3,060	2,801
1,152	84.92%	509	459	448	97.60	2,742	1,831	2,881	1,367	3,060	2,801
1,153	84.99%	509	459	448	97.63	2,738	1,828	2,877	1,365	3,056	2,797
1,154	85.07%	508	458	447	97.65	2,734	1,826	2,872	1,363	3,051	2,793
1,155	85.14%	508	458	447	97.65	2,734	1,826	2,872	1,363	3,051	2,793
1,156	85.21%	508	458	447	97.65	2,734	1,826	2,872	1,363	3,051	2,793
1,157	85.29%	508	458	447	97.65	2,734	1,826	2,872	1,363	3,051	2,793
1,158	85.36%	508	458	447	97.65	2,734	1,826	2,872	1,363	3,051	2,793
1,159	85.44%	507	457	446	97.67	2,730	1,823	2,868	1,361	3,046	2,789
1,160	85.51%	505	455	445	97.71	2,722	1,817	2,859	1,356	3,037	2,780
1,161	85.58%	504	454	444	97.75	2,714	1,813	2,852	1,353	3,029	2,773
1,162	85.66%	504	454	444	97.75	2,714	1,813	2,852	1,353	3,029	2,773
1,163	85.73%	504	454	444	97.75	2,714	1,813	2,852	1,353	3,029	2,773
1,164	85.80%	504	454	444	97.75	2,714	1,813	2,852	1,353	3,029	2,773
1,165	85.88%	503	453	443	97.78	2,707	1,808	2,845	1,349	3,022	2,766
1,166	85.95%	502	452	442	97.80	2,703	1,805	2,840	1,347	3,016	2,761
1,167	86.03%	502	452	442	97.81	2,701	1,804	2,838	1,346	3,015	2,760
1,168	86.10%	502	452	442	97.81	2,701	1,804	2,838	1,346	3,015	2,760
1,169	86.17%	500	450	441	97.84	2,695	1,799	2,831	1,343	3,008	2,753
1,170	86.25%	499	449	439	97.88	2,687	1,794	2,823	1,339	2,999	2,745
1,171	86.32%	498	448	439	97.90	2,683	1,792	2,819	1,337	2,994	2,741
1,172	86.39%	498	448	439	97.90	2,683	1,792	2,819	1,337	2,994	2,741
1,173	86.47%	498	448	438	97.91	2,681	1,790	2,817	1,336	2,992	2,739
1,174	86.54%	498	448	438	97.91	2,681	1,790	2,817	1,336	2,992	2,739
1,175	86.62%	497	447	437	97.94	2,675	1,786	2,811	1,333	2,986	2,733
1,176	86.69%	497	447	437	97.94	2,675	1,786	2,811	1,333	2,986	2,733
1,177	86.76%	494	444	435	98.01	2,660	1,777	2,795	1,326	2,969	2,718
1,178	86.84%	494	444	435	98.01	2,660	1,777	2,795	1,326	2,969	2,718
1,179	86.91%	493	443	434	98.02	2,657	1,774	2,792	1,324	2,966	2,715
1,180	86.98%	493	443	434	98.03	2,655	1,773	2,790	1,323	2,963	2,713
1,181	87.06%	493	443	434	98.03	2,655	1,773	2,790	1,323	2,963	2,713
1,182	87.13%	493	443	434	98.03	2,655	1,773	2,790	1,323	2,963	2,713
1,183	87.21%	492	442	433	98.06	2,649	1,769	2,784	1,320	2,957	2,706
1,184	87.28%	491	441	433	98.07	2,648	1,768	2,782	1,320	2,955	2,705
1,185	87.35%	490	440	432	98.10	2,640	1,763	2,774	1,316	2,946	2,697
1,186	87.43%	490	440	432	98.10	2,640	1,763	2,774	1,316	2,946	2,697
1,187	87.50%	489	439	431	98.13	2,635	1,760	2,769	1,313	2,941	2,692
1,188	87.57%	489	439	431	98.13	2,633	1,758	2,767	1,312	2,939	2,690
1,189	87.65%	488	438	430	98.16	2,628	1,755	2,761	1,310	2,933	2,685
1,190	87.72%	488	438	430	98.16	2,627	1,754	2,760	1,310	2,932	2,684
1,191	87.79%	486	436	428	98.20	2,619	1,749	2,752	1,306	2,923	2,676
1,192	87.87%	485	435	428	98.21	2,615	1,746	2,748	1,304	2,919	2,672
1,193	87.94%	485	435	428	98.21	2,615	1,746	2,748	1,304	2,919	2,672
1,194	88.02%	485	435	428	98.21	2,615	1,746	2,748	1,304	2,919	2,672
1,195	88.09%	485	435	427	98.22	2,613	1,745	2,745	1,302	2,916	2,669
1,196	88.16%	485	435	427	98.23	2,611	1,744	2,744	1,302	2,914	2,668
1,197	88.24%	482	432	424	98.30	2,595	1,733	2,727	1,293	2,896	2,651
1,198	88.31%	481	431	424	98.32	2,591	1,730	2,723	1,292	2,892	2,647
1,199	88.38%	480	430	423	98.34	2,586	1,727	2,717	1,289	2,886	2,642
1,200	88.46%	480	430	423	98.34	2,585	1,726	2,716	1,288	2,885	2,641

Victoria Lake Monthly Outflow			After Amenity Flow / Maximum Power Discharge	Annual Average Power Discharge	Energy Calculation for MP						Energy Calculation for Pre FS
Duration	Probability	Flow			Plant Factor	Annual Energy Production (GWh)					
(Month)		(m^3/s)	(m^3/s)	(m^3/s)	(%)	Karuma	Oriang	Ayago	Kiba	Murchison	Ayago
1,201	88.53%	478	428	421	98.38	2,578	1,721	2,708	1,285	2,877	2,633
1,202	88.61%	478	428	421	98.39	2,575	1,719	2,705	1,283	2,874	2,631
1,203	88.68%	478	428	421	98.39	2,575	1,719	2,705	1,283	2,874	2,631
1,204	88.75%	476	426	419	98.44	2,563	1,711	2,693	1,277	2,860	2,618
1,205	88.83%	475	425	419	98.45	2,561	1,710	2,691	1,276	2,858	2,616
1,206	88.90%	475	425	418	98.45	2,559	1,709	2,689	1,275	2,856	2,614
1,207	88.97%	474	424	418	98.47	2,555	1,706	2,684	1,273	2,851	2,610
1,208	89.05%	474	424	418	98.47	2,555	1,706	2,684	1,273	2,851	2,610
1,209	89.12%	474	424	417	98.48	2,553	1,705	2,682	1,272	2,849	2,608
1,210	89.20%	473	423	417	98.50	2,548	1,702	2,677	1,270	2,844	2,603
1,211	89.27%	471	421.1	415	98.54	2,538	1,695	2,666	1,265	2,832	2,592
1,212	89.34%	471	420.8	415	98.55	2,536	1,694	2,665	1,264	2,831	2,591
1,213	89.42%	471	420.7	415	98.55	2,536	1,693	2,664	1,264	2,830	2,590
1,214	89.49%	470	420.4	414	98.55	2,534	1,692	2,663	1,263	2,828	2,589
1,215	89.56%	470	420.4	414	98.55	2,534	1,692	2,663	1,263	2,828	2,589
1,216	89.64%	470	420.4	414	98.55	2,534	1,692	2,663	1,263	2,828	2,589
1,217	89.71%	469	419	413	98.59	2,524	1,685	2,652	1,258	2,817	2,579
1,218	89.79%	468	418	412	98.60	2,523	1,685	2,651	1,258	2,816	2,577
1,219	89.86%	468	418	412	98.60	2,522	1,684	2,650	1,257	2,815	2,576
1,220	89.93%	467	417	411	98.63	2,514	1,679	2,642	1,253	2,806	2,569
1,221	90.01%	467	416.7	411	98.63	2,514	1,679	2,641	1,253	2,806	2,568
1,222	90.08%	467	417	411	98.63	2,514	1,679	2,641	1,253	2,806	2,568
1,223	90.15%	467	417	411	98.63	2,514	1,679	2,641	1,253	2,806	2,568
1,224	90.23%	466	416	411	98.64	2,512	1,677	2,639	1,252	2,803	2,566
1,225	90.30%	466	416	411	98.64	2,512	1,677	2,639	1,252	2,803	2,566
1,226	90.38%	466	416	410	98.65	2,510	1,676	2,637	1,251	2,801	2,564
1,227	90.45%	465	415	410	98.66	2,506	1,673	2,633	1,249	2,797	2,560
1,228	90.52%	463	413	408	98.70	2,495	1,666	2,622	1,244	2,785	2,549
1,229	90.60%	463	413	408	98.71	2,493	1,665	2,619	1,243	2,783	2,547
1,230	90.67%	463	413	408	98.71	2,493	1,665	2,619	1,243	2,783	2,547
1,231	90.74%	463	413	408	98.71	2,493	1,665	2,619	1,243	2,783	2,547
1,232	90.82%	462	412	407	98.73	2,487	1,661	2,613	1,239	2,775	2,540
1,233	90.89%	462	412	407	98.73	2,487	1,661	2,613	1,239	2,775	2,540
1,234	90.97%	461	411	406	98.74	2,485	1,659	2,611	1,239	2,773	2,538
1,235	91.04%	459	409	404	98.78	2,472	1,651	2,598	1,232	2,759	2,526
1,236	91.11%	459	409	404	98.78	2,472	1,651	2,597	1,232	2,759	2,525
1,237	91.19%	459	409	404	98.79	2,470	1,649	2,595	1,231	2,757	2,523
1,238	91.26%	457	407	402	98.82	2,460	1,643	2,585	1,226	2,745	2,513
1,239	91.33%	457	407	402	98.82	2,459	1,642	2,583	1,226	2,744	2,512
1,240	91.41%	457	407	402	98.83	2,458	1,641	2,582	1,225	2,743	2,511
1,241	91.48%	455	405	401	98.85	2,451	1,637	2,576	1,222	2,736	2,504
1,242	91.56%	455	405	401	98.85	2,451	1,637	2,576	1,222	2,736	2,504
1,243	91.63%	455	405	401	98.85	2,450	1,636	2,574	1,221	2,735	2,503
1,244	91.70%	455	405	400	98.86	2,447	1,634	2,571	1,220	2,731	2,500
1,245	91.78%	455	405	400	98.86	2,447	1,634	2,571	1,220	2,731	2,500
1,246	91.85%	455	405	400	98.86	2,447	1,634	2,571	1,220	2,731	2,500
1,247	91.92%	455	405	400	98.86	2,447	1,634	2,571	1,220	2,731	2,500
1,248	92.00%	455	405	400	98.86	2,447	1,634	2,571	1,220	2,731	2,500
1,249	92.07%	452	402	398	98.90	2,433	1,625	2,556	1,213	2,715	2,485
1,250	92.15%	451	401	397	98.92	2,428	1,622	2,551	1,210	2,710	2,481
1,251	92.22%	451	401	397	98.92	2,426	1,620	2,549	1,209	2,708	2,479
1,252	92.29%	451	401	396	98.93	2,424	1,619	2,547	1,208	2,705	2,476
1,253	92.37%	449	399	395	98.96	2,414	1,612	2,536	1,203	2,694	2,466
1,254	92.44%	448	398	394	98.97	2,409	1,609	2,532	1,201	2,689	2,461
1,255	92.51%	448	398	393	98.98	2,407	1,607	2,529	1,200	2,686	2,459
1,256	92.59%	445	395	392	99.02	2,395	1,599	2,516	1,194	2,673	2,446
1,257	92.66%	443	393	389	99.05	2,381	1,590	2,502	1,187	2,657	2,432
1,258	92.74%	441	391	387	99.09	2,367	1,581	2,487	1,180	2,642	2,418
1,259	92.81%	441	391	387	99.09	2,367	1,581	2,487	1,180	2,642	2,418
1,260	92.88%	438	388	384	99.14	2,351	1,570	2,470	1,172	2,624	2,402
1,261	92.96%	438	388	384	99.14	2,350	1,569	2,469	1,171	2,623	2,401
1,262	93.03%	437	387	384	99.15	2,346	1,567	2,465	1,169	2,618	2,397
1,263	93.10%	437	387	384	99.15	2,346	1,567	2,465	1,169	2,618	2,397
1,264	93.18%	437	387	384	99.15	2,346	1,567	2,465	1,169	2,618	2,397
1,265	93.25%	436	386	383	99.17	2,342	1,564	2,460	1,167	2,614	2,392
1,266	93.33%	436	386	383	99.17	2,341	1,563	2,460	1,167	2,613	2,392
1,267	93.40%	436	386	383	99.17	2,341	1,563	2,460	1,167	2,613	2,392
1,268	93.47%	433	383	380	99.21	2,325	1,552	2,442	1,159	2,594	2,375
1,269	93.55%	433	383	380	99.21	2,325	1,552	2,442	1,159	2,594	2,375
1,270	93.62%	433	383	380	99.22	2,322	1,551	2,440	1,157	2,591	2,372
1,271	93.69%	432	382	379	99.22	2,321	1,550	2,439	1,157	2,591	2,371
1,272	93.77%	432	382	379	99.22	2,319	1,548	2,436	1,156	2,588	2,369
1,273	93.84%	430	380	378	99.25	2,310	1,542	2,427	1,151	2,578	2,359
1,274	93.92%	430	380	377	99.26	2,306	1,540	2,422	1,149	2,573	2,355
1,275	93.99%	426	376	373	99.32	2,282	1,524	2,397	1,137	2,547	2,331
1,276	94.06%	424	374	372	99.33	2,275	1,519	2,390	1,134	2,539	2,324
1,277	94.14%	424	374	372	99.33	2,275	1,519	2,390	1,134	2,539	2,324
1,278	94.21%	424	374	372	99.33	2,275	1,519	2,390	1,134	2,539	2,324
1,279	94.28%	422	372	369	99.37	2,258	1,508	2,373	1,125	2,520	2,307
1,280	94.36%	421	371	369	99.38	2,257	1,507	2,371	1,125	2,519	2,306

Victoria Lake Monthly Outflow			After Amenity Flow / Maximum Power Discharge (m^3/s)	Annual Average Power Discharge (m^3/s)	Energy Calculation for MP						Energy Calculation for Pre FS
Duration (Month)	Probability	Flow (m^3/s)			Plant Factor (%)	Annual Energy Production (GWh)					
						Karuma	Oriang	Ayago	Kiba	Murchison	Ayago
1,281	94.43%	421	371	369	99.38	2,256	1,507	2,371	1,125	2,518	2,305
1,282	94.51%	418	368	366	99.42	2,239	1,495	2,352	1,116	2,499	2,287
1,283	94.58%	418	368	366	99.42	2,239	1,495	2,352	1,116	2,499	2,287
1,284	94.65%	418	368	366	99.42	2,239	1,495	2,352	1,116	2,499	2,287
1,285	94.73%	418	368	366	99.42	2,239	1,495	2,352	1,116	2,499	2,287
1,286	94.80%	418	368	366	99.42	2,237	1,494	2,350	1,115	2,496	2,285
1,287	94.87%	414	364	362	99.47	2,217	1,480	2,329	1,105	2,474	2,265
1,288	94.95%	414	364	362	99.47	2,217	1,480	2,329	1,105	2,474	2,265
1,289	95.02%	414	364	362	99.47	2,217	1,480	2,329	1,105	2,474	2,265
1,290	95.10%	414	364	362	99.47	2,214	1,479	2,327	1,104	2,471	2,262
1,291	95.17%	414	364	362	99.47	2,214	1,479	2,327	1,104	2,471	2,262
1,292	95.24%	414	364	362	99.47	2,213	1,478	2,325	1,103	2,469	2,260
1,293	95.32%	413	363	361	99.48	2,208	1,475	2,320	1,101	2,465	2,256
1,294	95.39%	411	361	359	99.51	2,195	1,466	2,306	1,094	2,450	2,243
1,295	95.46%	409	359	357	99.53	2,185	1,459	2,296	1,089	2,439	2,232
1,296	95.54%	407	357	356	99.55	2,176	1,453	2,286	1,085	2,429	2,223
1,297	95.61%	406	356	354	99.56	2,167	1,447	2,277	1,080	2,418	2,214
1,298	95.69%	405	355	354	99.57	2,165	1,446	2,274	1,079	2,416	2,211
1,299	95.76%	403	353	352	99.59	2,152	1,437	2,261	1,072	2,401	2,198
1,300	95.83%	401	351.2	350	99.61	2,140	1,429	2,248	1,067	2,388	2,186
1,301	95.91%	401	351.2	350	99.61	2,140	1,429	2,248	1,067	2,388	2,186
1,302	95.98%	401	351.0	350	99.62	2,138	1,428	2,247	1,066	2,387	2,184
1,303	96.05%	399	349	348	99.63	2,130	1,422	2,238	1,061	2,377	2,176
1,304	96.13%	399	349	348	99.63	2,130	1,422	2,238	1,061	2,377	2,176
1,305	96.20%	399	349	348	99.63	2,130	1,422	2,238	1,061	2,377	2,176
1,306	96.28%	399	349	348	99.63	2,130	1,422	2,238	1,061	2,377	2,176
1,307	96.35%	397	347	346	99.65	2,117	1,414	2,225	1,055	2,363	2,163
1,308	96.42%	397	347	346	99.65	2,117	1,414	2,225	1,055	2,363	2,163
1,309	96.50%	396	346	345	99.67	2,108	1,407	2,214	1,051	2,352	2,153
1,310	96.57%	395	345	344	99.67	2,105	1,406	2,212	1,049	2,350	2,151
1,311	96.64%	395	345	344	99.68	2,102	1,404	2,208	1,048	2,346	2,147
1,312	96.72%	393	343	342	99.69	2,090	1,395	2,195	1,041	2,332	2,135
1,313	96.79%	392	342	341	99.70	2,086	1,393	2,191	1,040	2,328	2,131
1,314	96.87%	392	342	341	99.70	2,086	1,393	2,191	1,040	2,328	2,131
1,315	96.94%	392	342	341	99.70	2,083	1,391	2,189	1,038	2,325	2,128
1,316	97.01%	391	341	340	99.71	2,079	1,388	2,184	1,036	2,320	2,124
1,317	97.09%	390	340	339	99.72	2,072	1,384	2,177	1,033	2,313	2,117
1,318	97.16%	389	339	338	99.72	2,066	1,380	2,171	1,030	2,306	2,111
1,319	97.23%	389	339	338	99.73	2,066	1,379	2,170	1,030	2,305	2,110
1,320	97.31%	388	338	337	99.73	2,059	1,375	2,163	1,026	2,298	2,103
1,321	97.38%	388	338	337	99.73	2,059	1,375	2,163	1,026	2,298	2,103
1,322	97.46%	385	335	334	99.75	2,041	1,363	2,145	1,017	2,278	2,085
1,323	97.53%	384	334	334	99.75	2,040	1,363	2,144	1,017	2,277	2,084
1,324	97.60%	382	332	332	99.77	2,028	1,354	2,131	1,011	2,263	2,072
1,325	97.68%	382	332	331	99.77	2,026	1,353	2,128	1,010	2,261	2,069
1,326	97.75%	377	327	326	99.80	1,997	1,333	2,098	995	2,228	2,040
1,327	97.82%	374	324	324	99.82	1,979	1,322	2,080	987	2,209	2,022
1,328	97.90%	374	324	324	99.82	1,979	1,322	2,080	987	2,209	2,022
1,329	97.97%	374	324	323	99.82	1,976	1,320	2,077	985	2,206	2,019
1,330	98.05%	373	323	323	99.82	1,974	1,318	2,074	984	2,203	2,017
1,331	98.12%	373	323	323	99.82	1,974	1,318	2,074	984	2,203	2,017
1,332	98.19%	370	320	320	99.84	1,956	1,306	2,055	975	2,183	1,999
1,333	98.27%	370	320	320	99.84	1,956	1,306	2,055	975	2,183	1,999
1,334	98.34%	370	320	319	99.84	1,952	1,303	2,051	973	2,178	1,994
1,335	98.41%	368	318	317	99.85	1,941	1,296	2,039	967	2,166	1,983
1,336	98.49%	366	316	316	99.86	1,931	1,289	2,029	962	2,155	1,972
1,337	98.56%	366	316	315	99.86	1,929	1,288	2,027	962	2,153	1,971
1,338	98.64%	363	313	312	99.87	1,910	1,275	2,007	952	2,132	1,951
1,339	98.71%	362	312	312	99.88	1,907	1,273	2,003	950	2,128	1,948
1,340	98.78%	358	308	308	99.89	1,884	1,258	1,980	939	2,103	1,925
1,341	98.86%	358	308	308	99.89	1,884	1,258	1,980	939	2,103	1,925
1,342	98.93%	355	305	305	99.90	1,867	1,246	1,961	930	2,083	1,907
1,343	99.00%	348	298	297	99.92	1,819	1,215	1,911	907	2,030	1,858
1,344	99.08%	347	297	297	99.92	1,816	1,213	1,909	905	2,027	1,856
1,345	99.15%	343	293	293	99.93	1,794	1,198	1,885	894	2,002	1,833
1,346	99.23%	343	293	293	99.94	1,793	1,197	1,884	894	2,001	1,832
1,347	99.30%	340	290	290	99.94	1,771	1,183	1,861	883	1,977	1,809
1,348	99.37%	340	290	290	99.94	1,771	1,183	1,861	883	1,977	1,809
1,349	99.45%	336	286	286	99.95	1,746	1,166	1,835	870	1,949	1,784
1,350	99.52%	335	285	285	99.95	1,741	1,163	1,829	868	1,943	1,779
1,351	99.59%	332	282	282	99.96	1,726	1,152	1,813	860	1,926	1,763
1,352	99.67%	329	279	278	99.96	1,703	1,137	1,789	849	1,901	1,740
1,353	99.74%	306	256	256	99.98	1,566	1,046	1,646	781	1,748	1,600
1,354	99.82%	293	243	243	99.99	1,487	993	1,563	741	1,660	1,520
1,355	99.89%	285	235	235	100.00	1,439	961	1,512	717	1,606	1,470
1,356	99.96%	280.0	230	230	100.00	1,407	939	1,478	701	1,570	1,437

Appendix I-3

Study on Optimum Development Scale of Ayago Hydropower Project

Data Table of Figure 7.7-1 and Table 7.7-1 Study on Optimum Development Scale of Ayago Hydropower Project

Item	Unit	Description						
		Ayago Hydropower						
Installed Capacity	MW	100	200	300	400	500	600	800
Maximum Power Discharge	m^3/s	140	281	421	562	702	842	1,122.8
Firm Discharge	m^3/s	467						
Min imum Amenity Flow	m^3/s	50						
Firm Power Discharge	m^3/s	140	280	417	417	417	417	417
Effective Head	m	80.7						
Combined Efficiency	%	90.2						
Firm Capacity	MW	100.0	200.0	297.1	297.1	297.1	297.1	297.1
Annual Total Energy Production	GWh	876	1,740	2,592	3,285	3,830	4,244	4,800
Annual Firm Energy Production	GWh	876	1,740	2,568	2,568	2,568	2,568	2,568
Annual Incremental Total Energy Production	GWh		864	853	692	546	413	556
Annual Plant Factor	%	100	99	99	94	87	81	68
Station Survices use	%	1.00						
Annual Forced Outage	%	0.50						
Annual Scheduled Outage	%	2.00						
Effective Total Capacity	MW	96.5	193.0	289.5	386.0	482.5	579.0	772.0
Effective Firm Capacity	MW	96.5	193.0	286.7	286.7	286.7	286.7	286.7
Effective Annual Total Energy	GWh	845	1,679	2,502	3,170	3,696	4,095	4,632
Effective Annual Firm Energy	GWh	845	1,679	2,478	2,478	2,478	2,478	2,478
Ecconomic Life Years for Civil Works	year	50						
Ecconomic Life Years for Hydro & Electro-mechanical Works	year	30						
Construction Cost for Civil Works	10^{3}US$	283,491	456,253	626,456	828,424	1,010,518	1,195,436	1,604,876
Construction Cost for Hydro & Electro-mechanical Works	10^{3}US$	103,144	163,238	222,022	284,979	345,009	403,857	525,599
Total Construction Cost	10^{3}US$	386,635	619,491	848,478	1,113,403	1,355,527	1,599,293	2,130,475
Incremental Total Construction Cost	104US$		232,856	228,987	264,925	242,124	243,766	531,182
Discount Ratio	%	10.00%						
Annual Investment Cost Recoverly Ratio for Civil Works	%	11.09%						
Annual Investment Cost Ratio for Hydro & Electro-mechanical Works	%	11.61%						
Annual Operation and Maintenace Ratio for Civil Works	%	0.50%						
Annual Operation and Maintenace Cost Ratio for Hydro & Electro-mechanical Works	%	1.50%						
Annual Operation and Maintenace Ratio for Civil Works	%	11.59%						
Annual Operation and Maintenace Cost Ratio for Hydro & Electro-mechanical Works	%	13.11%						
Annual Cost for Civil Works	10^{3}US$	32,845	52,861	72,581	95,981	117,078	138,502	185,940
Annual Cost Hydro & Electro-mechanical Works	10^{3}US$	13,520	21,397	29,103	37,355	45,223	52,937	68,895
Total Annual Cost	10^{3}US$	46,365	74,258	101,683	133,335	162,301	191,439	254,835
Total Incremental Annual Cost	104US$		27,893	27,425	31,652	28,966	29,138	63,395
Unit Construction Cost/Total Capacity	Cent/kW	3,866	3,097	2,828	2,784	2,711	2,665	2,663
Unit Construction Cost/Firm Capacity	Cent/kW	3,866	3,097	2,856	3,748	4,563	5,383	7,171
Unit Construction Cost/Total Annual Energy	Cent/kWh	46	37	34	35	37	39	46
Unit Construction Cost/Annual Firm Energy	Cent/kWh	46	37	34	45	55	65	86
Unit Construction Cost/Incremental Total Annual Energy	Cent/kWh		27	27	38	44	59	96
Unit Annual Total Energy Price	Cent/kWh	5.48	4.42	4.06	4.21	4.39	4.67	5.50
Unit Firm Energy Price	Cent/kWh	5.48	4.42	4.10	4.92	5.71	6.54	8.12
Unit Incremental Annual Total Energy Price	Cent/kWh		3.23	3.22	4.57	5.31	7.05	11.40
Net Annual Cost of Hydropower	10^{3}US$	46,365	74,258	101,683	133,335	162,301	191,439	254,835
Incremental Cost for buck up Thermal	10^{3}US$	0	0	291	10,327	20,363	30,399	50,470
Total Annual Cost of Hydropower	10^{3}US$	46,365	74,258	101,974	143,662	182,664	221,838	305,305
Annual kW Benefit	10^{3}US$	9,685	19,369	29,054	38,739	48,423	58,108	77,477
Annual kWh Benefit	10^{3}US$	101,896	202,368	301,554	382,070	445,560	493,621	558,296
Annual Total Benegit	10^{3}US$	111,581	221,737	330,608	420,808	493,984	551,729	635,773
Annual Surplus Benefit	10^{3}US$	65,216	147,479	228,634	277,146	311,319	329,890	330,468
Benefit Cost Ratio		2.41	2.99	3.24	2.93	2.70	2.49	2.08
1. Preparation and Land acquision	10^{3}US$	22,393	24,977	27,522	30,542	33,265	36,030	42,152
(1) Access road	10^{3}US$	13,500	13,500	13,500	13,500	13,500	13,500	13,500
(2) Compensation & Resettlment	10^{3}US$	5,000	5,000	5,000	5,000	5,000	5,000	5,000
(3) Camp & Facilities	10^{3}US$	3,893	6,477	9,022	12,042	14,765	17,530	23,652
2. Environmental mitigation cost	10^{3}US$	9,733	16,192	22,554	30,105	36,912	43,825	59,131
3. Civil work	10^{3}US$	194,667	323,833	451,089	602,092	738,238	876,494	1,182,618
4. Hydraulic euipment	10^{3}US$	10,982	16,524	21,018	28,850	34,340	38,886	51,212
5. Electro-mechanical equipment	10^{3}US$	42,533	85,067	127,600	170,133	212,667	255,200	340,267
6. Transmission line	10^{3}US$	29,000	29,000	29,000	29,000	29,000	29,000	29,000
Direct cost	10^{3}US$	309,308	495,593	678,783	890,723	1,084,422	1,279,434	1,704,380
7. Administration and Engineering service	10^{3}US$	46,396	74,339	101,817	133,608	162,663	191,915	255,657
8. Contingency	10^{3}US$	30,931	49,559	67,878	89,072	108,442	127,943	170,438
Total cost	10^{3}US$	386,635	619,491	848,478	1,113,403	1,355,527	1,599,293	2,130,475

Alternative Thermal Power Plant

Items	Unit	Discription
Plant		Gas Turbine
Installed Capacity	MW	348
Firm Capacity	MW	348
Annual Total Energy Production	GWh	3,048
Annual Firm Energy Production	GWh	3,048
Annual Plant Factor	%	100
Station Survices use	%	2.00
Annual Forced Outage	%	2.00
Annual Scheduled Outage	%	5.00
Effective Total Capacity	MW	316.68
Effective Firm Capacity	MW	316.68
Effective Annual Total Energy	GWh	2,774
Effective Annual Firm Energy	GWh	2,774
Ecconomic Life Years for Plant	year	20
Construction Cost	10^3US$	201,840
Discount Ratio		10%
Annual Investment Cost Recoverly Ratio for Civil Works		12.75%
Annual Investment Cost Ratio for Hydro & Electro-mechanical Works		3%
Annual Fixed Cost Ratio		15.75%
Annual Fixed Cost	104US$	31,782
kW Benefit by Gas Turbine	US$/kW	100.36
Fuel Cost	Cent/kWh	10.97
kWh Benefit by Gas Turbine (Cent/kWh)		12.05

Appendix J

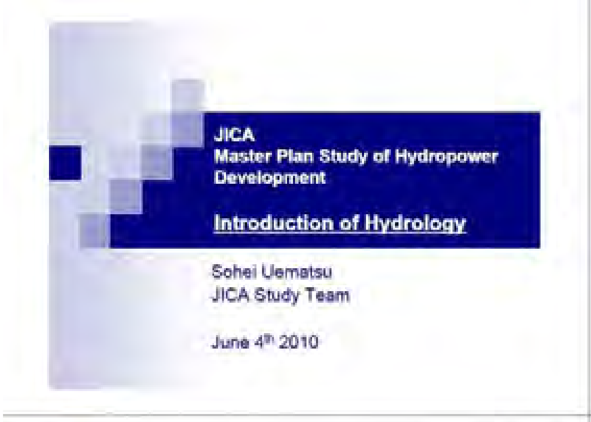
Technical Transfer

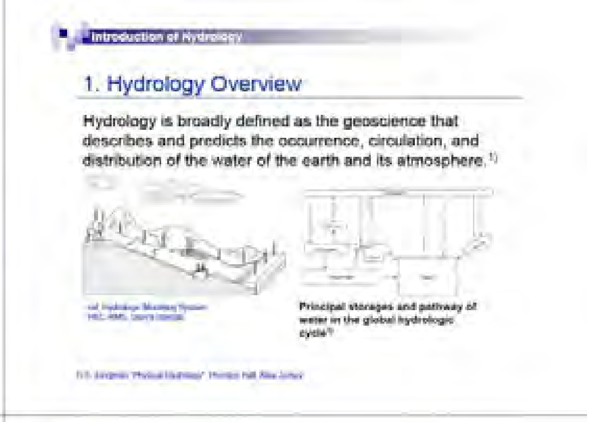
Appendix J-1

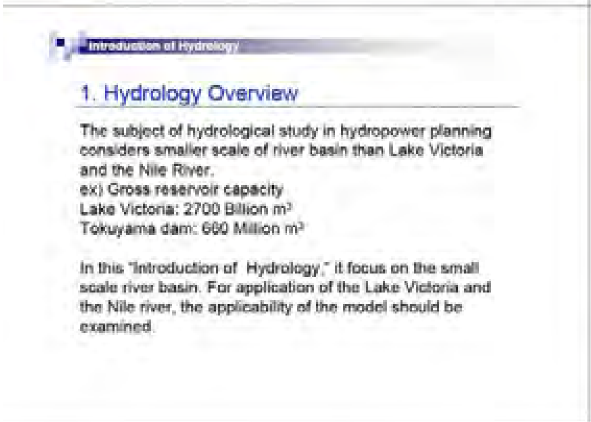
Hydrology

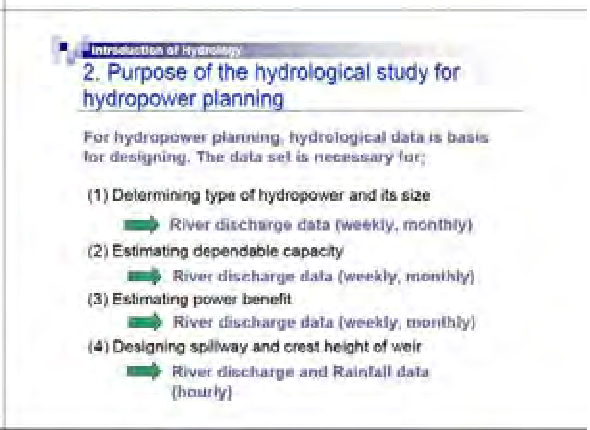
LIST OF CONTENTS

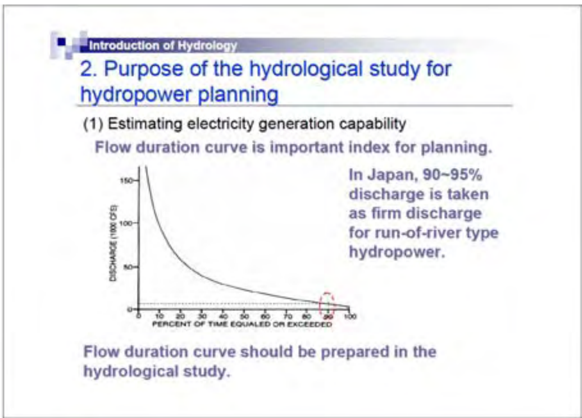
1. Introduction of Hydrology

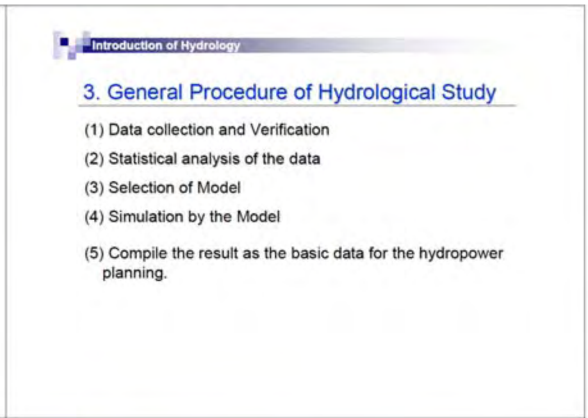


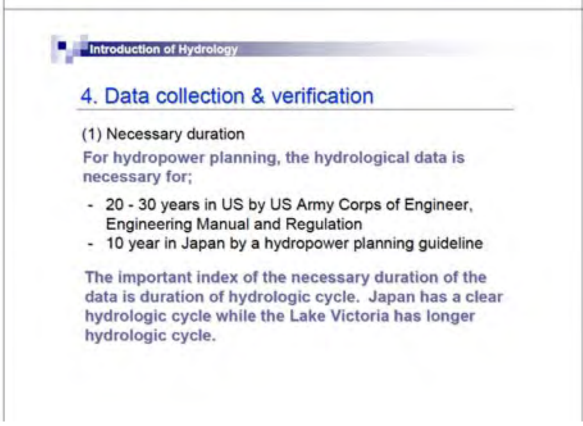


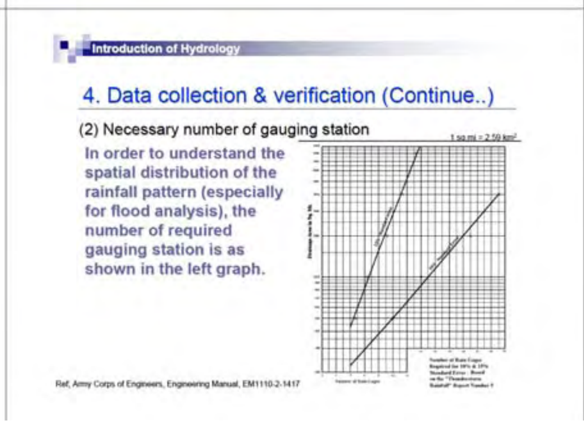












4. Data collection & verification (Continue..)

(3) Visual Inspection of Gauging Station

If it is suspicious for observation error, go and check the condition.

- Example

Leakage in rainfall collector

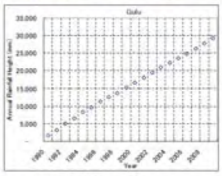
Clogged by sand

Introduction of Hydrology

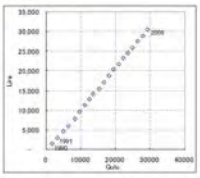
4. Data collection & verification (Continue..)

(4) Check by Single or Double Mass Curve

The consistency of the data should be checked by single/double mass curve analysis.



Single Mass Curve



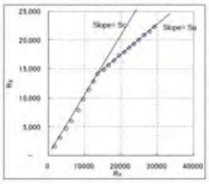
Double Mass Curve

Introduction of Hydrology

4. Data collection & verification (Continue..)

(4) Check by Single or Double Mass Curve

If the double mass curve is not on a single straight line, there should be an error



*Rcx = Rx * Sc / Sa*

where

Rcx : corrected rainfall values at any time period at station X

Rx : original recorded rainfall values at any time period at station X

Sc : corrected slope of the double-mass curve

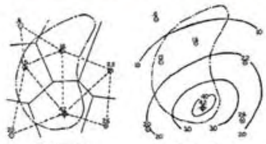
Sa : original slope of the mass curve

Introduction of Hydrology

4. Data collection & verification (Continue..)

(5) Obtain the basin average rainfall

Thiessen and Isohyetal methods are popular.



Thiessen Isohyet

average basin rainfall =

$$R_{ave} = \sum_{i=1}^{n} \frac{A_i}{A_{all}} R_i$$

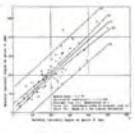
The two methods give the same basin average rainfall. Isohyet method requires judgment and experience.

Ref; Army Corps of Engineers, Engineering Manual, EM1110-2-1417

Introduction of Hydrology

5. Statistical Analysis

(1) Regression Analysis



num of data	5% significant level
3	0.997
4	0.950
5	0.878
6	0.811
7	0.754
8	0.707
9	0.666

The correlation of rainfall data should be examined. If the correlation is greater than the coefficient of significant level then the data is judged to be correlated.

if R> significant level then we can say the two station data is correlated.

Ref; Manual for River Works in Japan; Survey

Introduction of Hydrology

5. Statistical Analysis

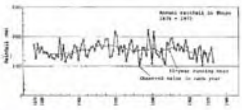
(3) Time series analysis

Time series data are subject to examined for the following aspects;

- Long term trend, Cyclic change, Continuity, Abrupt change

- Long term trend

The long term trend of the time series data is checked by moving average method.



Ref; Manual for River Works in Japan; Survey

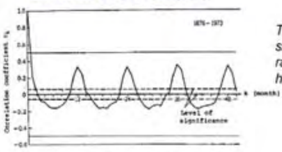
Introduction of Hydrology

5. Statistical Analysis (Continue..)

- *Cyclic change*

Cyclic change is examined by correlogram (time series correlation)

Example of correlogram



Monthly rainfall in Tokyo

The left example shows that monthly rainfall pattern in tokyo has a year cycle.

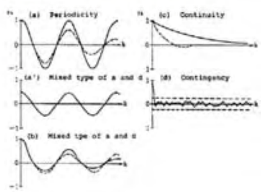
Ref; Manual for River Works in Japan; Survey

Introduction of Hydrology

5. Statistical Analysis (Continue..)

- *Continuity*

Continuity also can be checked by the correlogram for the following aspects.



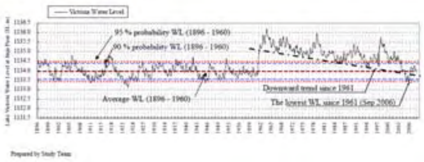
Ref; Manual for River Works in Japan; Survey

Introduction of Hydrology

5. Statistical Analysis (Continue..)

- *Lake Victoria Case*

a. Long term trend



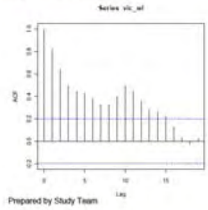
Prepared by Study Team

Introduction of Hydrology

5. Statistical Analysis (Continue..)

- *Lake Victoria Case*

b. Cyclic change



Correlogram of water level of the Lake Victoria shows 10-year cycle.

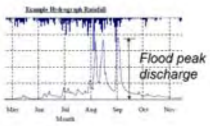
Prepared by Study Team

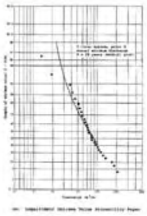
Introduction of Hydrology

5. Statistical Analysis (Continue..)

(4) Probability Distribution Function

Probability Distribution Function is used for estimating flood peak of "T" year return period.





Ref. Manual for River Works in Japan, Survey

Introduction of Hydrology

5. Statistical Analysis (Continue..)

(4) Probability Distribution Function (Continue)

There are a lot of type of probability distribution function.

Normal distribution	Extreme value distribution	Gamma distribution
Normal distribution	Gumbel distribution	Exponential distribution
Log-normal distribution	Log-gumbel distribution	Log-Pearson Type III distribution

In US, Log-Pearson Type III is recommended for estimation of flood peak discharge.

Introduction of Hydrology

6. Filling Missing Data

(1) Synthesizing missing data

In general, hydrological data has many missing data, especially in developing countries.

(2) Method of filling missing data

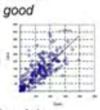
1) Filled by Regression analysis (Rainfall and discharge data)

	Gulu	Lira
1990/1/1	missing	28
1990/2/1	missing	111
1990/3/1	51	127
1990/4/1	168	133
1990/5/1	143	141
1990/6/1	151	86
1990/7/1	163	90

Missing data of Gulu can be filled by Lira. Since they have a good correlation.

$R_{Gulu} = a \times R_{Lira}$

a: Slope of regression line



2) Filled by Hydrologic model (Discharge data)

If there is no correlated observation data, the missing data can be filled by hydrologic model.

Introduction of Hydrology

7. Low Flow Analysis

General

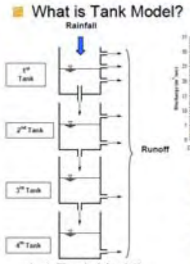
Low flow analysis is to estimate the long term river discharge flow for 1 to 10 years.

- The low flow analysis is important for hydropower planning.
- In Japan, tank model or statistical unit hydrograph, etc. are applied. But there are not so many models.
- In this presentation, tank model (Sugawara 1956) is introduced.

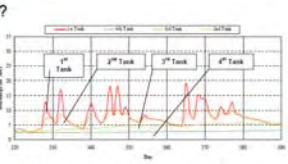
Introduction of Hydrology

7. Low Flow Analysis

- What is Tank Model?



4x1 Tank Model

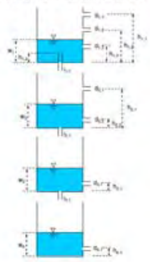


- Express storage water in underground by tank
- Each tank has infiltration and runoff hole
- No need to separately calculate rainfall loss
- Easy structure => good for novice hydrologist
- Applicable in mountainous area
- Difficult to apply urbanized area and vast flat plain

Introduction of Hydrology

7. Low Flow Analysis

- What is Parameters?



- Parameters of the model are;

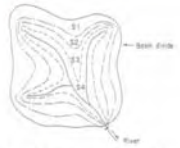
$d_{i,j}$: size of the hole in tank *i*

i_i: size of the hole of infiltration hole in tank *i*.

4x1 tank model sometimes found difficult for its applicability when the area has distinct wet and dry season.

7. Low Flow Analysis

- 4x4 Tank Model (Sugawara 1978)

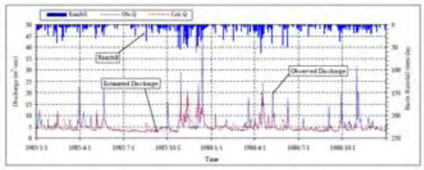


4x4 tank model produces better representation of flow.

7. Low Flow Analysis

- 4x4 Tank Model

Example of discharge estimation by 4x4 tank model



7. Low Flow Analysis

- Parameter Calibration

Parameters are calibrated so as to minimize the difference between estimates and observed data.

$$\text{Minimize } \sigma = \sqrt{\frac{\sum (Q_{obs} - Q_{est})^2}{N}}$$

where,

σ : deviation

Q_{obs} : daily observed discharge at Pangiringan SGS (m^3/s)

Q_{est} : daily estimated discharge by Tank Model (m^3/s)

N : number of data

Care should be given for minimizing deviation for low flow condition.

8. Flood Analysis

- **General**

  Flood analysis:
  1) Estimation of Peak Discharge
  2) Estimation of Flood Hydrograph

- Estimation of Peak Discharge

  -Probability Distribution Function: Use Log-Pearson Type III
  - Rational formula:
    Q = CIA (m^3/s)
    where,
    C : Runoff coefficient
    I : Rainfall Intensity
    A : Drainage area

Ref; Army Corps of Engineers, Engineering Manual, EM1110-2-1417

8. Flood Analysis

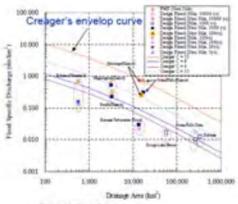
- Estimation of Peak Discharge (Continue)

- Creager Formula
Creager formula gives the envelop line of flood discharge respective to the drainage area.

$$Q_p = 0.503 \times C \times \left(\frac{A}{2.59}\right)^a$$

$$a = 0.894 \times \left(\frac{A}{2.59}\right)^{-0.048} - 1$$

Where, Q_p : Peak discharge (m^3/sec)
C : Creager's coefficient
A : Catchment area (km^2)



Prepared by Study Team

8. Flood Analysis

- Estimation of Flood Hydrograph

(1)Procedure
- Determine the duration of storm (rainfall)
- Determine the probable rainfall (T year return period)
- Determine the flood rainfall pattern
- Determine the rainfall loss
- Selection of a hydrological model
- Simulate by the hydrological model input by flood rainfall
- Check the peak discharge either Creager formula or rational formula.

8. Flood Analysis

- Estimation of Flood Hydrograph

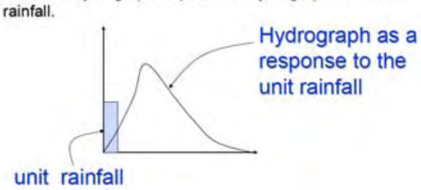
(2) Hydrological Model
- Unit hydrograph
- Storage Function model
- Tank Model
- Kinematic wave model (overland flow model)

(3) Unit hydrograph
The unit hydrograph is a common tool for estimation of flood hydrograph in US. The unit hydrograph is applicable except for urban area. In urban area, "Kinematic wave model" is recommended.
Both "Unit hydrograph" and "Kinematic wave" are applicable in HEC-HMS.

8. Flood Analysis

- Unit hydrograph

First, unit hydrograph requires the hydrograph for a unit rainfall.

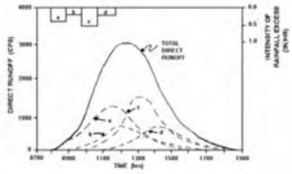


Introduction of Hydrology

8. Flood Analysis

- Unit hydrograph

Flood hydrograph can be obtained by superimposing the hydrograph respects to each rainfall.



Ref; Army Corps of Engineers, Engineering Manual, EM1110-2-1417

Introduction of Hydrology

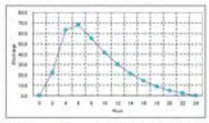
8. Flood Analysis

- Unit hydrograph

Example)

Unit hydrograph is given for unit rain of R0 = 20mm

Hour	0	2	4	6	8	10	12	14	16	18	20	22	24
Discharge	0.0	22.4	63.2	68.0	55.2	41.6	30.0	21.2	14.4	8.8	4.8	2.4	0.0



Derive hydrograph when the following rainfall occurs.

Hour	0	2	4	6	8	10
Rainfall	0.0	20.0	36.0	80.0	24.0	0.0

Ref; Araki, Tsubaki, "Applied Hydraulics"

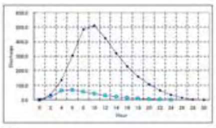
Introduction of Hydrology

8. Flood Analysis

- Unit hydrograph

Calculation table

	Rainfall R (mm)		Hour 0	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30
1	R0=20	Q0	0.0	22.4	63.2	68.0	55.2	41.6	30.0	21.2	14.4	8.8	4.8	2.4	0.0			
2	10	Q0 × 10/20	0.0	11.2	31.6	34.0	27.6	20.8	15.0	10.6	7.2	4.4	2.4	1.2	0.0			
3	36	Q0 × 36/20		0.0	40.3	113.8	122.4	99.4	74.9	54.0	38.2	25.9	15.8	8.6	4.3	0.0		
4	80	Q0 × 80/20			0.0	89.6	252.8	272.0	220.8	166.4	120.0	84.8	57.6	35.2	19.2	9.6	0.0	
5	24	Q0 × 24/20				0.0	26.9	75.8	81.6	66.2	49.9	36.0	25.4	17.3	10.6	5.8	2.9	0.0
6	Total		0.0	33.6	135.1	305.4	484.9	509.6	422.3	318.4	229.7	158.9	106.1	64.7	34.1	15.4	2.9	0.0



Ref; Araki, Tsubaki, "Applied Hydraulics"

Introduction of Hydrology

8. Flood Analysis

- Unit hydrograph

Example2)

Derive unit hydrograph for observed rainfall and hydrograph

Calculate the distribution of flow (p_i); 1[st] Iteration

1)	2) Period (hr)	3) Effective Rainfall (mm)	4) Observed Discharge (cms)	5) p 1% discharge (4883xR/89.2)/100 (cms)	6) Tentative Ratio of Distribution p0 (%) 3	10	25	20	15	10	7	5	3	2	7) Sum (cms)	8) Residual 4)−7) (cms)	9) p0* (Residual/2137) (%)	10) p0 (%)	11) p1 (p0*+p0)/2 (%)
1	0 to 3	10.8	20	5.91	17.7										18	2	0.1%		
2	3 to 6	50.0	195	27.37	–	59									59	136	6.0%	3%	4%
3	6 to 9	22.4	570	12.26	36.8	–	148								185	385	14.1%	10%	12.0%
4	9 to 12	6.0	992	3.28	9.8	123	–	118							251	741	27.1%	25%	26.0%
5	12 to 15		825			33	307	–	89						428	397	18.2%	20%	19.1%
6	15 to 18		743				82	246	–	59					386	357	13.0%	15%	14.0%
7	18 to 21		526					66	184	–	41				291	235	8.6%	10%	9.3%
8	21 to 24		364						49	123	–	30			201	162	5.9%	7%	6.5%
9	24 to 27		225							33	86	–	18		136	89	3.2%	5%	4.1%
10	27 to 30		160								23	61	–	12	96	64	2.2%	3%	2.7%
11	30 to 33		97									16	37	–	53	44	1.6%	2%	1.8%
12	33 to 36		48										10	25	34	14	0.5%		
13	36 to 39		18											7	7	-11	0.4%		
Total		89	4,883													2,137			

5.91 x 25% x 100

Ref; Araki, Tsubaki, "Applied Hydraulics"

Introduction of Hydrology

8. Flood Analysis

- Unit hydrograph

Example2)

Calculate the distribution of flow (p_i); 2[nd] Iteration

1)	2) Period (hr)	3) Effective Rainfall (mm)	4) Direct Runoff (cms)	5) p 1% discharge (4883xR/89.2)/100 (cms)	6) Tentative Ratio of Distribution p1 (%) 4.0%	12.0%	26.0%	19.1%	14.0%	9.3%	6.5%	4.1%	2.7%	1.8%	7) Sum (cms)	8) Residual 4)−7) (cms)	9) p1* (Residual/2748) (%)	10) p1 (%)	11) p2 (p1*+p1)/2 (%)
1	0 to 3	10.8	20	5.91	23.5										24	-4	-0.1%		
2	3 to 6	50.0	195	27.37	–	71									71	124	4.5%	4%	4%
3	6 to 9	22.4	570	12.26	48.8	–	154								203	367	13.4%	12%	12.7%
4	9 to 12	6.0	992	3.28	13.1	148	–	113							274	718	26.1%	26%	26.1%
5	12 to 15		825			40	319	–	83						442	383	17.8%	19%	18.3%
6	15 to 18		743				86	234	–	35					374	369	12.8%	14%	13.7%
7	18 to 21		526					63	172	–	38				273	253	9.2%	9%	9.3%
8	21 to 24		364						46	114	–	24			184	180	6.5%	6%	6.5%
9	24 to 27		225							31	76	–	16		126	99	3.6%	4%	3.9%
10	27 to 30		160								21	50	–	11	82	78	2.8%	3%	2.7%
11	30 to 33		97									14	33	–	46	51	1.8%	2%	1.8%
12	33 to 36		48										9	22	31	17	0.6%		
13	36 to 39		18											6	6	12	0.4%		
Total		89	4,883													2,748			

p1 ≒ p2 (%), therefore iteration stop.

Introduction of Hydrology

8. Flood Analysis

- Unit hydrograph

Example2)

after determining distribution, get the unit hydrograph for 50mm unit rainfall.

1)	2) Period (hr)	3) Effective Rainfall (mm)	4) Direct Runoff (cms)	5) p 1% discharge (4883xR/89.2)/100 (cms)	6) Tentative Ratio of Distribution p1 (%) 4.2%	12.7%	26.1%	18.3%	13.7%	9.3%	6.5%	3.9%	2.7%	1.8%	7) Sum (cms)
1	0 to 3		20		–										–
2	3 to 6	50.0	195	27.37	109.0	–									109
3	6 to 9		570		–	330	–								330
4	9 to 12		992		–	–	713	–							713
5	12 to 15		825			–	–	522	–						522
6	15 to 18		743				–	–	384	–					384
7	18 to 21		526					–	–	254	–				254
8	21 to 24		364						–	–	177	–			177
9	24 to 27		225							–	–	113	–		113
10	27 to 30		160								–	–	73	–	73
11	30 to 33		97									–	–	49	49
12	33 to 36		48										–	–	–
13	36 to 39		18											–	–
Total		50	4,883												

50/89x4883/100

unit hydrograph is as follows

Hour	0	3	6	9	12	15	18	21	24	27	30	33	36
Discharge	0.0	109.0	329.6	712.8	522.2	383.5	254.4	177.1	112.7	73.0	49.3	0.0	0.0

Introduction of Hydrology

8. Flood Analysis

- Unit hydrograph

Example2)

Using the distribution, we can calculate a hydrograph for a unit rainfall of 10mm.

1)	2) Period (hr)	3) Effective Rainfall (mm)	4) Direct Runoff (cms)	5) p 1% discharge (4883xR/89.2)/100 (cms)	6) Tentative Ratio of Distribution p1 (%) 4.2%	12.7%	26.1%	18.3%	13.7%	9.3%	6.5%	3.9%	2.7%	1.8%	7) Sum (cms)
1	0 to 3		20		–										–
2	3 to 6	10.0	195	5.47	21.8	–									22
3	6 to 9		570		–	65.9	–								66
4	9 to 12		992		–	–	142.8	–							143
5	12 to 15		873			–	–	104.4	–						104
6	15 to 18		743				–	–	76.7	–					77
7	18 to 21		526					–	–	50.9	–				51
8	21 to 24		364						–	–	35.4	–			35
9	24 to 27		225							–	–	22.5	–		23
10	27 to 30		160								–	–	14.8	–	15
11	30 to 33		97									–	–	9.9	10
12	33 to 36		48										–	–	–
13	36 to 39		18											–	–
Total		10	4,883												

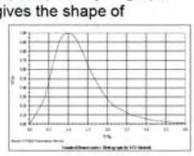
Introduction of Hydrology

8. Flood Analysis

- Flood Analysis for Ungauged Basin

There is many situation that it necessary to estimate the flood hydrograph, but no hydrologic data is available.

US Army Corps of Engineer's Manual suggests to use U.S. Soil Conservation Service (SCS) unit hydrograph. SCS unit hydrograph already gives the shape of hydrograph for a unit rainfall.



Ref; Army Corps of Engineers, Engineering Manual, EM1110-2-1417

2. Introduction of Reservoir Operation for a Small Scale Reservoir

4 June, 2010

Introduction of Reservoir Operation for a small scale reservoir

by Sohei Uematsu, JICA Study Team

Introduction of reservoir operation

This introduction is focusing on the small scale reservoir. Applicability to Lake Victoria should carefully be examined.

2

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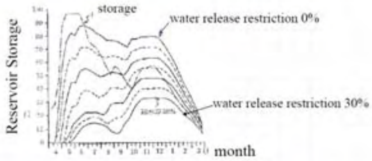
1. Draught Duration Curve

In Japan, draught duration curve (Takeuchi,1984) is developed for water supply dams during draught management.



Ref. Nanasawa et al. "Reservoir Operation Rules Based on Regional Characteristics" Institute of Civil Engineering, Japan 1987

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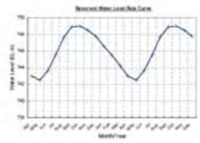
2. Rule Curve Base Reservoir Operation

- ▶ Rule curve is used as the guide of reservoir operation.
- ▶ Rule curve is developed by applying optimization techniques.

Example of rule curve



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3. Optimization technique

- Procedure of Optimization

1.Formulation of the problem
2.Defining Objective
3.Defining variable
4.Defining Constraints
5.Optimization
6.Sensitivity Analysis

→

For Hydropower
•Need more energy
•Energy maximization
•Release of water
•Available water and fulfill electricity demand
•Optimization
•Sensitivity Analysis

5

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3. Optimization technique

- Operation Research, and System Analysis

1940s: Linear programming and simplex method
1950s:
Non-Linear programming
Dynamic programming
Integer programming
Chance constraints programming, etc.

1960s:
Applied Nonlinear programming
Markov decision process
Fuzzy set theory
Goal programming

6

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3. Optimization technique

- Operation Research, and System Analysis

1970s;
Decision support system
Multi-criteria decision making
Lagrangian relaxation

1980s:
Analytic hierarchy process
Expert system
Artificial neural networks
Genetic Algorithm

1990s:
Integration of artificial intelligence

7

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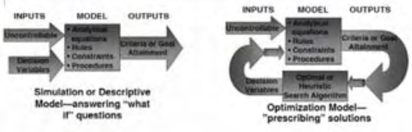
3. Optimization technique

- Difference between Simulation and Optimization



Ref. Colorado State University, CE645 Handout material

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3. Optimization technique

- Deterministic Optimization

Directory use the historical hydrologic data;
Applied to Linear Programming (LP), Dynamic Programming (DP), etc

- Stochastic Optimization

Input of the hydrological data is hydrological distribution.

➡ **Stochastic DP. Methods are more time consuming.**

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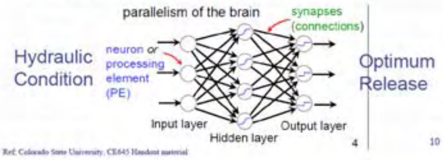
3. Optimization technique

- Real-Time Control with Forecasting

Typical Method;
Artificial Neural Network,
Real time operation with Kalman Filter
Fuzzy Theory

例) Artificial Neural Network (ANN);



Ref. Colorado State University, CE645 Handout material

4

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3. Optimization technique

- Heuristic programming method

Typical Method;
Genetic Algorithm (GA),
Evolutional Algorithm (EA)
Particle Swarm Optimization (PSO)
Ex) Genetic Algorithm (GA)
DNA resembles the set of solution.

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3. Optimization technique

- Single Objective and Multi-Objective

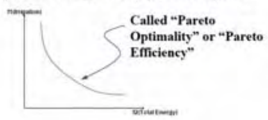
For the single objective, the optimum solution is only one. While, multi-objective function is dependent on the weights imposed on the objective.

•Single Objective Function

$$\text{Max} \sum \text{Total energy}$$

•Multi-Objective Function

$$\text{Max} \quad w1 \sum \text{Total energy} + w2 \sum \text{Fulfill Irrigation}$$



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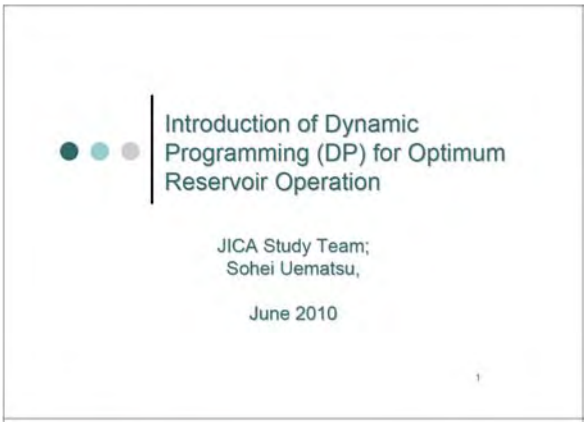
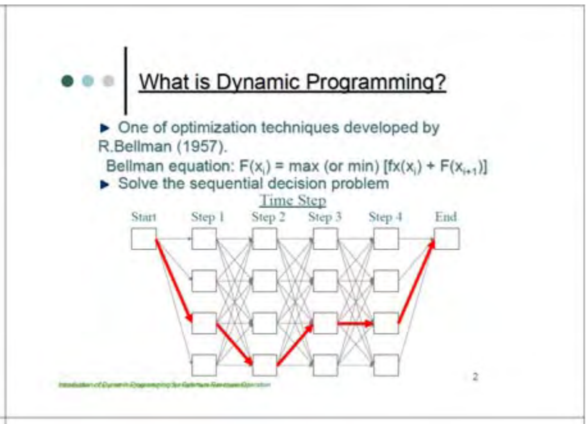
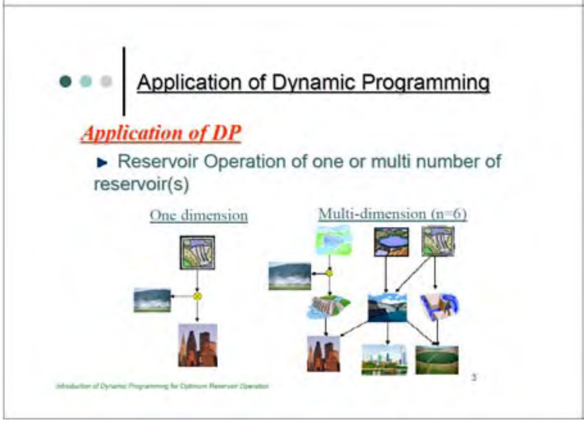
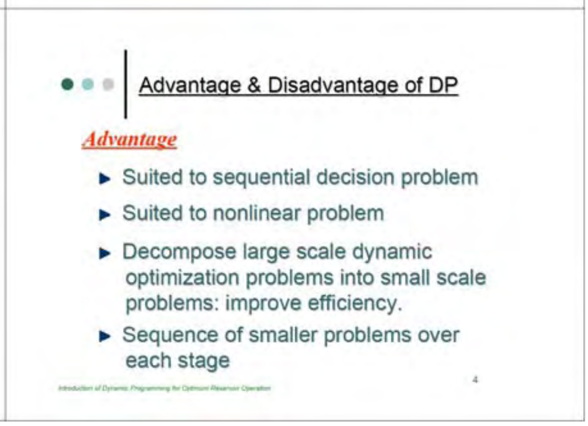
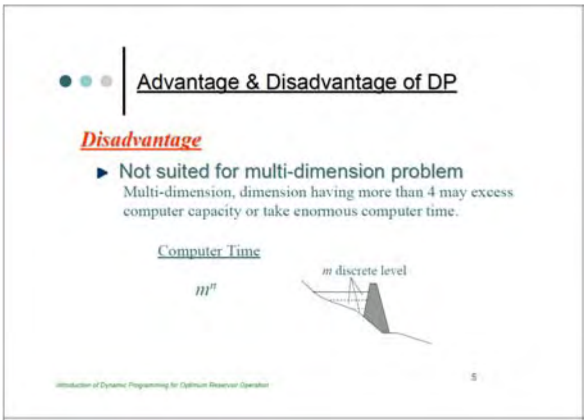
3. Introduction of Dynamic Programming (DP) for Optimum Reservoir Operation

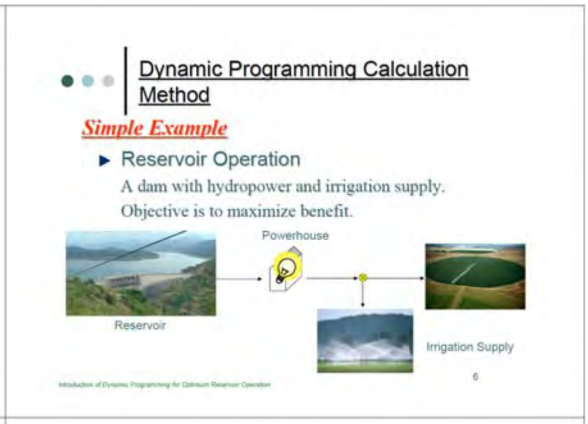


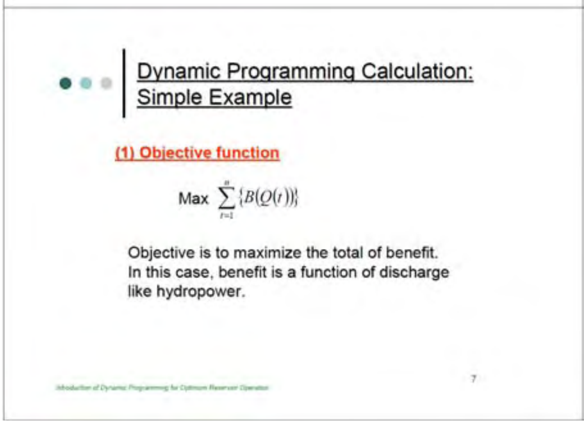


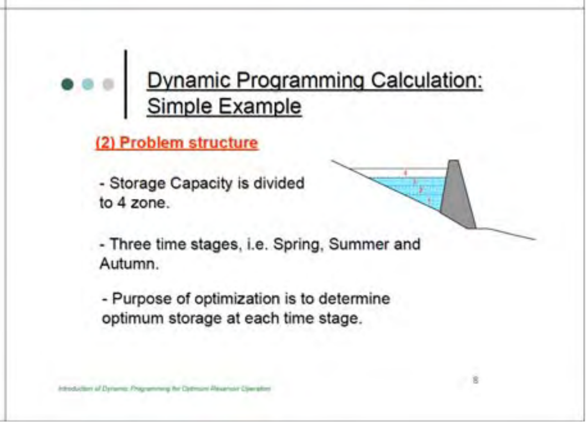






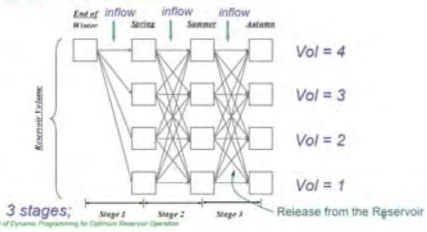






Dynamic Programming Calculation: Simple Example

(2) Problem structure



Dynamic Programming Calculation: Simple Example

(3) Inflow to the Reservoir

Stage 1	Stage 2	Stage 3
1	1	1

(5) Irrigation requirement

Stage 1	Stage 2	Stage 3
1	2	0

Irrigation requirement is set as minimum discharge.

(4) Discharge benefit

Discharge	Stage 1	Stage 2	Stage 3
0	0	0	0
1	1	3	1
2	3	3	2
3	3	3	2
4	5	3	4

Benefit mainly due to the hydropower.

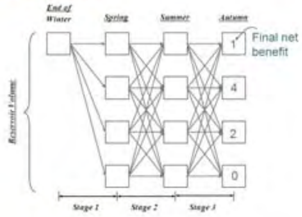
(6) Final Net Benefit at Reservoir Level

Reservoir Volume	4	3	2	1
Benefit	1	4	2	0

Benefit relevant to water level, such as recreation.

Dynamic Programming Calculation: Simple Example

(7) Final Net Benefit



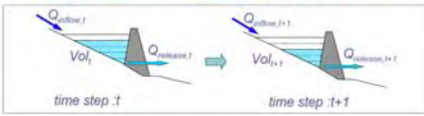
Dynamic Programming Calculation: Simple Example

(8) Water Balance of Reservoir

Called as "state equation";

$Q_{release,t} = Vol_t - Vol_{t+1} + Q_{inflow,t}$

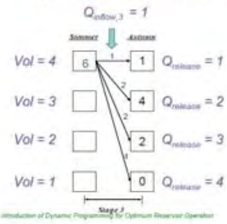
The equation shows the water balance of the reservoir.



Dynamic Programming Calculation: Simple Example

Calculation Procedure

(1) Backward DP: Start from the last stage (t = 3)



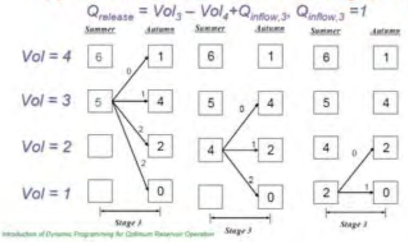
$Q_{release} = Vol_3 - Vol_4 + Q_{inflow,3}$

$Q_{inflow,3} = 1$

Dynamic Programming Calculation: Simple Example

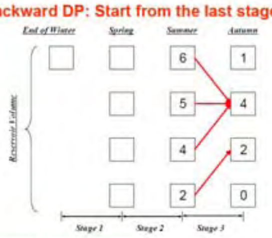
(1) Backward DP: Start from the last stage (t = 3)

$Q_{release} = Vol_3 - Vol_4 + Q_{inflow,3}$, $Q_{inflow,3} = 1$



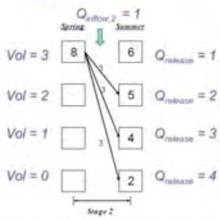
Dynamic Programming Calculation: Simple Example

(1) Backward DP: Start from the last stage (t = 3)



Dynamic Programming Calculation: Simple Example

(2) t = 2



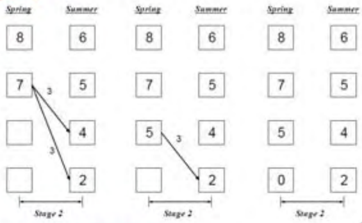
$Q_{release} = Vol_2 - Vol_3 + Q_{inflow,2}$

$Q_{inflow,2} = 1$

$Q_{release}$ should be greater than 1 to satisfy irrigation demand.

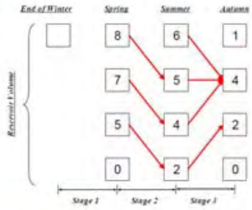
Dynamic Programming Calculation: Simple Example

(2) t = 2



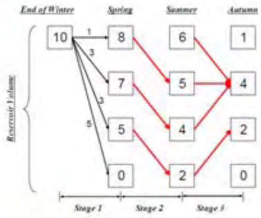
Dynamic Programming Calculation: Simple Example

(2) t = 2



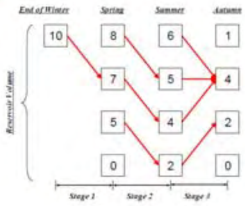
Dynamic Programming Calculation: Simple Example

(3) t = 1



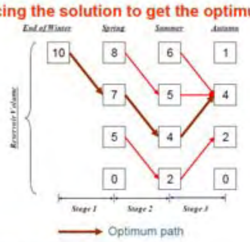
Dynamic Programming Calculation: Simple Example

(3) t = 1



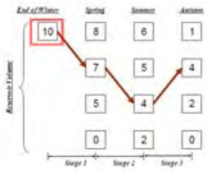
Dynamic Programming Calculation: Simple Example

(3) Tracing the solution to get the optimum path

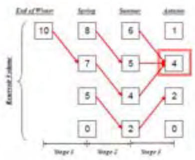


Dynamic Programming Terminology

Traceback



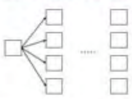
Feedback



Dynamic Programming Terminology

Forward DP

- Calculation starts from the initial stage:



Best for the final value problem, but it does not provide "feedback".

Dynamic Programming Terminology

State Equation

(1) Inverted form

$Q_{release,t} = Vol_t - Vol_{t+1} + Q_{inflow,t}$

Good if constraints on Vol_t more restrictive than constraints on $Q_{release,t}$.

(2) Non-Inverted form

$Vol_{t+1} = Vol_t - Q_{release,t} + Q_{inflow,t}$

Good if constraints on $Q_{release,t}$ more restrictive than constraints on Vol_t.

Dynamic Programming Terminology

Multi-Dimension DP

Solving Multi-dimension DP is more challenging. Solved by Incremental DP, Dynamic Programming Successive Approximation, etc..

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Dynamic Programming Terminology

Variation of DP method

- Stochastic DP
- Continuous DP
- Discrete Deferential DP
- Neuro-dynamic programming
- Hybrid of Linear Programming (LP) and DP
- etc.

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Application to Hydropower Operation Planning

(2) Objective function

Objective function can be formed of various type dependent on the condition in each country.

Example:

a. Maximizing Energy Production
b. Maximizing Revenue
c. Maximizing Firm Power
d. Minimizing Import Energy

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Application to Hydropower Operation Planning

Characteristics of hydropower

The power is a function of hydraulic head.

$$Power = 9.81 \times \varepsilon(Vol_t, Q_t) \times H(Vol_t, Q_t) \times Q(t) \text{ (kW)}$$

Therefore higher head gives larger power.

↓

It is better to maintain high water level to produce a large power.

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Application to Hydropower Operation Planning

a. Maximizing Energy Production

$$\text{Max} \sum_{t=1}^{n} \{Energy(Q(t), hour(t), \varepsilon(Vol_t, Q_t))\}$$

$$Energy = 9.81 \times \varepsilon(Vol_t, Q_t) \times H(Vol_t, Q_t) \times Q(t) \times hour(t)$$

where;

$\varepsilon(Vol_t, Q_t)$; combined efficiency of generator and turbine, which is a function of volume and discharge.

$H(Vol_t, Q_t)$; Effective head which is a function of volume and discharge.

$Q(t)$; discharge for hydropower which is determined by CSUDP.

$hour(t)$; duration of generation hours in month (t)

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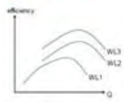
Application to Hydropower Operation Planning

a. Maximizing Energy Production

- efficiency

$\varepsilon(Vol_t, Q_t)$



Efficiency is obtained by interpolating each efficiency curve.

- effective head equation,

$$H(Vol_t, Q_t) = WL(t) - TWL(t) - Headloss(Q_t)$$

WL	:	Water level of the reservoir
TWL	:	Tail water level
Headloss(Qt)	:	Headloss which is a function of Qt

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Application to Hydropower Operation Planning

a. Maximizing Energy Production

- Constraints are to;

(1) Fulfill the domestic demand with reserve margin

Domestic supply + import >=
Domestic demand + export + reserve margin

(2) Limit the import/export power capacity

Import/Export power < T/L capacity

(3) Limit hydraulic capacity (discharge and reservoir volume)

Vol <= Volmax: Reservoir capacity
Q <= Qmax : Discharge capacity

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Application to Hydropower Operation Planning

b. Maximizing Revenue

To maximizing the revenue is much more complicated.

$$\text{Max} \sum_{t=1}^{n} Revenue$$

for hydro-system

Revenue1 = (domestic sale) + (export revenue) - (import cost) + (imported energy sold to domestic consumer) – (miscellaneous cost)

for hydro-thermal system

Revenue2 = Revenue1 – Thermal_cost

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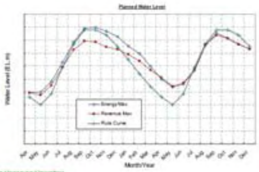
Application to Hydropower Operation Planning

- Example

A power company wants to develop the reservoir operation curve, with maximization or revenue maximization.

Result

Energy maximization stays higher in order to produce energy efficiently.



Introduction of Dynamic Programming for Optimum Reservoir Operation 33

Question?

Introduction of Dynamic Programming for Optimum Reservoir Operation 34

Appendix J-2

Hydropower Development in Japan & Hydrological Analysis

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PROJECT FOR MASTER PLAN STUDY
ON
HYDROPOWER DEVELOPMENT
IN
THE REPUBLIC OF UGANDA

Counterpart Training in Japan

Hydropower Development in Japan

J - Power
August 2010

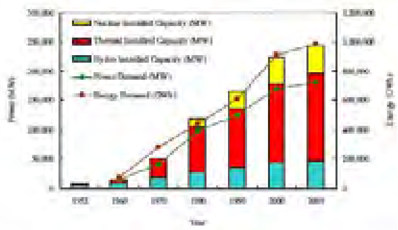
Contents

History of Hydropower Development in Japan

Chronograph

- First Electric Power Company in 1882
- First Hydropower in 1889
- First Major Hydropower for System in 1907
- First National Hydropower Potential Study in 1910
- Japan Generation and Transmission Company in 1939
- Started World War II in 1941
- Un Conditional Surrender in 1945
- Re Organization of Electric Power Sector (9 Company) in 1949
- Establishment of J Power in 1952 for Development of Large Scale and Difficult Hydropower Project

Development of Power Sector and Hydropower

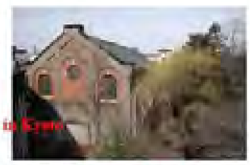


First Hydropower Project in Japan in 1889

Sankyozawa Hydro 15 kW
in Miyagi Prefecture for private use

First Hydropower in Japan by Power Utility in 1891

Keage Hydro 160 kW in Kyoto



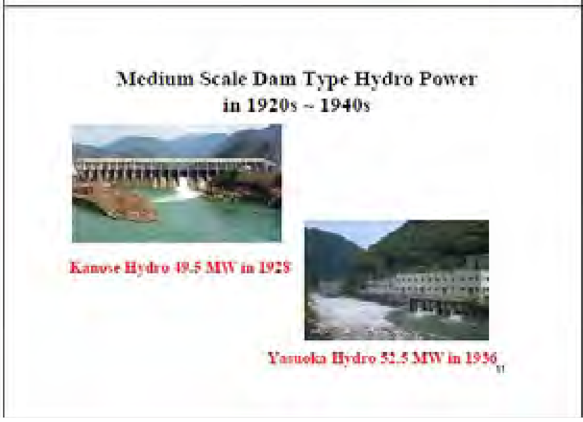
Present 4,500 kW

made in USA

First Hydro Power Energy to Tokyo in 1904


First Major Hydro Power and High Voltage
and Long Distance Transmission in 1914
Tokyo
Google
9

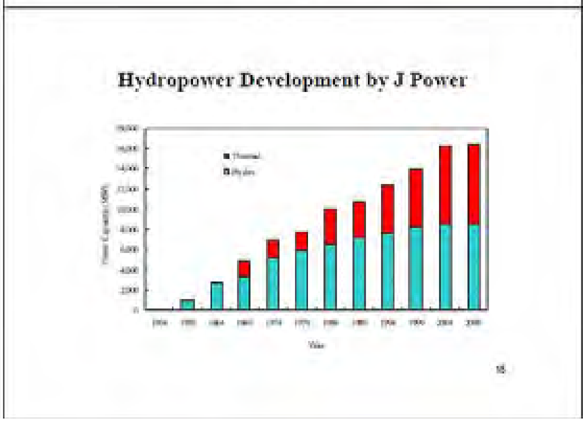

Large Scale Run of River Type Hydro Power
in 1920s ~ 1940s
Nakatsukawa No.1 Hydro 126 MW
in 1921 in Niigata Pre.
Shinanogawa Hydro 177 MW
in 1939 in Niigata Pre.
10

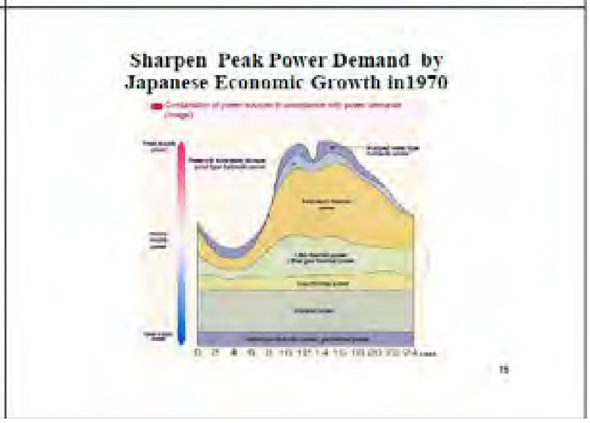

Medium Scale Dam Type Hydro Power
in 1920s ~ 1940s
Kanose Hydro 49.5 MW in 1928
Yasuoka Hydro 52.5 MW in 1936
11


War Damage in Tokyo in 1945
Lost Every Thing
Before
After
12


Established J Power in 1952 for Large Scale
and Difficult Project
Challenge for Reconstruction War Damage
Sakuma Project 350 MW in 1956 by J Power introducing
Technology from USA


Large Scale and Difficult Project for Economic Development
By Priority Production System for Power Coal and Iron
Tagokura 390 MW in 1959
Okutadami 560 MW in 1960
Kurobe No.4 335 MW in 1961
Miboro 215 MW in 1961
14


Hydropower Development by J Power
Thermal
Hydro
Year
15


Sharpen Peak Power Demand by
Japanese Economic Growth in1970
0 2 4 6 8 10 12 14 16 18 20 22 24
16

Peak Power by Large Scale Pumped Storage Project for Rapid Economic Growth in1970

	Shiroyama	Numappara	Okukiyotsu	Shimogo
Capacity (MW)	[illegible]	[illegible]	[illegible]	[illegible]
Completion	[illegible]	[illegible]	[illegible]	[illegible]
Company	[illegible]	[illegible]	[illegible]	[illegible]
Total in Japan	[illegible]			

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Hydropower Development by New Technology and Consideration to Environment

Okinawa Sea Water Pumped Storage Power
30 MW in 1999

Best Mix of Power Sources

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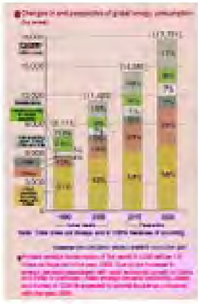
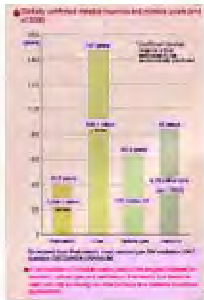




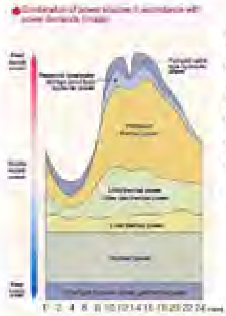
In developing countries, economies are expected to develop rapidly as population increases. Global energy consumption tends to further increase.

Though energy demands continue to increase, energy resources like petroleum, coal and natural gas are limited. If nothing is done, energy supplies will run short globally.

Now is the time to improve the structure of energy supply. At electric power companies, measures are taken to diversify the fuel for generating power, decentralize energy suppliers, and secure stable energy resources, thus contributing to a stable supply of electricity.

Main features of energy resources

Hydraulic power	[illegible]
Petroleum	[illegible]
Natural gas	[illegible]
Coal	[illegible]
Uranium (Nuclear power)	[illegible]



Unlike other industries, electric power is characterized by being produced and consumed at the same time. Therefore, supplies must always be guaranteed to meet demands.

Further, demand changes characteristics according to type and always continue to change on the hour. The functions available in power supply differ according to the type and form of power generation. How to combine economically stable supply powers in accordance with the changes in demands is, therefore, essential in supply/demand plans.

In Japan, power generation is operated by utilizing the main characteristics of power sources in accordance with power demands that change by the hour.

"Supply corresponding to demand" is carried out by combining power sources appropriate for peak, middle and base supplies.

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Main characteristics of power sources in supply/demand operation

Pumped water hydraulic power	[illegible]
Reservoir type/Water storage type hydraulic power	[illegible]
Petroleum thermal power	[illegible]
LNG thermal power and other gas thermal power	[illegible]
Coal thermal power	[illegible]
Nuclear power	[illegible]
Inflow type hydraulic power	[illegible]

Peak supply power: Plays the role of supplying peak power demands, and adjusts generated power in accordance with power demands. The unit price of construction is generally cheap, while the fuel unit price is high.

Middle supply power: Plays the role of supplying middle power demands, and adjusts generated power in accordance with daily changes in power demands. The unit price of construction and fuel unit price are generally between peak supply power and base supply power.

Base supply power: Plays the role of supplying base power demands, but does not adjust generated power in accordance with the changes in power demands. Operation continues with fixed power. The unit price of construction is generally high, but the fuel unit price is cheap.

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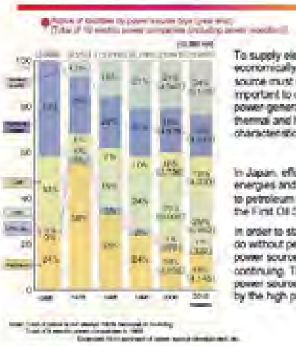

To supply electricity stably and economically for a long time, one power source must not be depended upon, but it is important to combine in good balance the power generating methods via nuclear, thermal and hydraulic by utilizing their characteristics, so that risks may be diffused.

In Japan, efforts have been made to save energies and develop alternative energies to petroleum following the experiences of the First Oil Shock in 1973.

In order to stabilize energy supply, efforts to do without petroleum and diversify the power source in good balance are continuing. The current composition of power sources is less likely to be affected by the high prices of crude oil.

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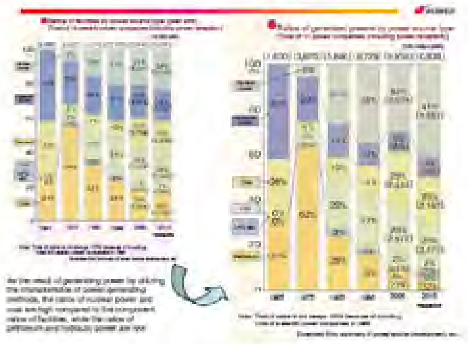

Discussion

Issue	Key Point
Economic Growth	•Population Increase •Changes in Demands
Energy Security	•Limited Energy Resources •Diversify the Fuel •Decentralize Energy Suppliers
Environmental Protection	•Alternative Energies •Global Warming Gas

• What the Best Mix is ....

The Best Mix of power sources is a configuration of power sources designed to achieve simultaneously the three issues of Economic Growth, Energy Security and Environmental Protection.

In order to achieve these targets in our country, efforts are continued to secure a stable supply of energies, make energy consumption more efficient, promote the introduction of non-fossil energies like new energies and nuclear power, and further to optimize the configuration of power sources by focusing the respective characteristics of conventional energies including petroleum, LPG, coal and natural gas.

To supply electric power stably and at cheap prices for a long time, supply/demand plans should be designed so as to secure the necessary supply power, make power supply more efficient and establish the Best Mix in power source composition, in supply/demand plans.

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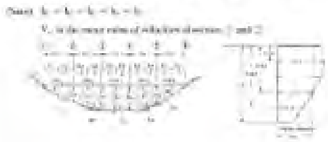
How to get River Runoff

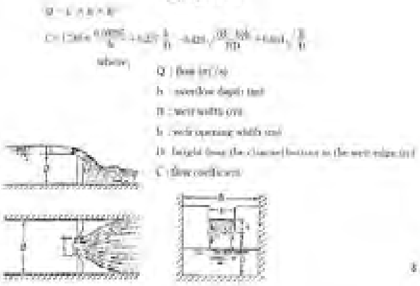
(1) by Gauging Station

- Measurement velocity of river flow and river section periodically
- Observation of river water level by automatic level gauge and or staff gage continuously



How to get River Runoff

(2) by Weir



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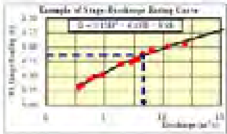
How to get River Runoff

(1) by Gauging Station

- Establish rating curve of water level and runoff
- Estimate daily runoff by the rating curve and observed water level



How to get River Runoff

(3) by Dam and Power Station (Bujagali Project)

Estimate by outflow and storage water

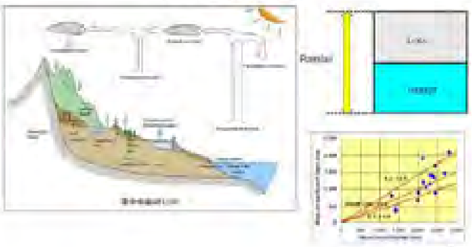
$Q_{in} = Q_{out} + (V_n - V_{n-1})/(tn - tn-1)$

How to get Inflow of Victoria Lake

Impossible to estimate inflow

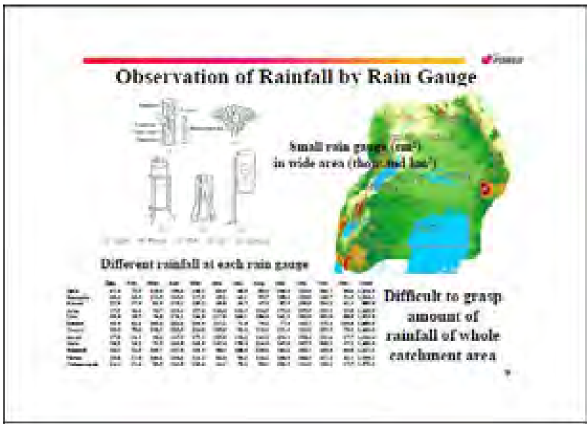
Because no exact figures of evaporation and rainfall can be estimated

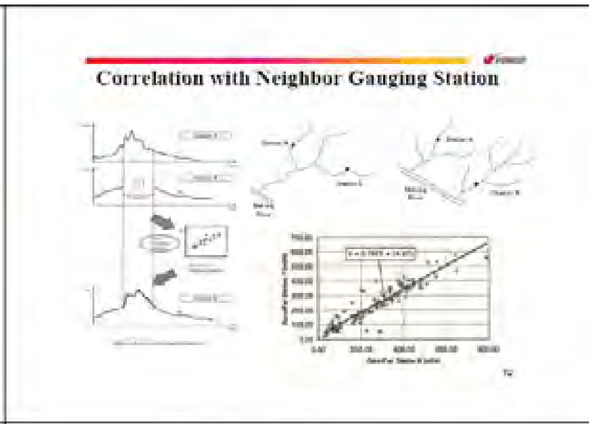
Runoff by Runoff Coefficient
Low reliability

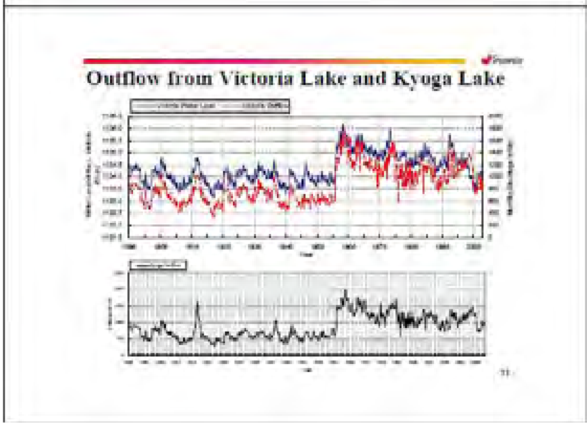


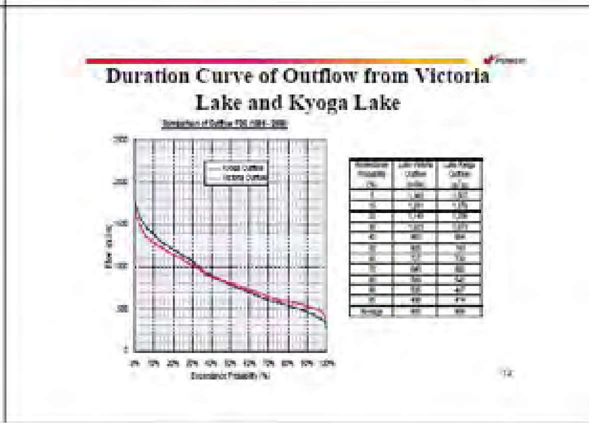
Unit of Runoff

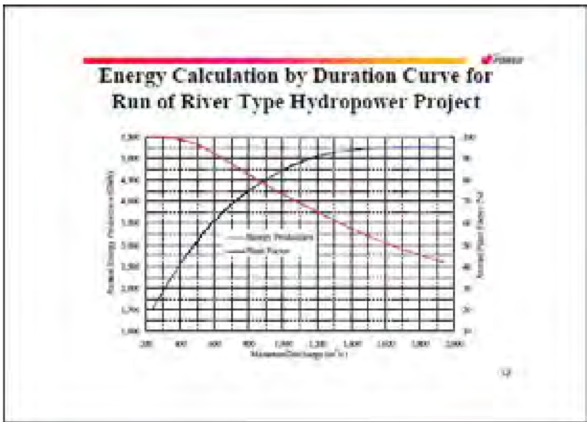
- Runoff of 1 m³/s for one day = 1 m³/s-d =1 m³/s × 3,600 sec × 24 hours = 87,600 m³
- Runoff of 1m³/s for one year= 365m³/s-d = 1 m³/s × 3,600 sec × 24 hours × 365 day = 31,974,000m³
- 1 million m³/(3,600 sec × 24 hours) =11.57m3/s-day
- 100 million m³/(3,600 sec × 24 hours × 365 days) = 3.16 m³/s-year
- 1 m Victoria Lake storage volume = 68,000 km² × 1 m = 68 billon m³ = 2,156 m³/s-year=68,000,000,000 m³/(3,600 sec × 24 hour × 365day)
- 10 cm up or down of Victoria Lake water level per one year is equivalent to 215.6 m³/s more or less inflow than out flow of the Lake

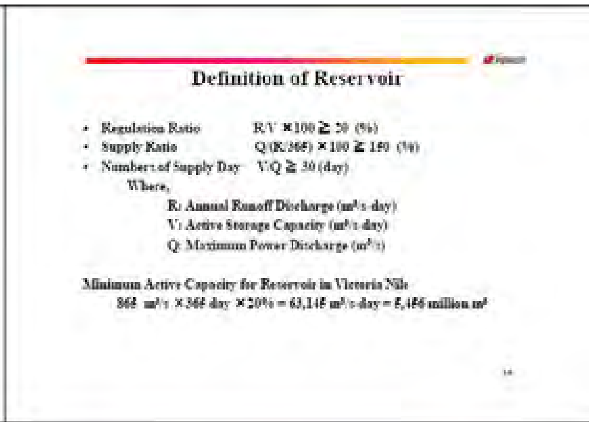

Observation of Rainfall by Rain Gauge
Small rain gauge (cm²) in wide area (thousand km²)
Different rainfall at each rain gauge
Difficult to grasp amount of rainfall of whole catchment area

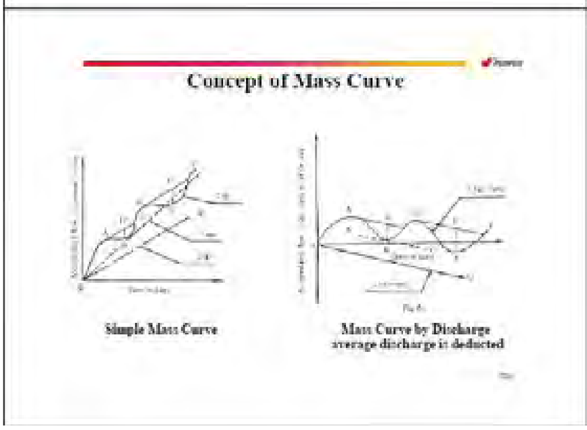

Correlation with Neighbor Gauging Station


Outflow from Victoria Lake and Kyoga Lake


Duration Curve of Outflow from Victoria Lake and Kyoga Lake


Energy Calculation by Duration Curve for Run of River Type Hydropower Project


Definition of Reservoir
• Regulation Ratio R/V ×100 ≧ 20 (%)
• Supply Ratio Q/(R/365) ×100 ≧ 150 (%)
• Numbers of Supply Day V/Q ≧ 30 (day)
Where,
R: Annual Runoff Discharge (m³/s·day)
V: Active Storage Capacity (m³/s·day)
Q: Maximum Power Discharge (m³/s)
Minimum Active Capacity for Reservoir in Victoria Nile
865 m³/s × 365 day × 20% = 63,145 m³/s·day = 5,456 million m³


Concept of Mass Curve
Simple Mass Curve
Mass Curve by Discharge
average discharge is deducted

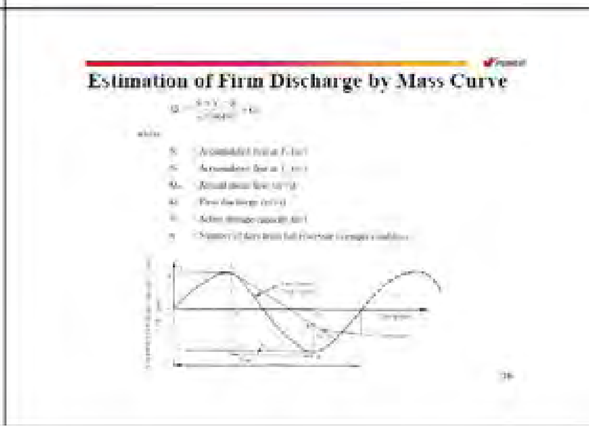

Estimation of Firm Discharge by Mass Curve

Image of Reservoir Operation by Mass Curve

Image of Optimum Reservoir Operation

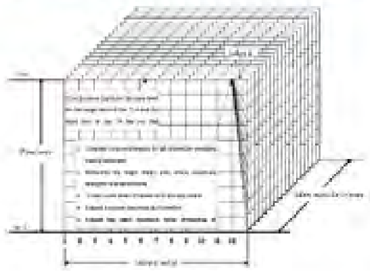
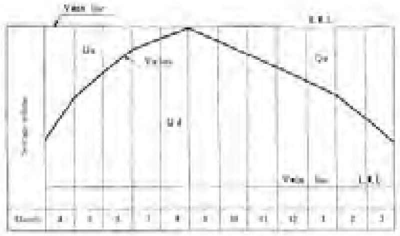
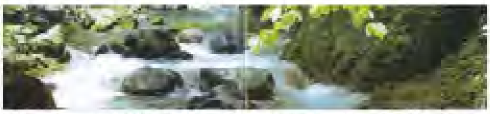


Image of Optimum Reservoir Operation Rule



Thank you very much



Integrated Hydropower Development Project in Tenryu River

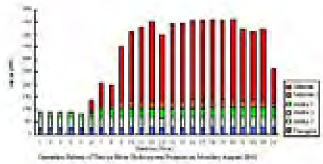
2

Hydropower Project in Tenryu River

		Sakuma	Sakuma 1	Akiba 1	Akiba 2	Akiba 3	Funagira
Dam Type		Concrete Gravity	-	Concrete Gravity			Concrete Gravity
Dam Height	m	155.5	-	89			24.5
Numbers of Waterway		2	1	1	1	1	
Waterway Type		Headrace	Tailrace				
Waterway Pressure	m	Pressure	Non Pressure	Pressure	Non Pressure	Non Pressure	
Waterway Diameter	m	7.0	10.3	7.0	7.0	8.5	
Waterway Length	m	3,884	3,241	4,867	1,133	3,943	
Maximum Discharge	m³/s	306	306	110	110	116	270
Rated Head	m	133.5	13.3	45.5 (47.1)	36.5	47.1	14.5
Installed Capacity	MW	350	32	45.8	34.9	46.9	32
Numbers of Unit		4	2	2	1	1	1

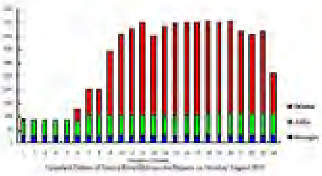
3

Image of Operation Pattern on Weekday Tenryu River Hydropower Projects



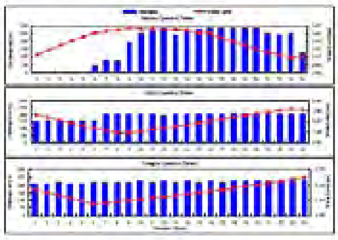
4

Image of Operation Pattern on Weekday Tenryu River Hydropower Projects



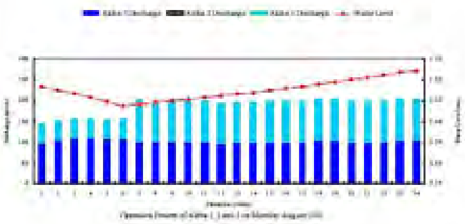
5

Image of Discharge Operation Pattern on Weekday Tenryu River Hydropower Projects



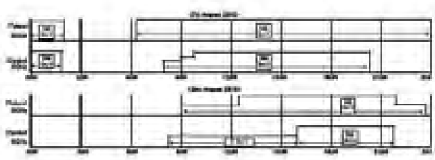
6

Image of Discharge Operation Pattern on Weekday Akiba No.1, 2 and 3 Hydropower Projects

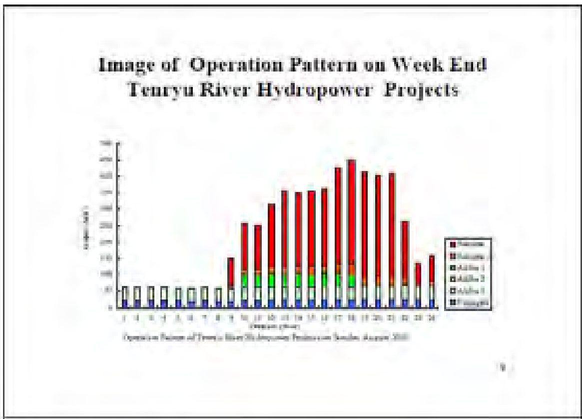


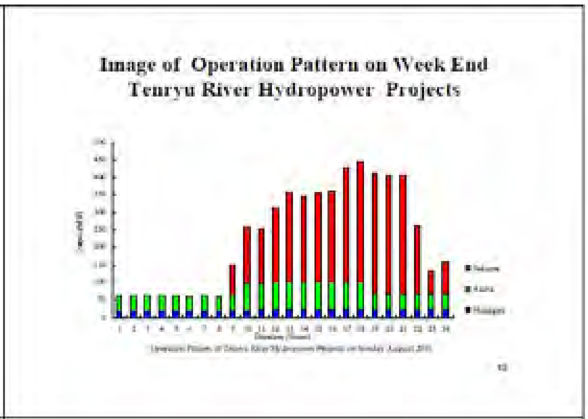
7

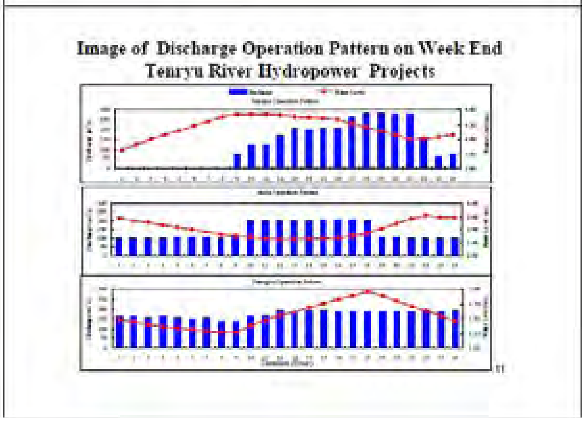
Image of Operation of Unit Sakuma Hydropower

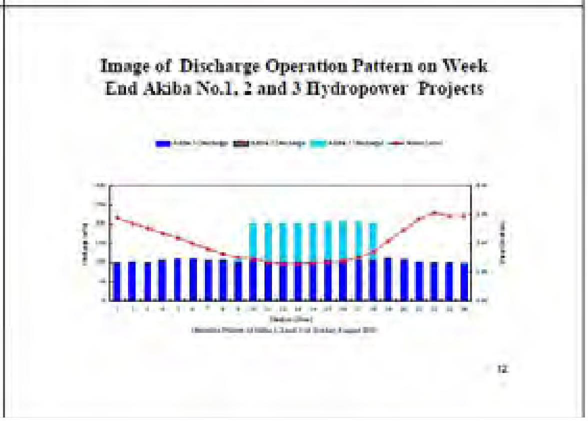


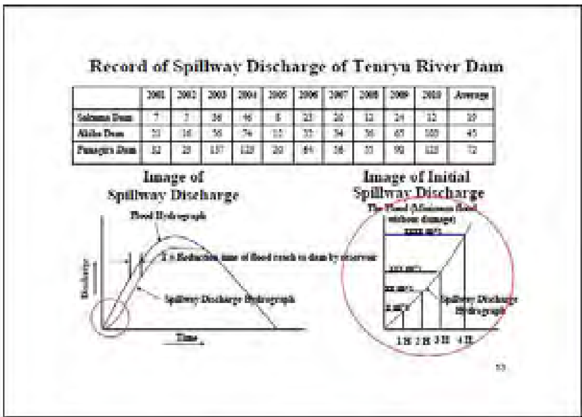
8



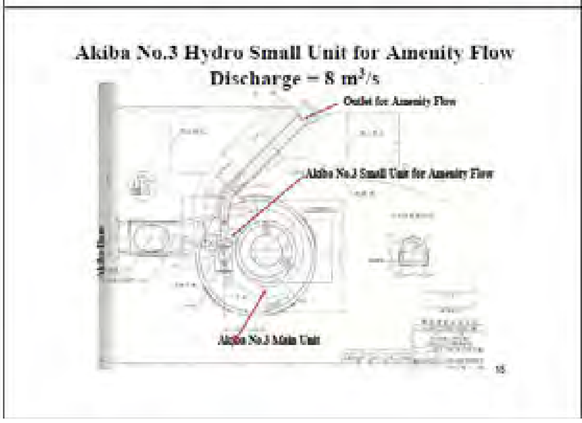


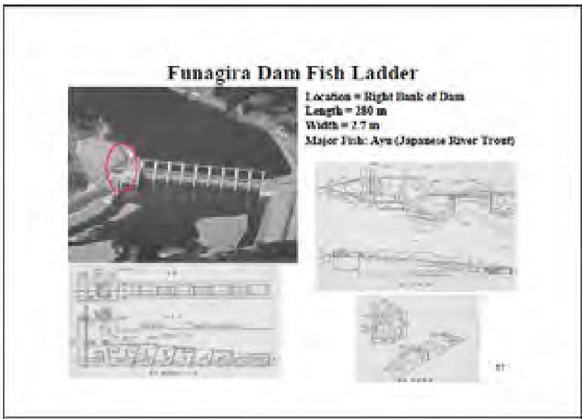


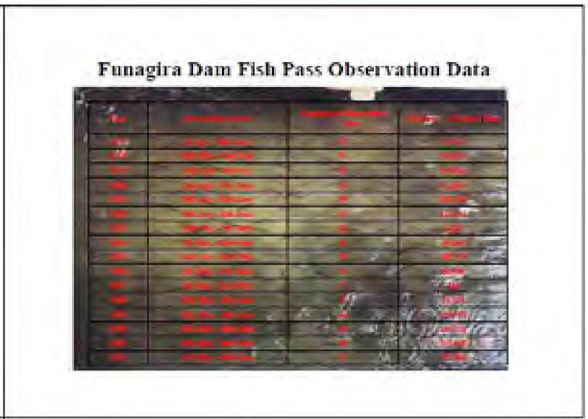


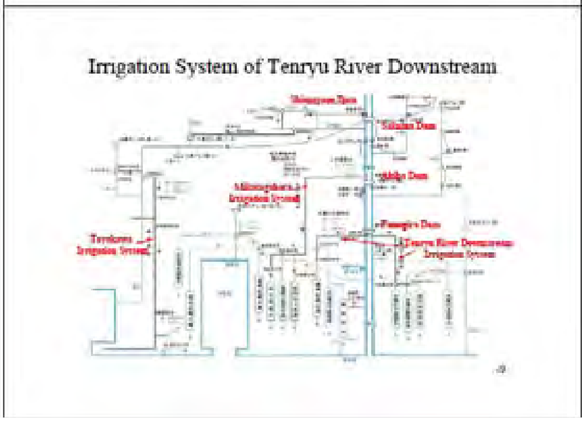


	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Average
Sakuma Dam	7	7	36	46	8	23	20	12	24	12	19
Akiba Dam	21	16	56	74	13	33	34	36	65	100	45
Funagira Dam	32	25	137	125	20	84	36	33	90	125	72




Funagira Dam Fish Ladder
Location = Right Bank of Dam
Length = 280 m
Width = 2.7 m
Major Fish: Ayu (Japanese River Trout)

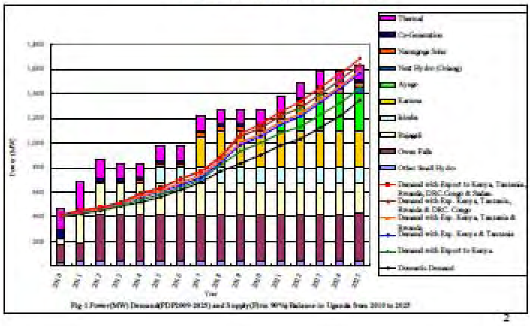

Funagira Dam Fish Pass Observation Data


Irrigation System of Tenryu River Downstream
Funagira Dam
Tenryu River Downstream
Irrigation System

Technical Transfer Seminar
Image Concept of Staging Development of Hydropower Project
July 6 2010
by Masayuki Seino

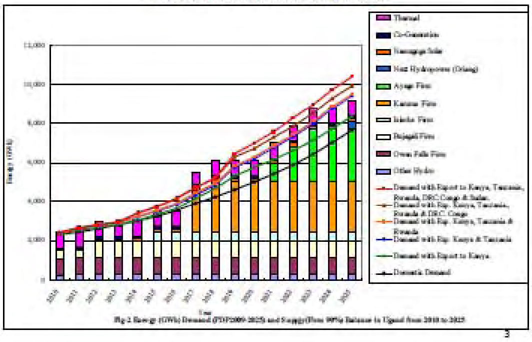
1

Power Balance of Uganda by GDP 2009-2025
50 MW Demand Increase in 1 Year



2

Energy Balance of Uganda by GDP 2009-2025
400 GWh Demand Increase in 1 Year



3

Image Concept of Dam (Regulating Pond) Type Hydropower Project

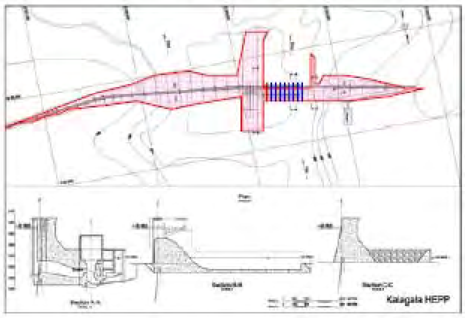


Image Concept of Waterway (Run of River) Type Hydropower Project
Proportion of Dam Construction Cost is Quite Small

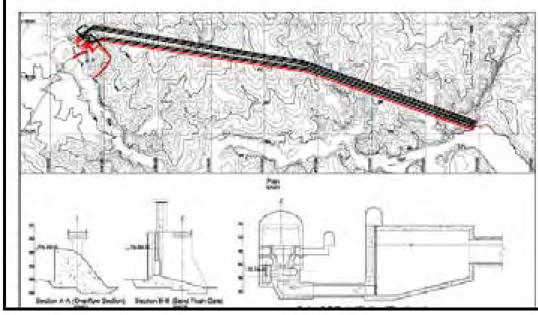
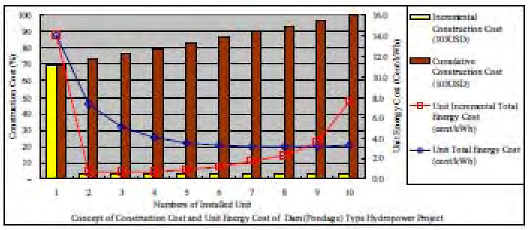


Image Concept for Staging Development of Dam (Regulating Pond) Type Hydropower Project
First unit commissioning needs 70 % of the total construction Cost



Concept of Construction Cost and Unit Energy Cost of Dam(Pondage) Type Hydropower Project

6

Image Concept for Staging Development of Waterway (Run of River) Type Hydropower Project

25 % of the total construction cost is enough for first unit commissioning

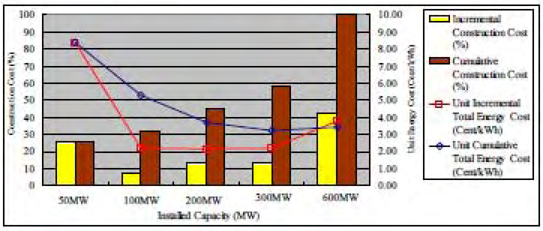


Image Concept for Staging Development of Waterway (Run of River) Type Hydropower Project

25 % of the total construction cost is enough for first unit commissioning

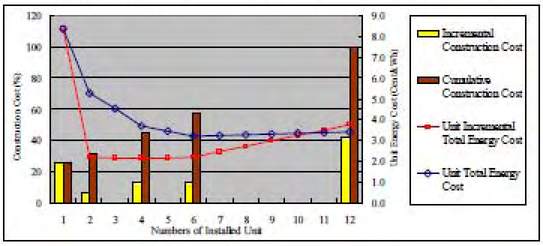


Image Concept of Co-financing Arrangement for first Stage of Staging Development and Full Scale Development

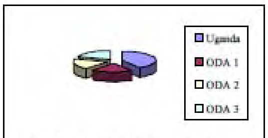


Image Concept of Financial Arrangement for Staging Development of Waterway (Run of River) Type Hydropower Project

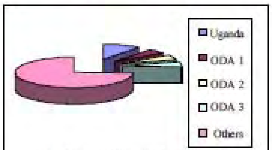


Image Concept of Financial Arrangement for Full Scale Development of Waterway (Run of River) Type Hydropower Project

Image Over View of Development Priority

	K 600MW	A 600MW	K 300MW	A 300MW	K 300MW+ A 300MW
Energy Reliability	B	B	A	A	A
Energy Production	B	B	C	C	A
Construction Cost	E	C	B	A	D
Economics	E	D	C	A	B