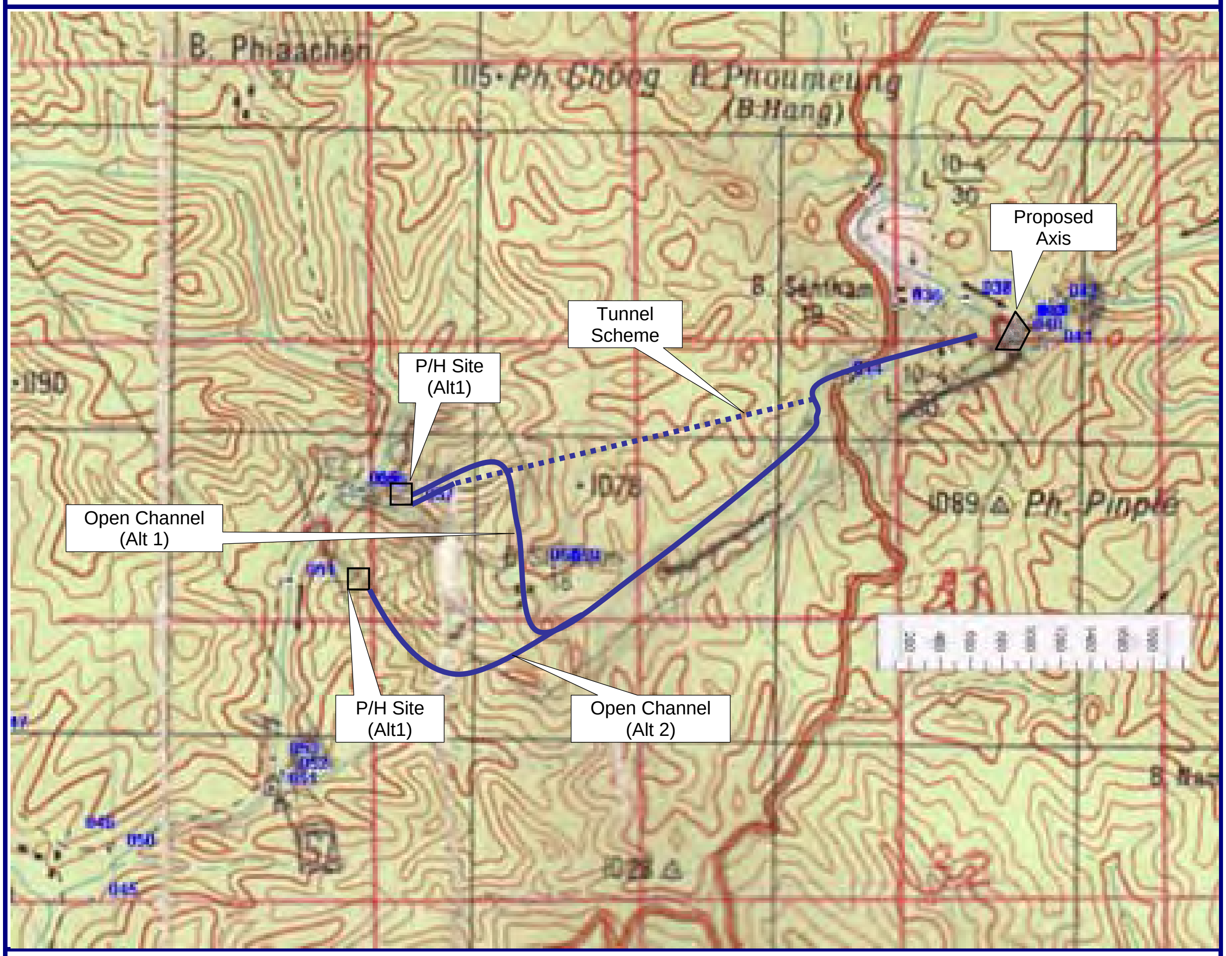
3. SMALL HYDROPOWER PLANNING

Tracing by GPS

Location Map



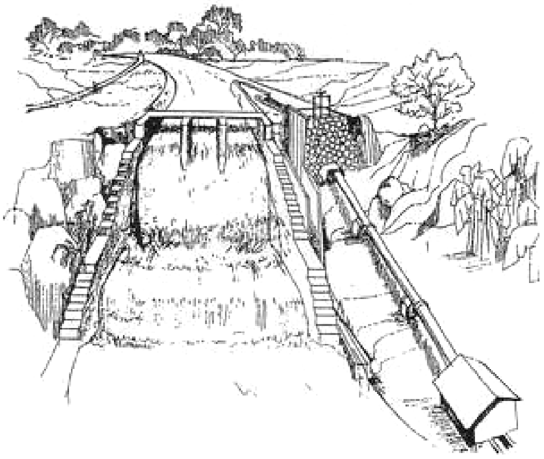
Waypoints

<Intake Site>	<Powerhouse site>
036 Ban Sentham 037, 038 Cross river by foot 039 Original axis 040 Alternative axis 1 (no slope on R/B) 041 Alternative axis 2 (no slope on R/B) 042 D/S side of paddy that extends on L/B 043 Paddy approx 100 m U/S of axis 044 Bridge over road	045 Bridge over river where water will be discharged 046 Village (Ban Somboun?) 050, 051 Farm and paddy along the river 052 Confluence of small river from L/B 053 Existing weir 054 Paddy area 055 Foot of mountain at the valley 056-057 Climb the valley along footpath (L/B of valley)(P/H site to be around this area) 058 Top of mountain 059 Flat land after climbing gentle slope from 058 From 059 to 044 is almost jeepable footpath. There are sugarcane farms along this footpath, and slope is generally gentle.

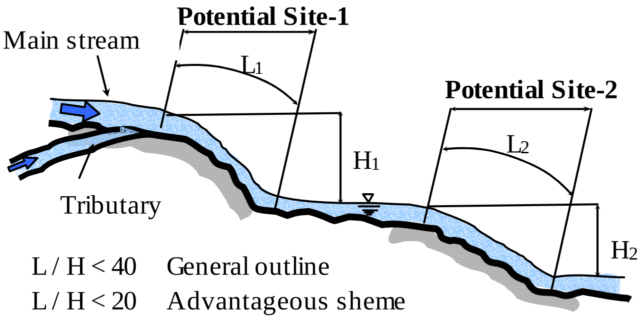
General Layout of Power Facilities

Site Selection

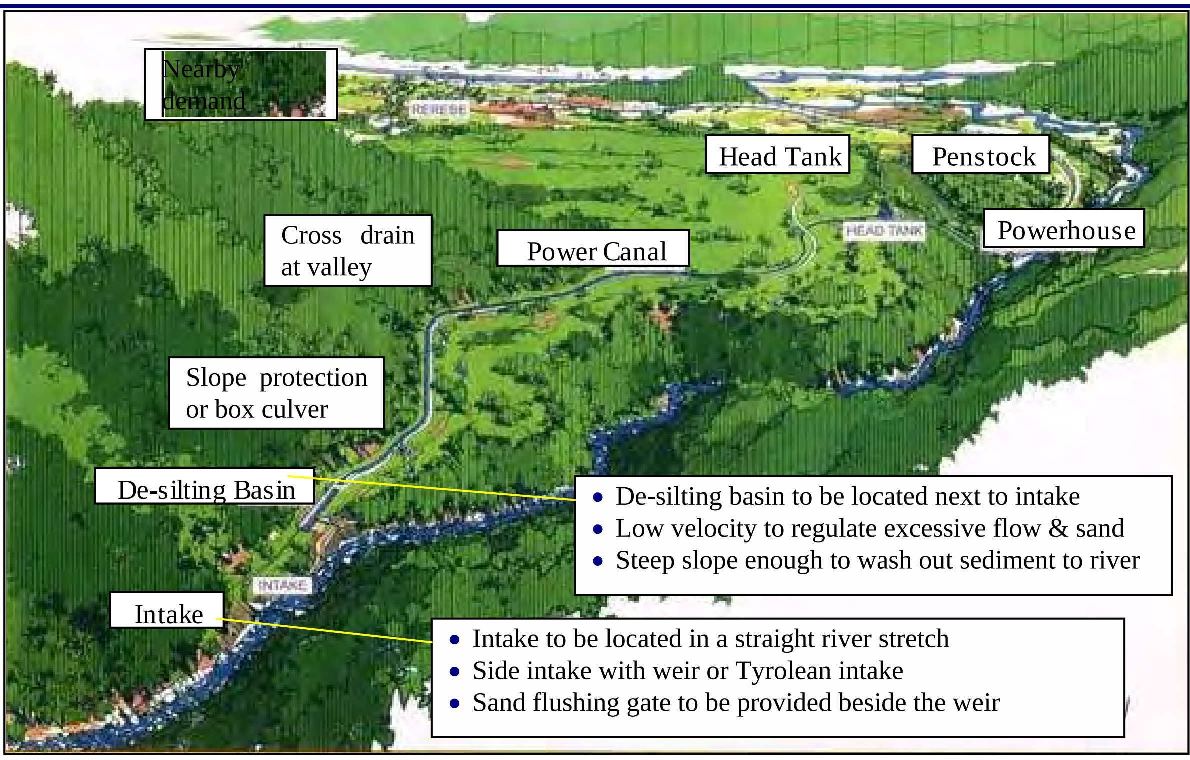
- Discharges are stable even in the dry season.
- Specific discharge ($m^3/sec/km^2$) in the dry season is relatively high.
- (L/H) rate is small.
- Distance from the demand centre is short.



Small/Mini Hydro Utilizing Drops or Falls

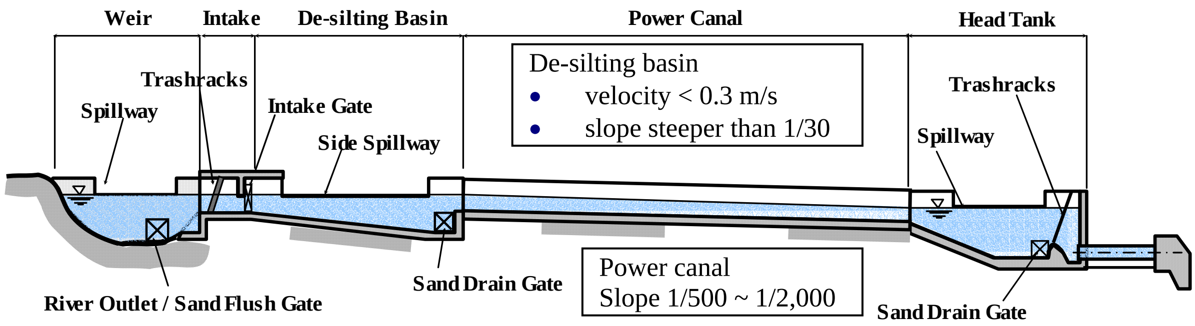


L / H < 40 General outline
L / H < 20 Advantageous sheme
L / H < 15 Excellent scheme
where L : length of waterway
H : head

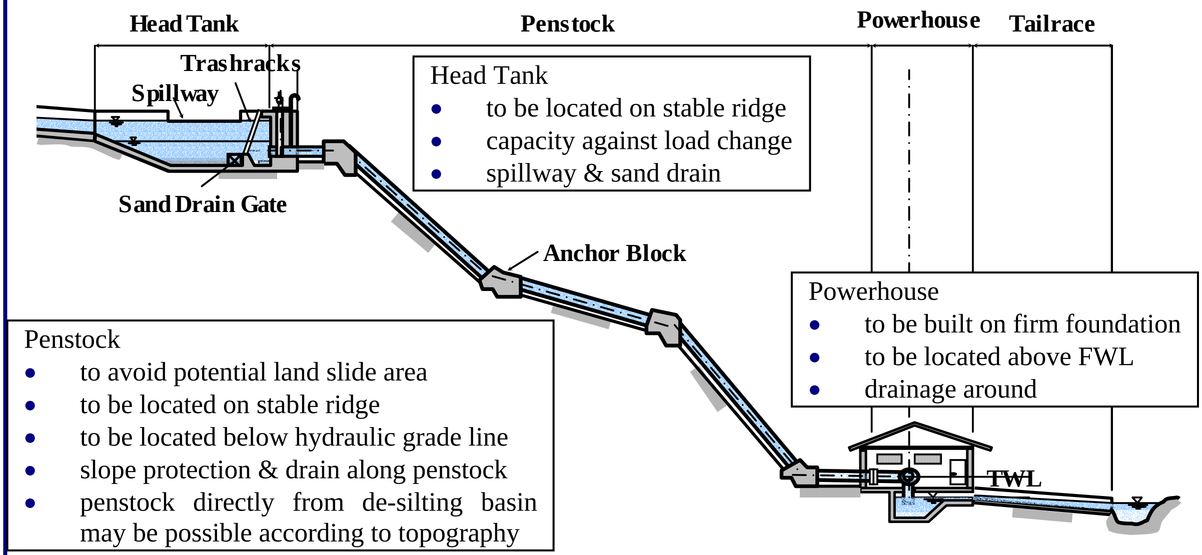


General Layout of Small Hydropower System

General Layout

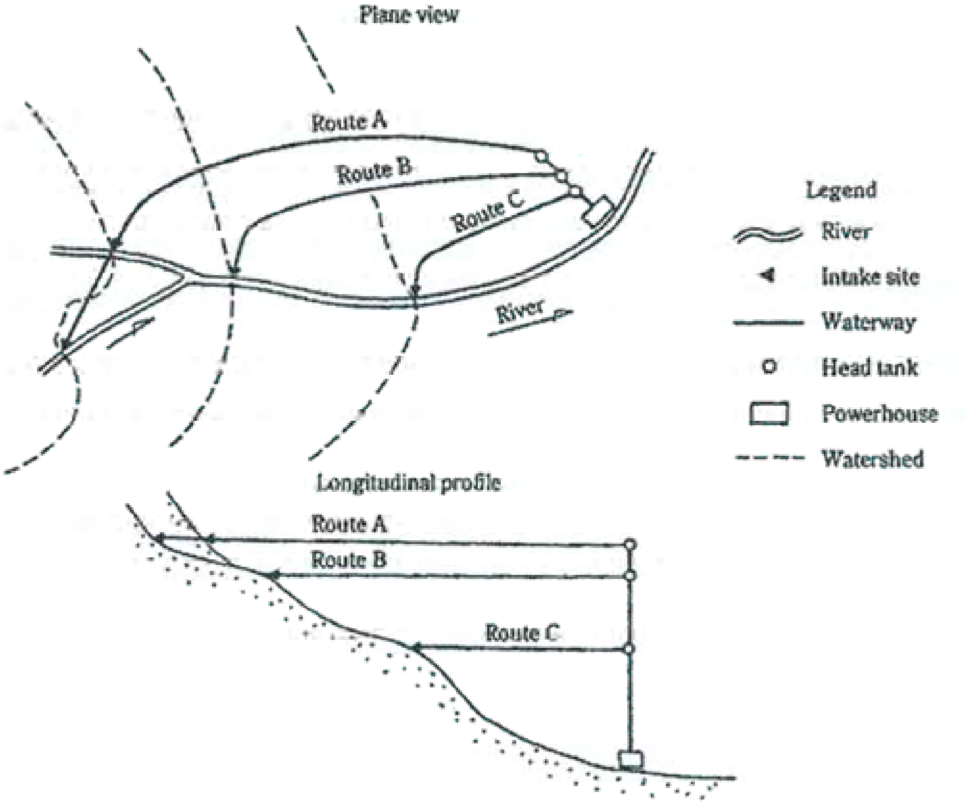


Typical Profile of Open Waterway System



Typical Profile of Waterway System

Selection of Waterway Route

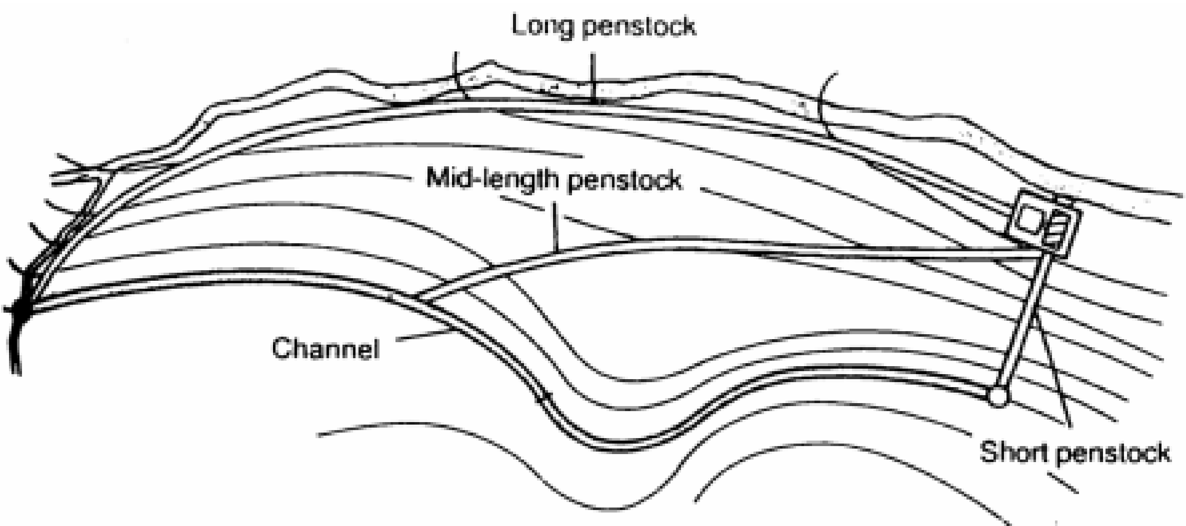


Features of Waterway Routes

Route	Catchment Area	River flow	Head	Waterway length
A	Small	Small	Large	Large
B	Medium	Medium	Medium	Medium
C	Large	Large	Small	Small

Source: Guide Manual for Development Aid Programs and Studies of Hydro Electric Power Projects / New Energy Foundation

Selection of Penstock Route

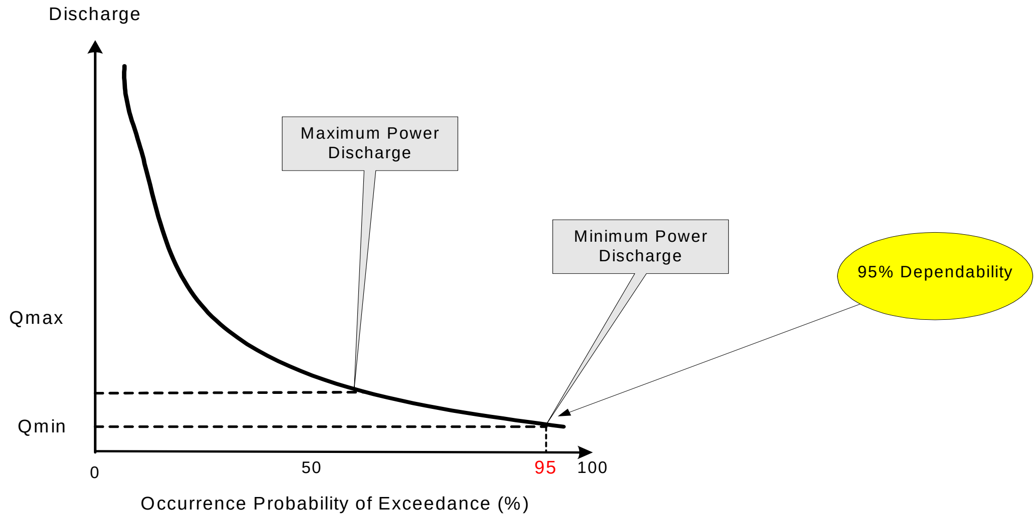


Notice that the channel can be shorted to avoid the risk and expense of construction across a steep slope.

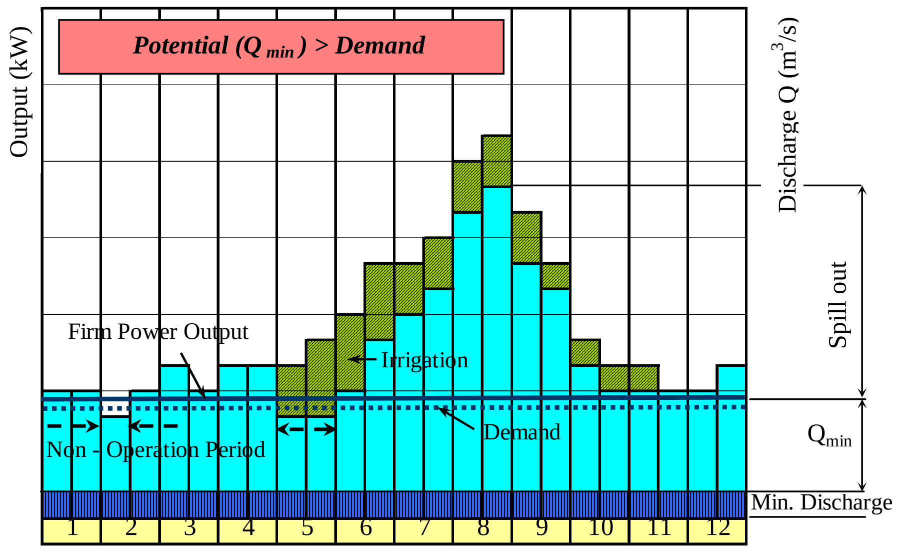
Source: JICA Study Team **Channel and Penstock Option**

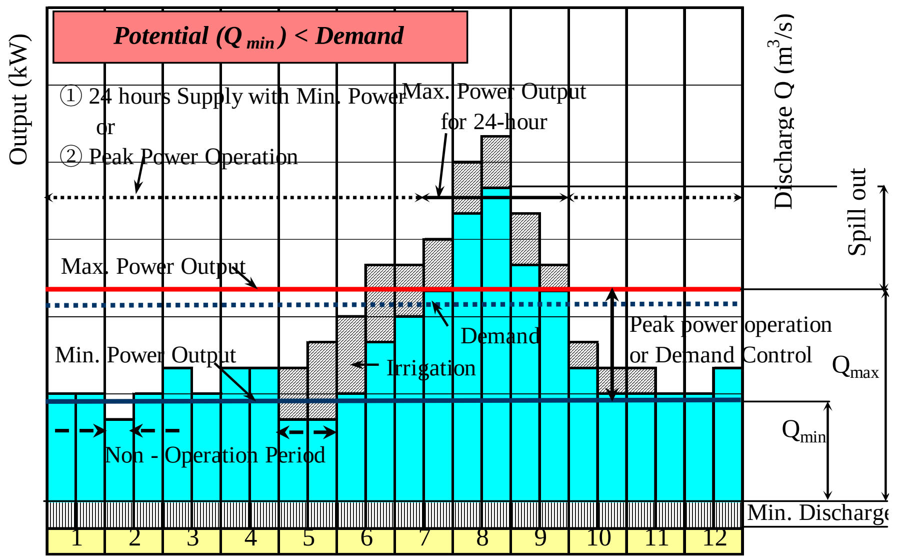
Determination of Design Discharge

Relationship between Maximum Discharge and Minimum Discharge

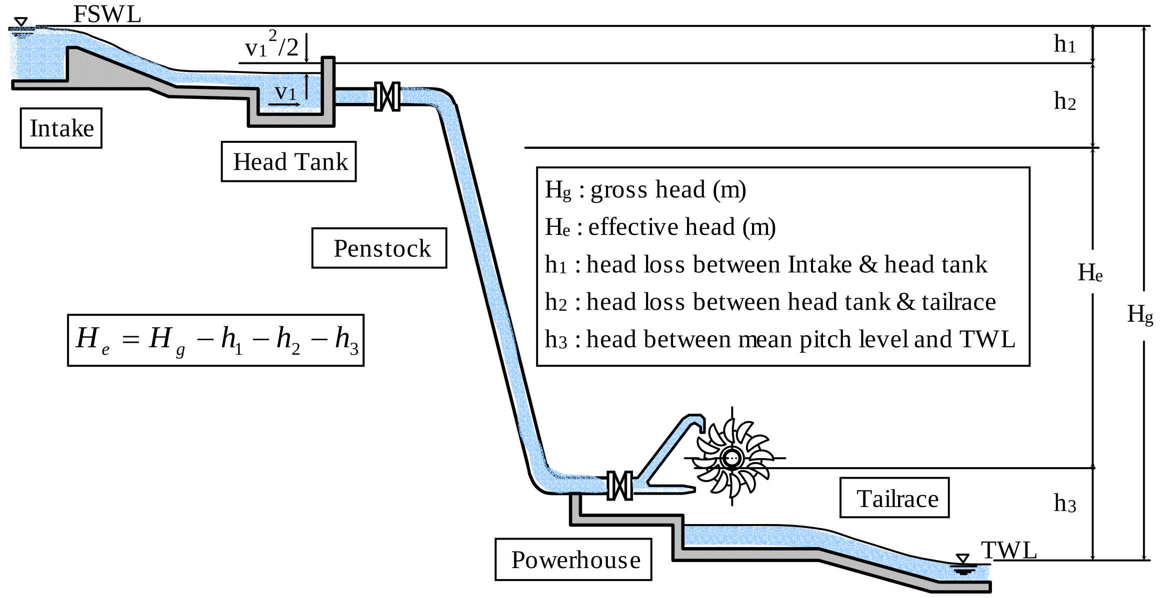


Relationship between Potential Discharge and Demand



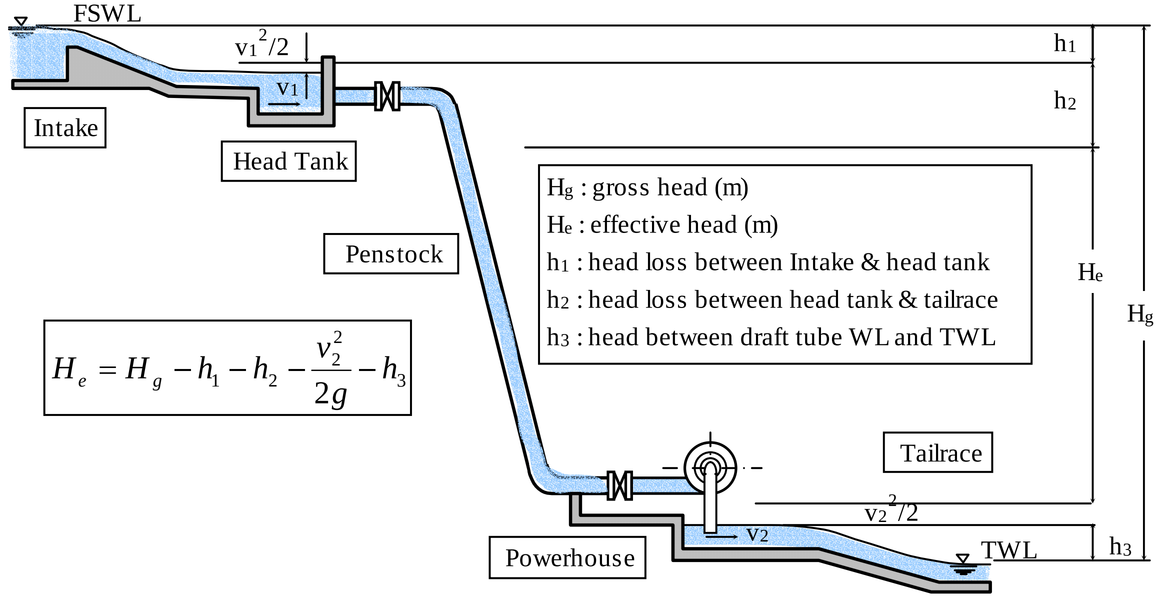


Calculating Head Loss and Effective Head



Source: JICA Study Team

Effective Head for Impulse Turbines

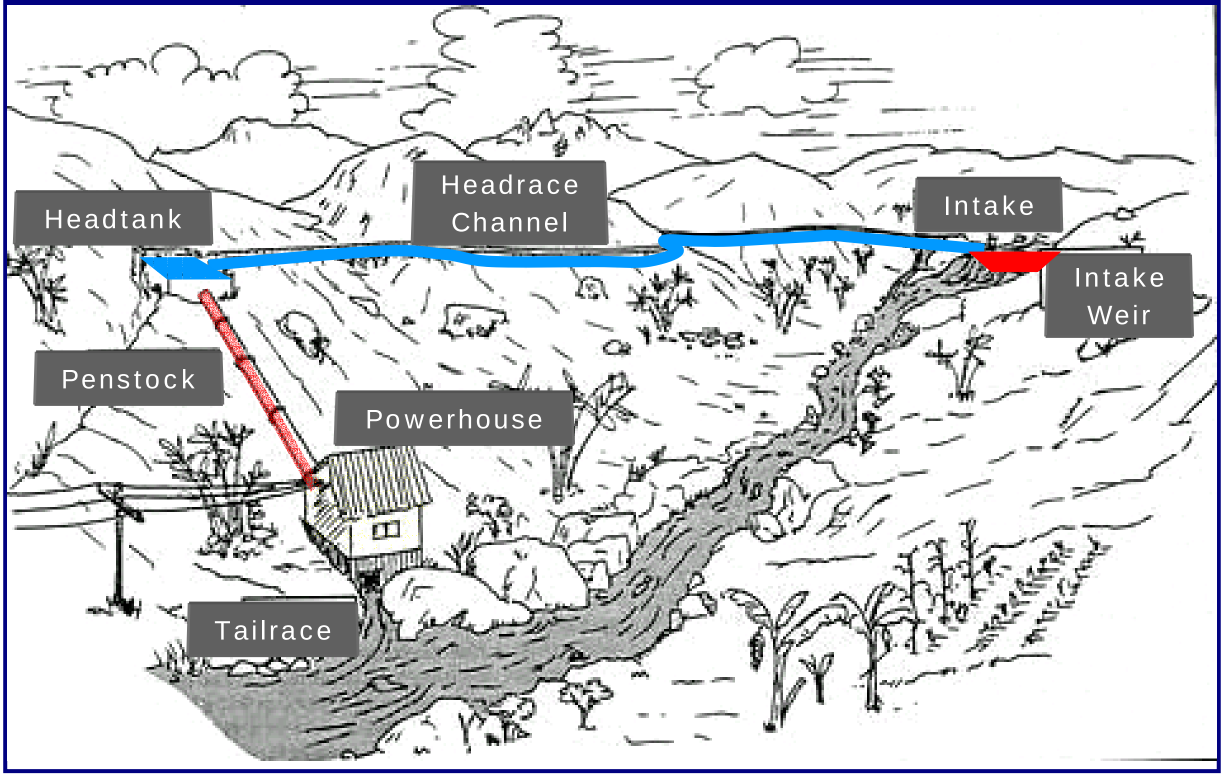


Source: JICA Study Team

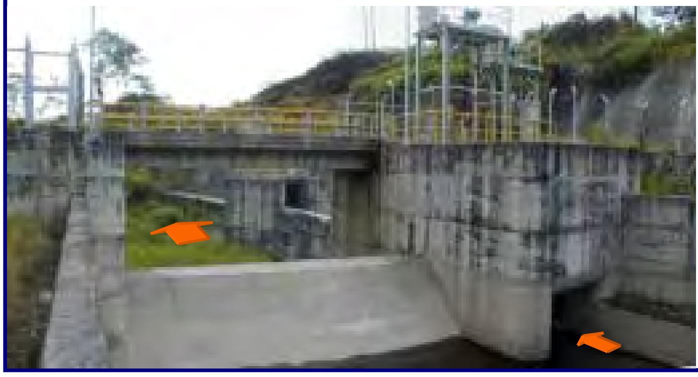
Effective Head for Reaction Turbines

4. DESIGN OF CIVIL STRUCTURES

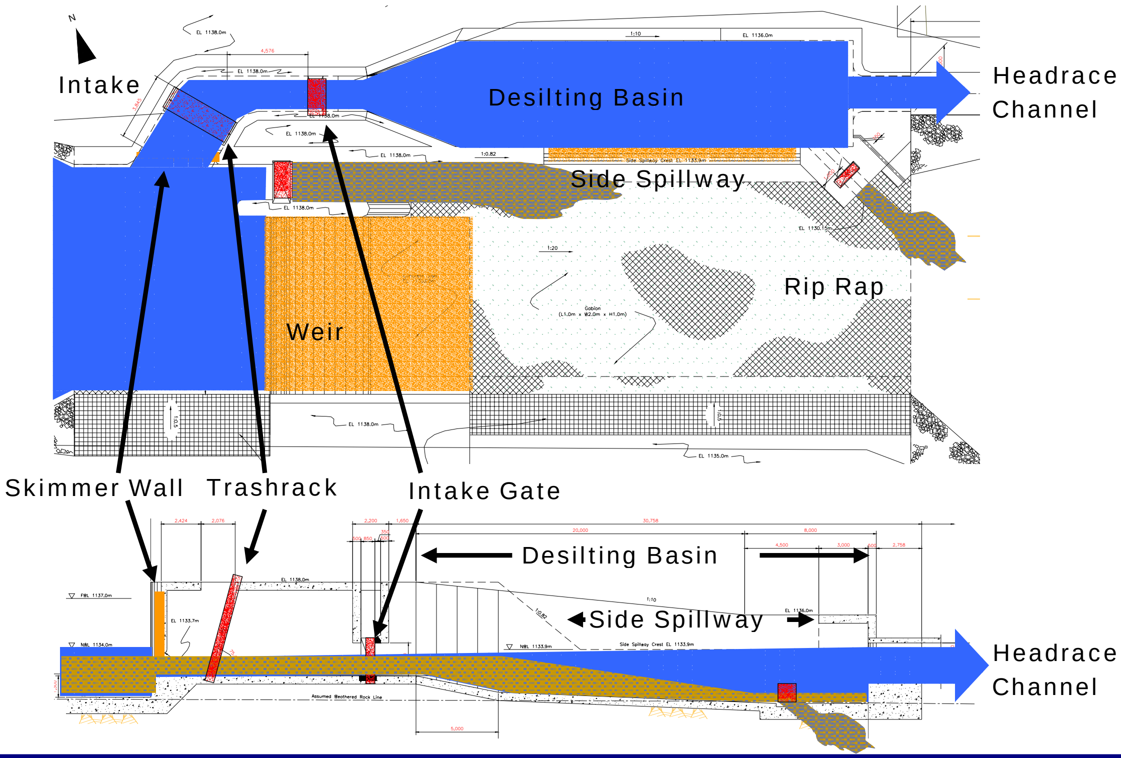
Major Civil Structures



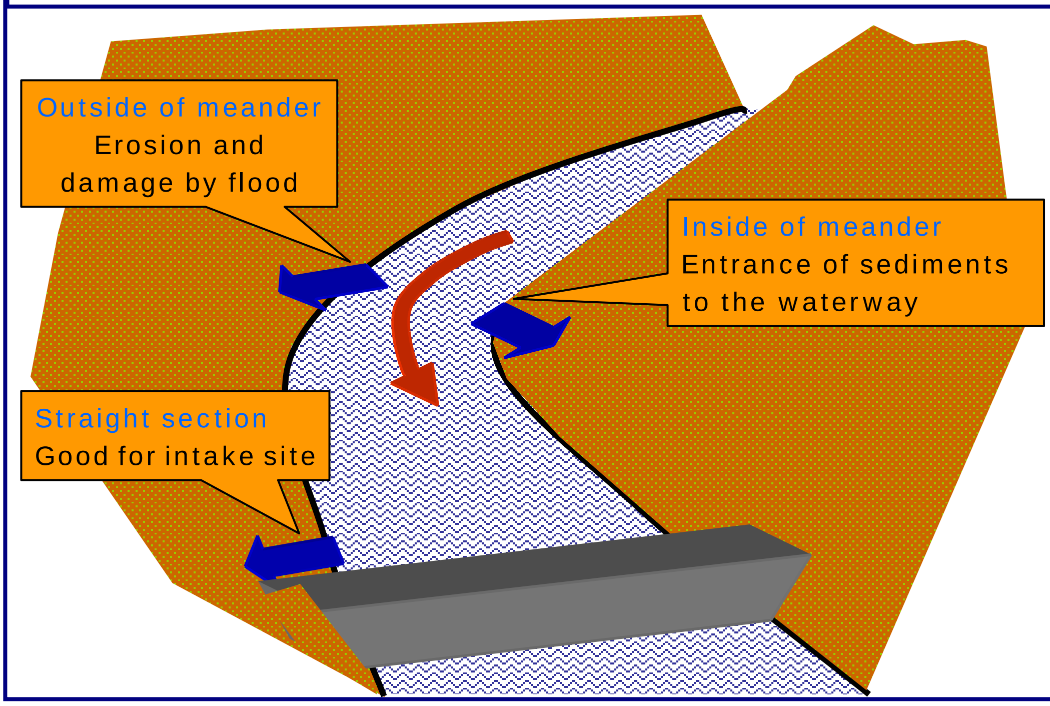
Intake and Desilting Basin



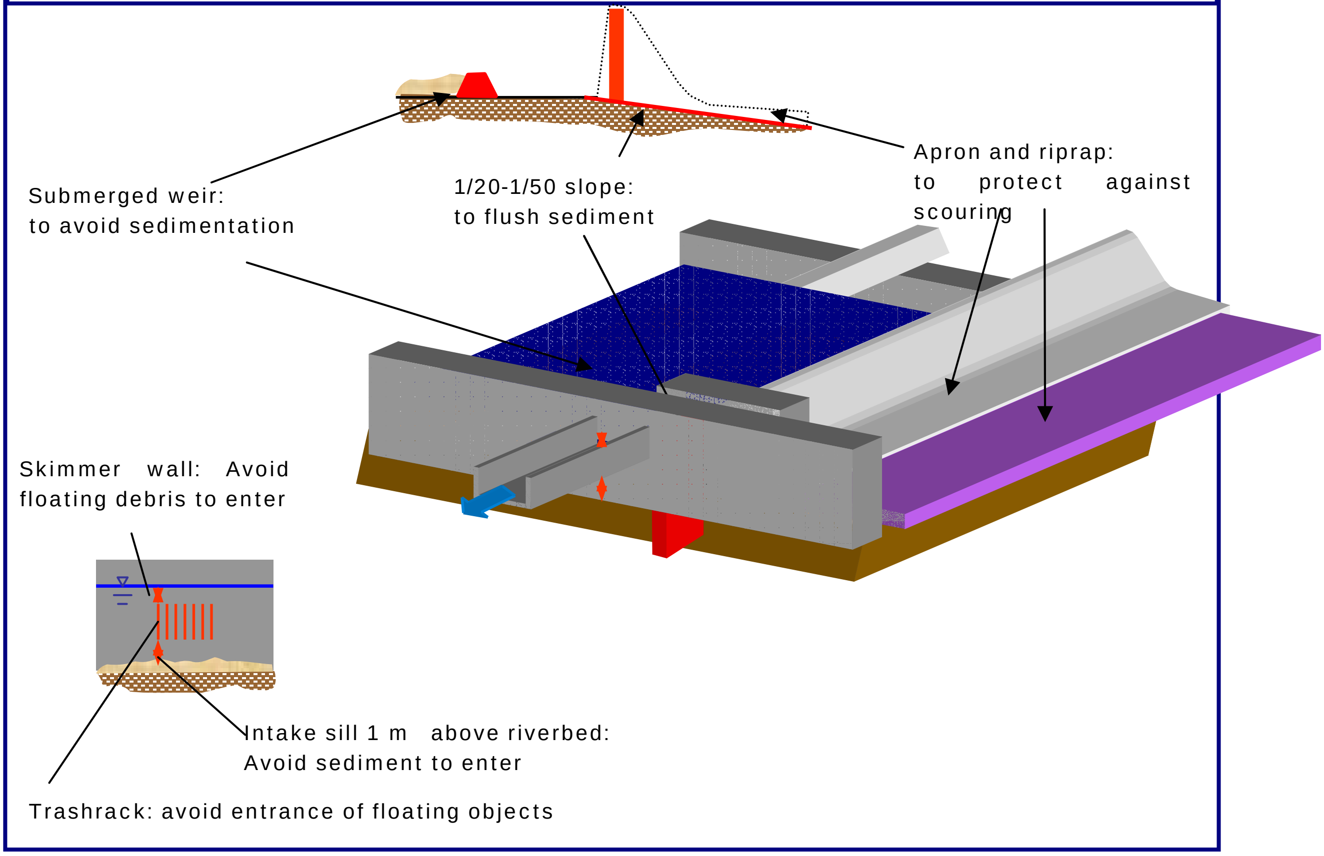
Design of Intake and Desilting Basin



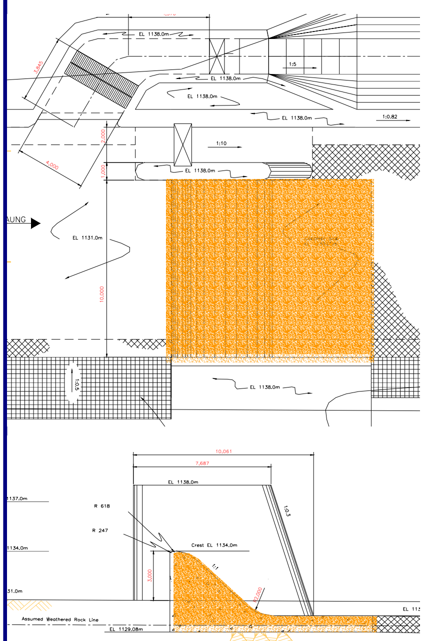
Location of Intake



Intake Design Considerations



Weir - Functions & Considerations



Functions

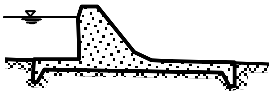
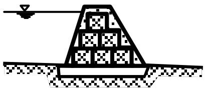
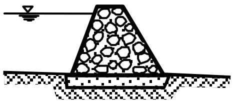
- To secure depth for intake
- To store water

Considerations

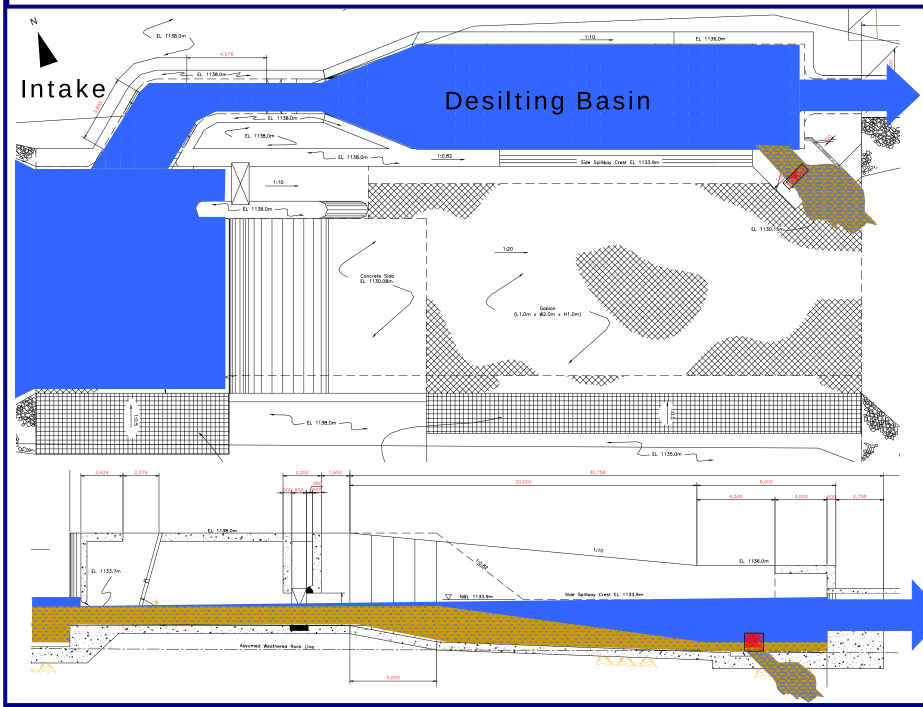
- Weir axis perpendicular to river
- structure to reach rock foundation
- Stability (Overturning, Sliding, Bearing)
- Backwater effect upstream
- Weir protected against erosion
- Apron to avoid scouring

SHAPE ¥* MERGEFORMAT

Weir - Types

Concrete Weir		- Structured on rock foundation - Most common - Durable - High cost
Floating Concrete Weir		- Structured on gravel foundation - Need seepage path - Durable - High cost
Concrete faced Gabion Weir		- Structured on gravel foundation - Surface protected with concrete - Relatively durable - Low cost
Gabion		- Structured on gravel foundation - Sediment between rock forms strong structure - Low cost
Stone Masonry		- Structured on gravel foundation - Low cost

Design of Desilting Basin



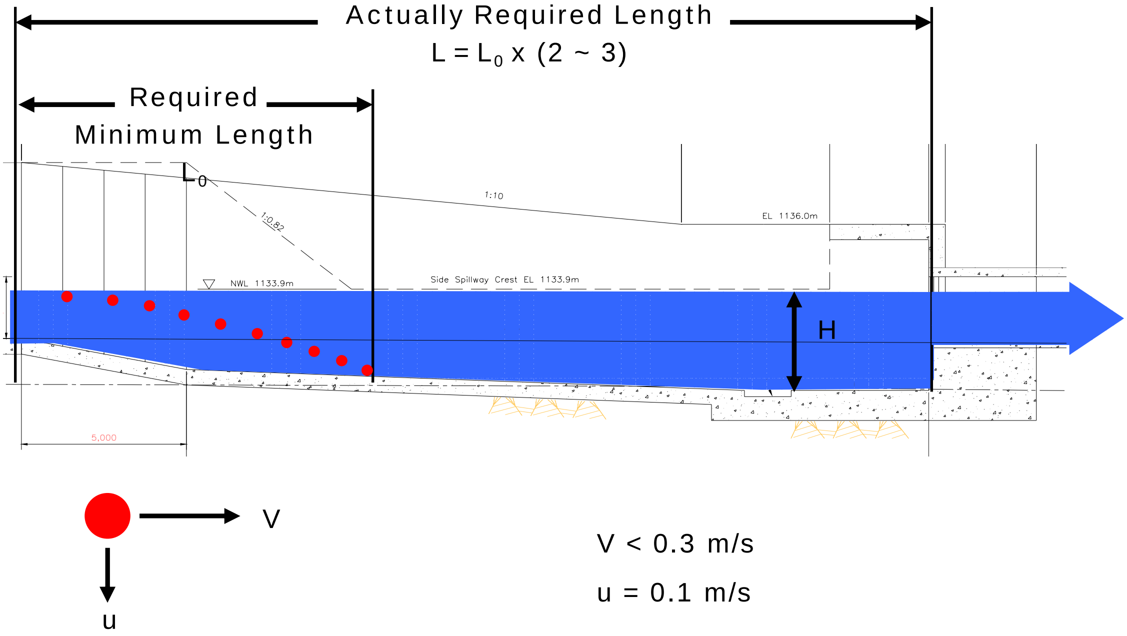
Functions

- To remove sediments
- To spill excess water

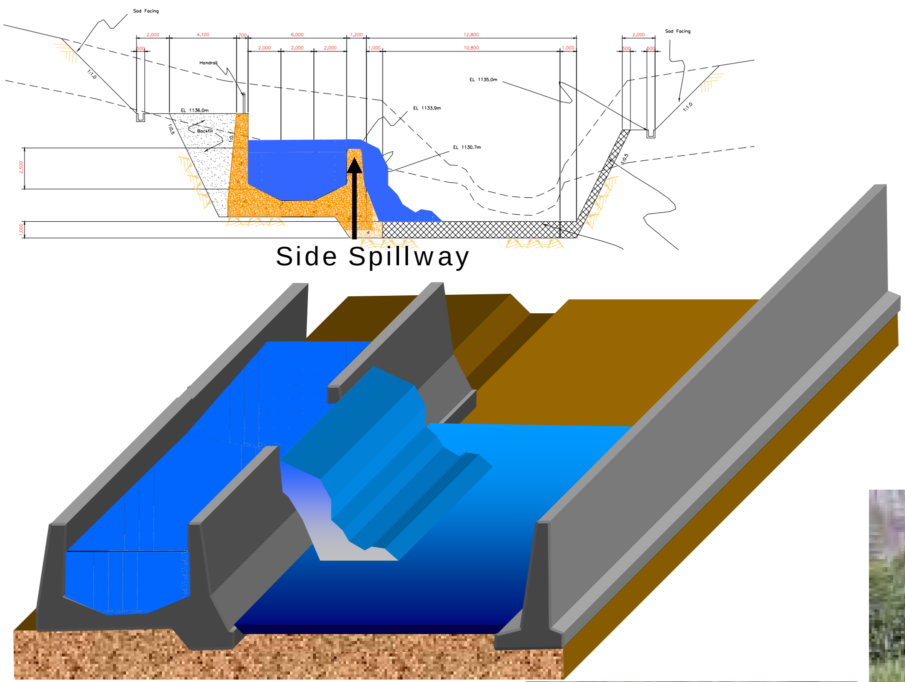
Consideration

- Appropriate length of basin
- Appropriate length of side spillway

Desilting Basin - Required Length



Desilting Basin - Side Spillway



Headrace Channel

Structures

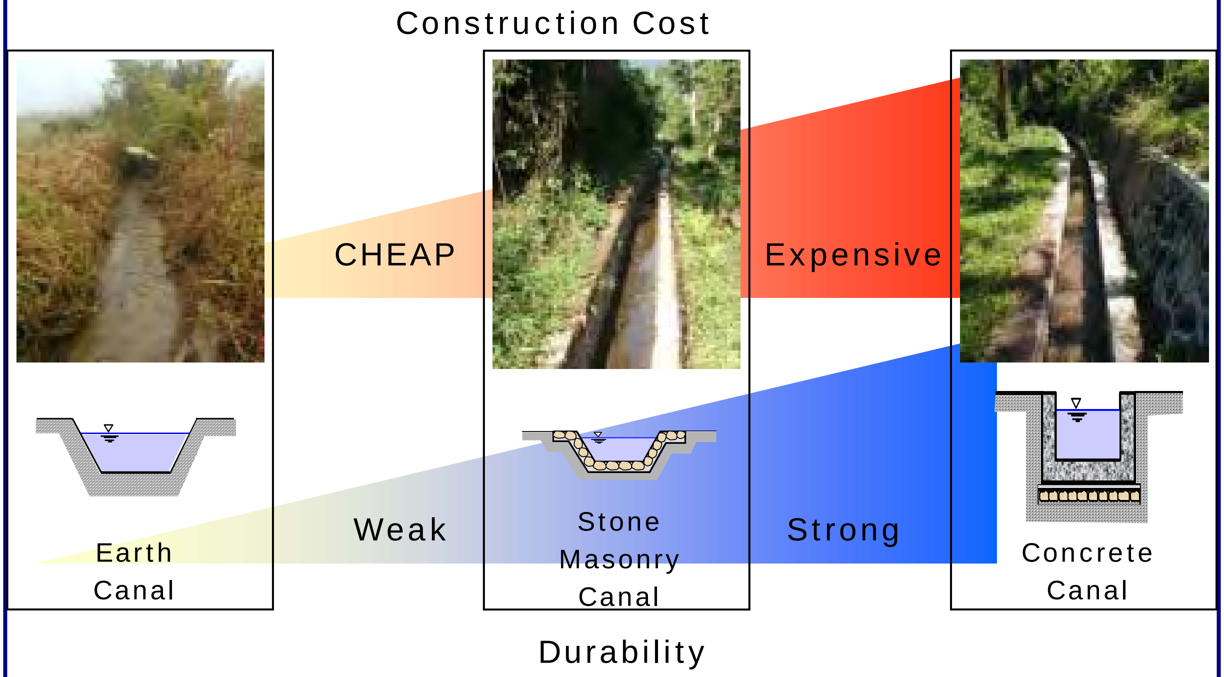
Functions

- To convey water until head tank where there is enough head

Considerations

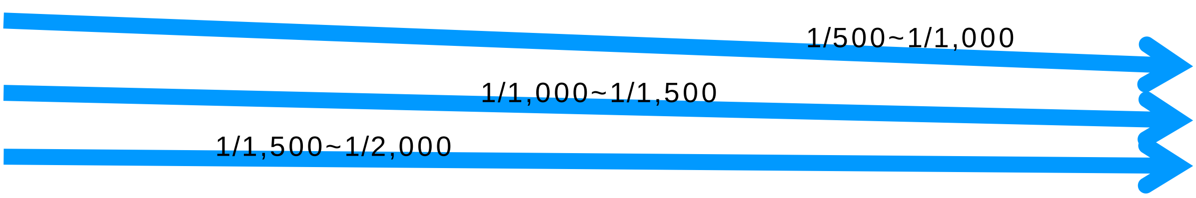
- Avoid steep channel slope so not to waste head
- Avoid passing channel through steep mountain side
- Slow velocity to avoid abrasion of canal
- Attention when crossing valleys

Open Channel Types



Channel Slope (S)

1/500~1/1,000	Channel section can be smaller, but head will be lost Good for high head schemes where loss of head is not critical
1/1,000~1/1,500	General application
1/1,500~1/2,000	Head loss can be reduced, but channel section will be bigger Good for low head schemes where loss of head is critical



Uniform Flow and Channel Section

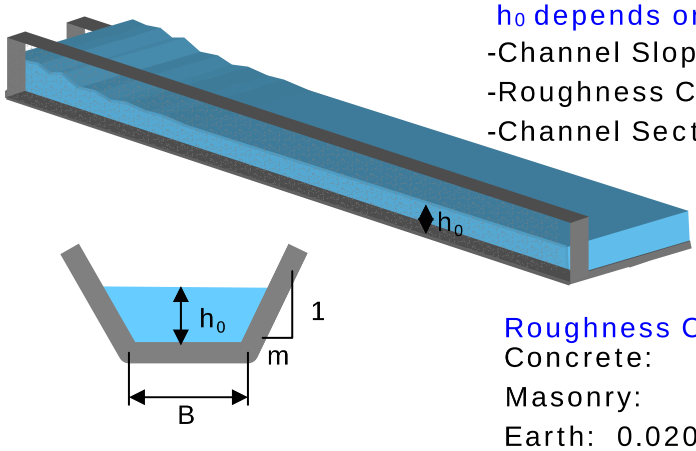
Uniform Depth (h_0) = Water finds its own depth

h_0 depends on:

-Channel Slope (S)

-Roughness Coefficient (n)

-Channel Section



Roughness Coefficient

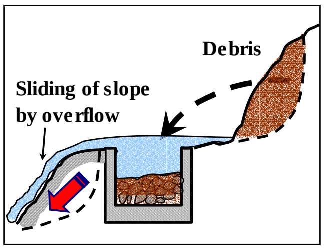
Concrete: 0.013~0.016

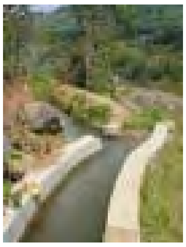
Masonry: 0.016~0.020

Earth: 0.020~0.025

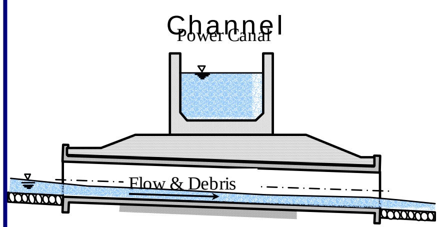
Design and Maintenance Considerations

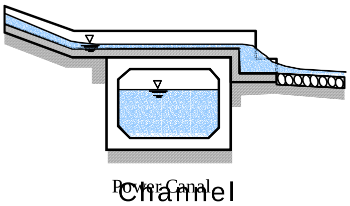
1. Slope Failure





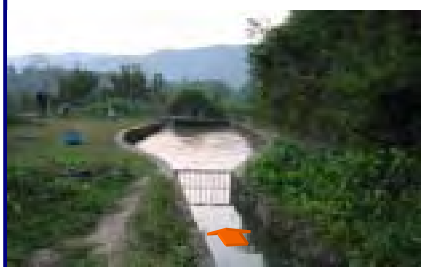
2. Valley Crossing





Head Tank

Functions & Considerations



Functions-1

- To control water flow into penstock
- To remove sediments

Considerations-1

- Enough volume for 2~3 minutes operation without water from canal
- Enough surface area to avoid waves
- Minimum depth to avoid vortex

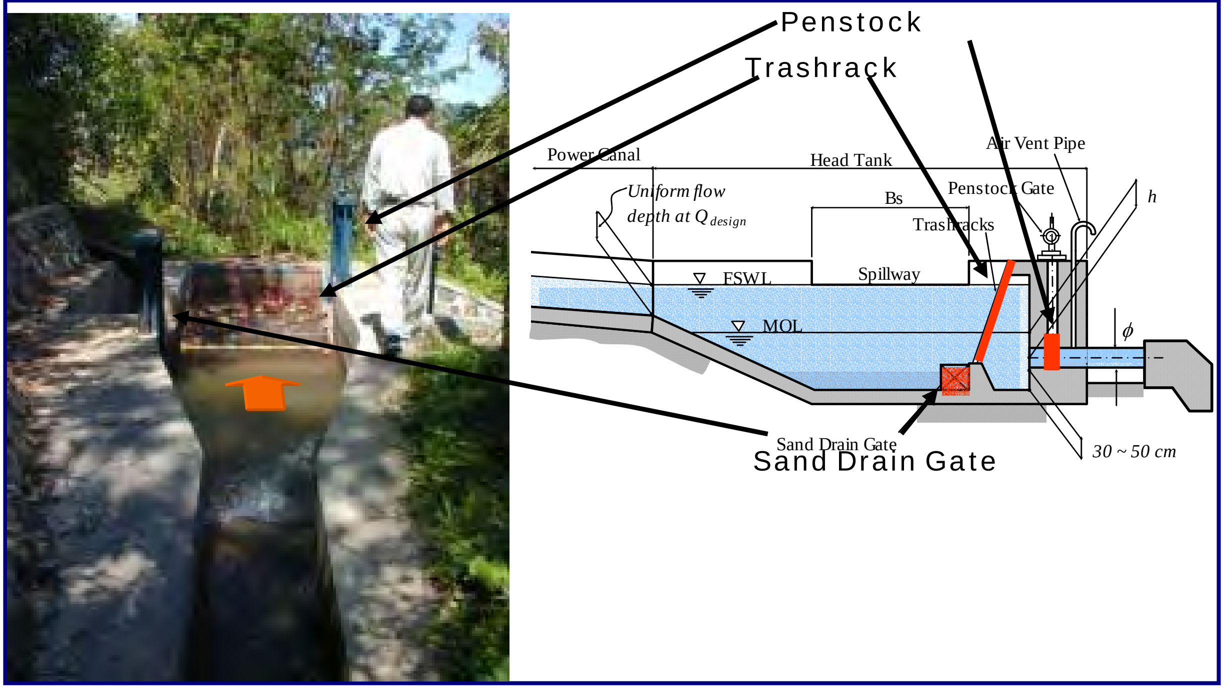
Functions-2

- To store water for peak power

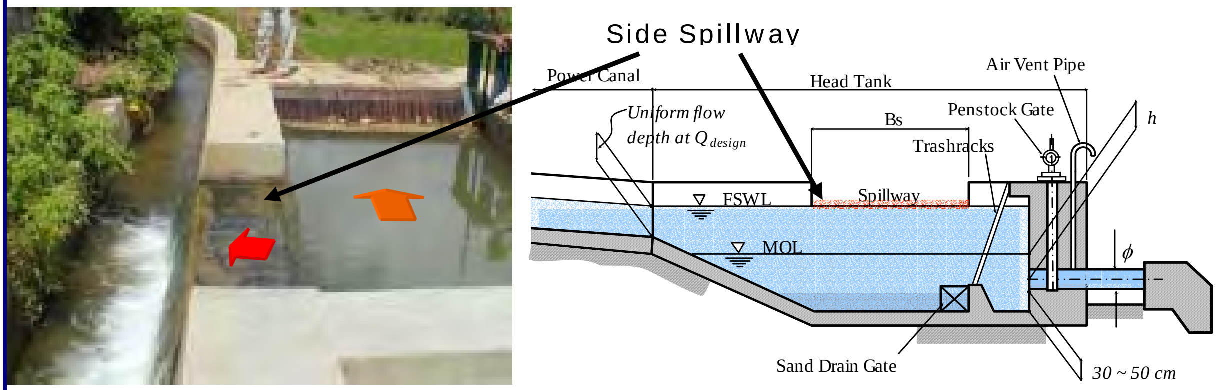
Considerations-1

- Enough volume for peak power

Components



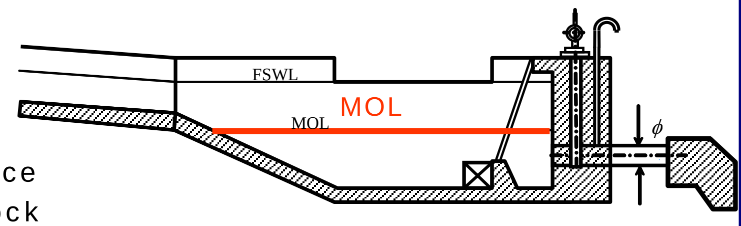
Side Spillway and Minimum Operation Level



WL < MOL

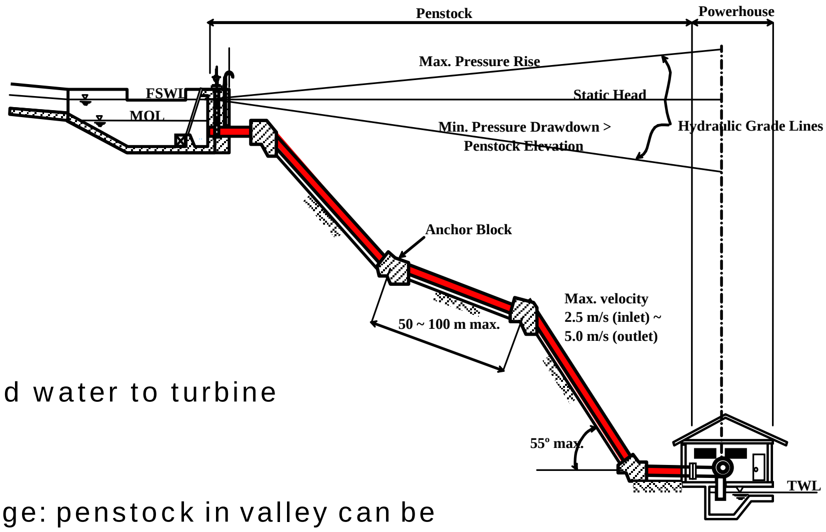
Vortex will form

Leaves and branches on surface will be sucked into the penstock



Penstock

Functions & Considerations



Functions

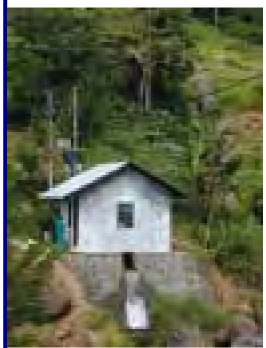
- To convey pressurized water to turbine

Considerations

- Penstock route on ridge: penstock in valley can be washed away
- Optimum diameter: small diameter may result in loss of head; big diameter is expensive
- Avoid long penstocks: expensive

Power Station

Functions & Considerations

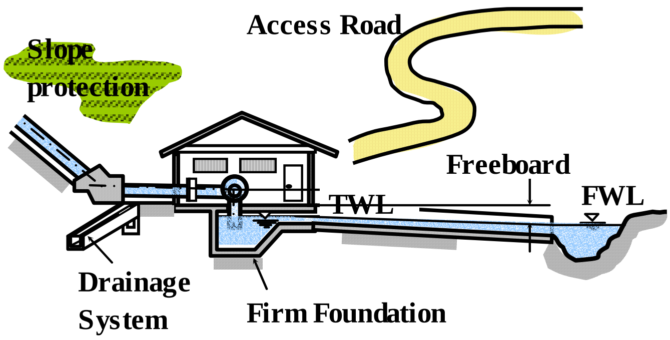


Functions

- To house the turbine and generator

Considerations

- Locate above flood water level (FWL)
- Firm foundation
- Easy access
- Slope protection
- Drainage

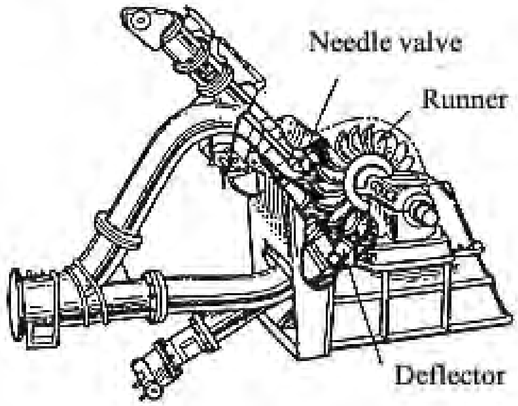


Flooded Powerhouse

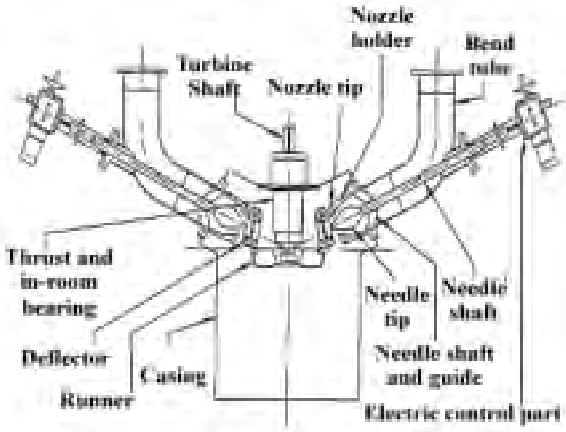
5. DESIGN OF ELECTRIC EQUIPMENT

Type of Turbines

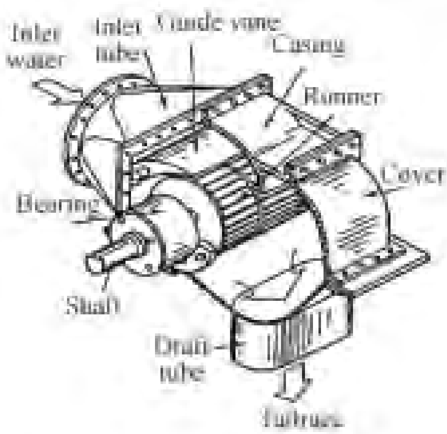
Pelton (H) Turbine



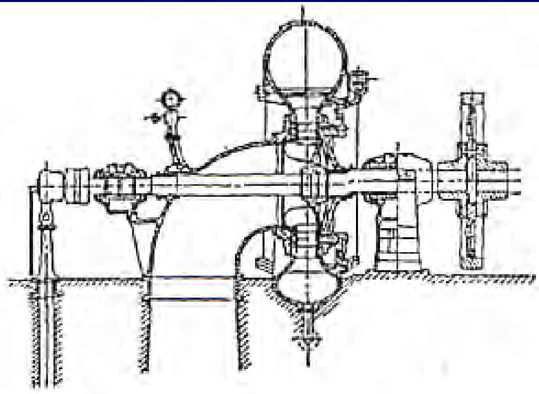
Turgo Impulse Turbine



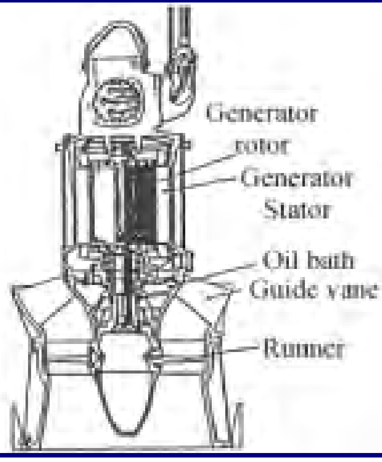
Cross Flow Turbine



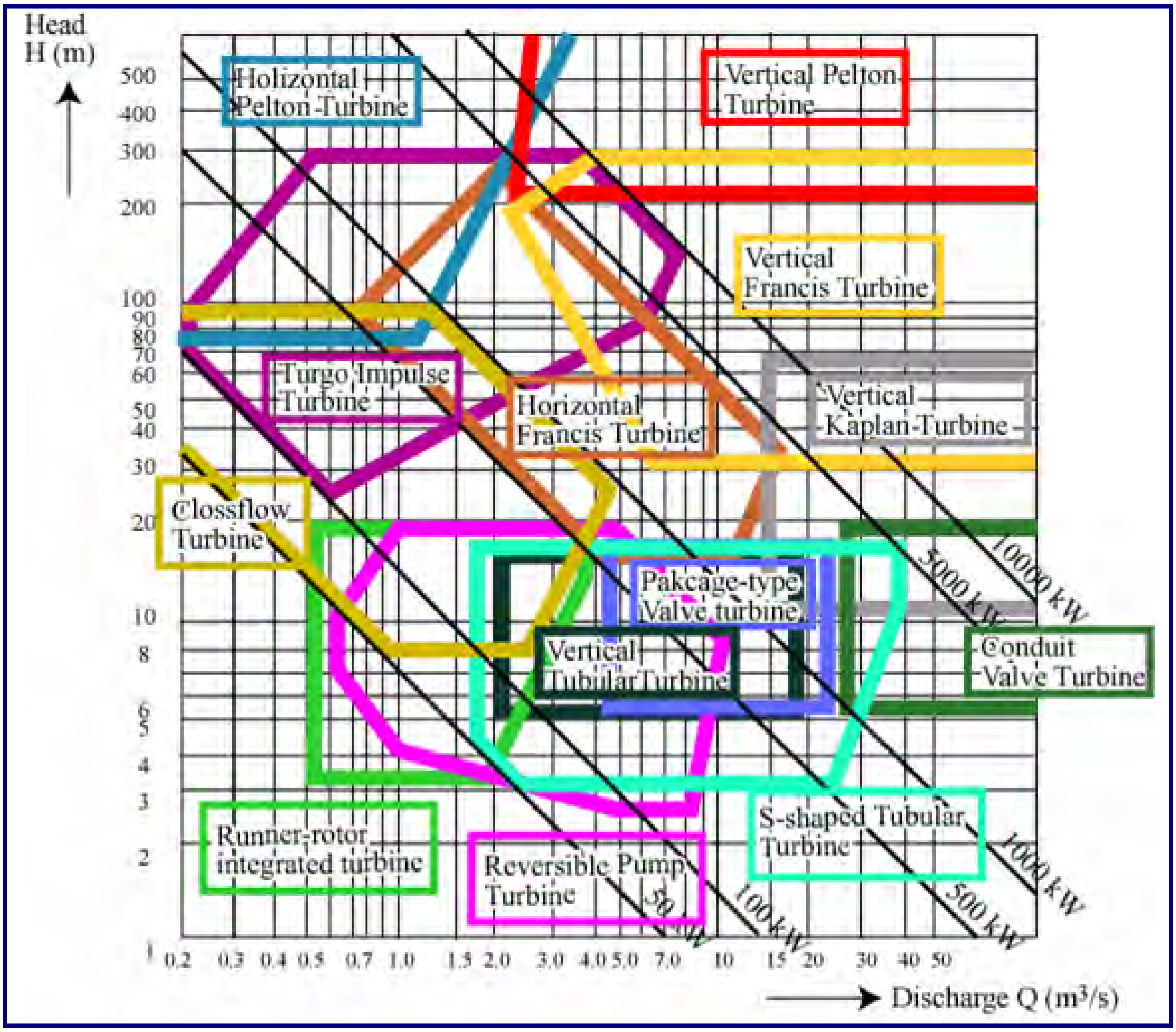
Francis (H) Turbine



Reversible Pump Turbine (Nam Mong 70 kW)



Turbine Selection Diagram



Generator

Synchronous Generator	Induction Generator
	
• Output : kVA	• Output : kW

• Widely Used for Small Hydropower	• Connect to Small Grid less than 1,000 kW • Cheap

Control Unit

1. Governor

- The governor adjusts the water inflow mechanism such as guide vanes, needle valves and deflectors, and controls the water inflow, turbine rotation speed, and output.
- Hydraulic servomotor is used for medium-small scale hydro.
- Electric servomotor is applied for small hydropower.
- For small hydropower less than 200 kW, the Dummy Load Governor may be applied.

Electric Servomotor

2. Integrated Control Panel

- An Integrated Control Panel uses the CPU to perform integrated operations of control, operations of protective equipment, and storage of operation records for the powerhouse.
- It is contained in a small board.

3. Direct Current Power Source Unit

- Batteries with chargers are used as a power source for the operation control and protective relay.
- Alkali batteries adopted more commonly than lead acid batteries.

4. AVR (Automatic Voltage Regulator)

- Control power generation by adjusting the excitation current in the Synchronous Generator.

Inlet Valves

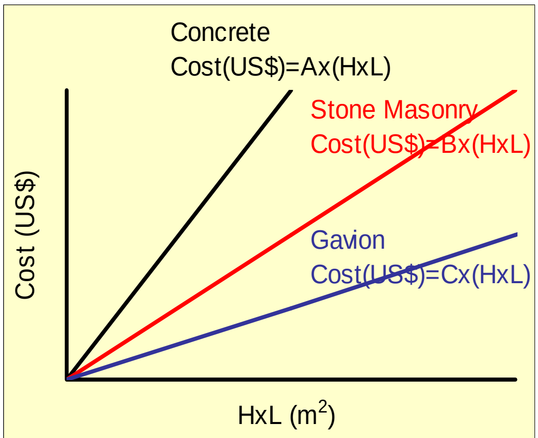
- Shutting off a flow path when the turbine is stopped.
- In this case, the water inflow to the runner is closed off by the preceding operation of the guide vane or the needle.
- Shutting off the water flow when the guide vanes and/or needles cannot be controlled.
- Stopping water flow during the turbine inspection.

Butterfly Valve

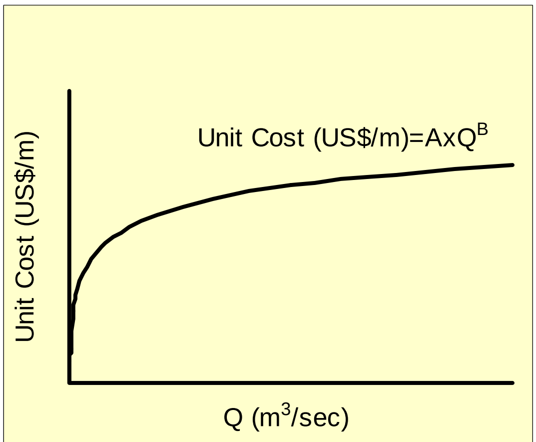
Sluice Valve

6. PRELIMINARY COST ESTIMATE

Cost Estimate at the Map Study Level



Cost Formula for Intake Weir



Cost Formula for Headrace Channel

Main Cost Item	Key Parameter	Cost Formula
Hydropower Generation Plan	Installed Capacity (kW) Design Discharge (m^3/sec) Head (m)	-
Intake Weir	Height of Weir (m), Length of Weir (m)	4,000 US$/$m^2$
Headrace Channel	Design Discharge (m^3/sec), Length of Headrace (m)	Formulas including channel excavation and concrete lining
Head Tank	Design Discharge (m^3/sec)	Formulas including channel excavation, wet masonry and concrete lining
Penstock	Design Discharge (m^3/sec), Length of Penstock (m)	Formulas including concrete works and penstock weight
Powerhouse	Installed Capacity (kW)	40 US$/kW
Turbine and Generator	Installed Capacity (kW)	400 US$/kW
22 kV Transmission Line	Length of Transmission Line (km)	10,000 US$/km
Transformer	No. of Village to be Electrified	6,000 US$/unit
Access Road	Length of Access Road (km)	50,000 US$/km

Reference on the kW Cost for Very Quick Cost Estimate:

It is found that the kW cost made in China varies 3,000 to 6,000 US$/kW.

Existing Small Hydropower Projects in Lao PDR（10 Sites）

No.	Project	Installed Cap. (kW)	Number of Turbine	Cost (US$)	Unit Cost (US$/kW)	Year	District	Province	Turbine Made in
1	Nam Ko	1,500	3x500	9,815,071	6,543	1996	Xai	Oudomxai	China
2	Nam Sam	110	2x55	678,000	6,163	1995	Xamtai	Huaphan	China
3	Nam Peun	60	1x60	1,791,000	29,850	1986	Huamuang	Huaphan	Germany
4	Nam Sipkha	55	1x55	220,030	4,000	-	Kham	Xieng Khouang	China
5	Nam Tien	75	1x75	227,661	3,035	-	Kham	Xieng Khouang	China
6	Nam Chat	100	1x100	366,451	3,665	-	Mot	Xieng Khouang	China
7	Ban Nong	40	1x40	166,467	4,162	1995	Phaxai	Xieng Khouang	China
8	Nam Ka	81	55+26	312,285	3,855	1995	Phaxai	Xieng Khouang	China
9	Houay Kasen	155	155	758,000	4,890	2002	Pakbeng	Oudomxai	China
10	Nam Mong	70	1x70	820,000	11,714	2000	Nam Bak	Louang Prabang	Japan

Cost Estimate at the Pre-feasibility Study Level

Work Items

Components	Work Item
Civil Works (Intake Weir, Intake, Headrace Channel /Tunnel, Head Tank, Penstock, Powerhouse, Tailrace, etc.)	Excavation-common
	Excavation-rock
	Excavation-channel
	Excavation-tunnel
	Concrete
	Gabion
	Wet Masonry
	Miscellaneous
Electro-Mechanical Works (Metal Work, Distribution Work, etc.)	Steel Penstock
	Gate and Trashracks
	Turbine and Generator
	Distribution line
	Transformer and Switchgears
	Miscellaneous

Cost of Work Item

Cost of Work Item = Unit Price x Work Quantity

Unit Price Table for the M/P Study on Small Hydropower in Northern Laos

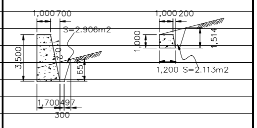
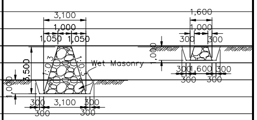
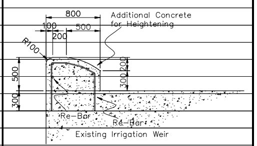
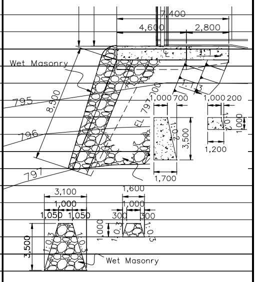
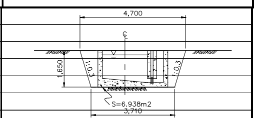
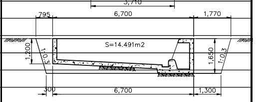
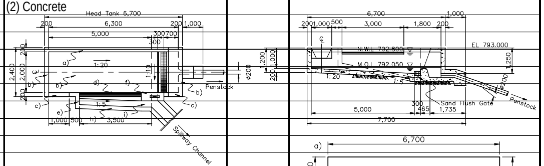
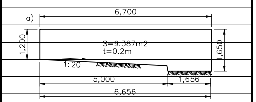
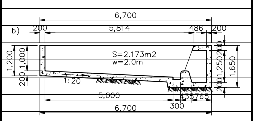
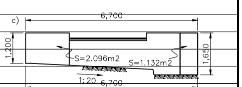
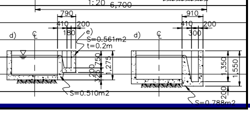
Work Item	Unit Price Table			Remarks
Excavation-common	V_E	US$/m^3	1.50	
Excavation-rock	V_E	US$/m^3	4.50	
Excavation-channel	V_E	US$/m^3	2.00	
Excavation-tunnel	V_E	US$/m^3	50.00	
Concrete	V_C	US$/m^3	220.00	Incl. Re-bar & Form
Wet Masonry	V_C	US$/m^3	70.00	
Gabion	V_C	US$/m^3	70.00	
Gate	W_G	US$/ton	6,000.00	
Screen	W_S	US$/ton	3,000.00	
Penstock	W_P	US$/ton	4,000.00	
Turbine & Generator	E	US$/ton	4,000.00	

BILL OF QUANTITY

No.	Work Item	unit	Q'ty	unit price (US$)	Amount (US$)
1.	**Civil Works**				
1.1	**Intake Weir**				
	Excavation-common	m^3		1.50	
	Excavation-rock	m^3		4.50	
	Concrete	m^3		220.00	
	Gabion	m^3		70.00	
	Sub-total				
1.2	**Intake**				
	Excavation-common	m^3		1.50	
	Excavation-rock	m^3		4.50	
	Concrete	m^3		220.00	
	Sub-total				
1.3	**De-silting Basin**				
	Excavation-common	m^3		1.50	
	Excavation-rock	m^3		4.50	
	Concrete	m^3		220.00	
	Sub-total				
1.4	**Headrace Channel or Tunnel**				
	Tunnel Excavation	m^3		50.00	
	Channel Excavation	m^3		2.00	
	Concrete	m^3		220.00	
	Wet Masonry	m^3		70.00	
	Sub-total				
1.5	**Head Tank (Surge Tank)**				
	Excavation-common	m^3		1.50	
	Excavation-rock	m^3		4.50	
	Concrete	m^3		220.00	
	Sub-total				
1.6	**Spillway**				
	Excavation-common	m^3		1.50	
	Excavation-rock	m^3		4.50	
	Concrete	m^3		220.00	
	Sub-total				
1.7	**Penstock**				
	Excavation-common	m^3		1.50	
	Excavation-rock	m^3		4.50	
	Concrete	m^3		220.00	
	Sub-total				
1.8	**Powerhouse**				
	Excavation-common	m^3		1.50	
	Excavation-rock	m^3		4.50	
	Concrete	m^3		220.00	
	Sub-total				
1.9	**Tailrace**				
	Excavation-channel	m^3		2.00	
	Concrete	m^3		220.00	
	Wet Masonry	m^3		70.00	
	Sub-total				
1.10	**Access Road**	km		10,000.00	
1.11	**Miscellaneous**	%	30		
	Total of Civil Works				
2.	**Steel Penstock**	ton		3,000.00	
3.	**Gate and Trashracks**	ton		1,500.00	
4.	**Turbine & Generator**	L.S.			
5.	**Transformer and Switchgears**	L.S.			
6.	**Distribution Lines**	km			
7.	**E&M Miscellaneous (2 ~ 6)**	%	10		
	Total of E&M Works				
8.	**Administration & Engineering Fee**	%	15		
	GRAND TOTAL				

Example of Cost Estimate at Pre-Feasibility Study Stage

Example of Quantity Calculation

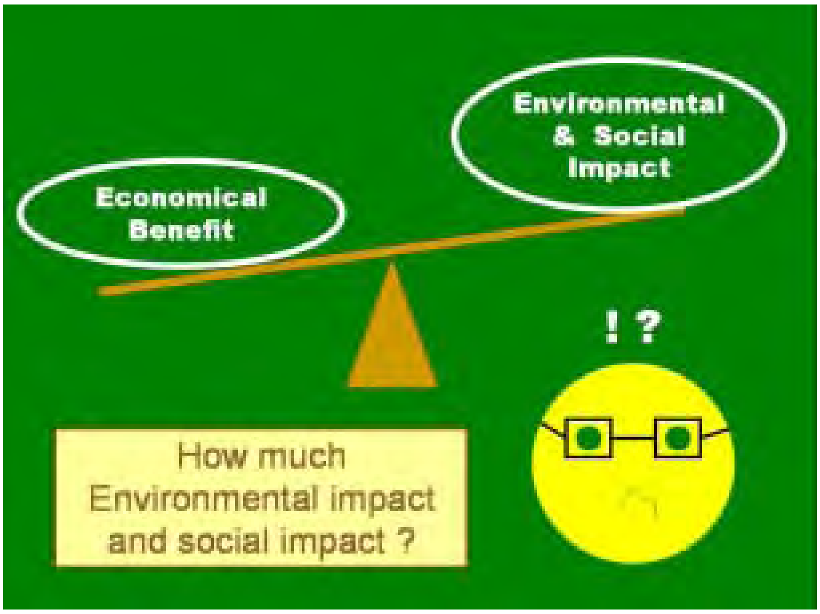
No.	Work Item	Q'ty	Remarks
1.	Civil Works		
1.1	Intake Weir		
	(1) Excavation		
	(Excavation for Gravity Retaining Wall)		
	Area = 2.906 m^2		
	Length = 4.6 m		
	Volume = 2.906 x 4.6 =	13.368	
	Aver. Area = (2.906 + 2.113) / 2 = 2.5095 m^2		
	Length = 2.8 m		
	Volume = 2.5095 x 2.8 =	7.027	
	(Excavation for Wet Masonry Wall)		
	Max Area = (3.7 + 4.3) x 1.0 / 2 = 4.0 m^2		
	Min Area = (2.2 + 2.8) x 1.0 / 2 = 2.5 m^2		
	Aver. Area = (4.0 + 2.5) / 2 = 3.25 m^2		
	Length = 8.5 + 40.0 = 48.5 m		
	Volume = 3.25 x 48.5 =	157.625	
	Sub-total	178.019	
	(2) Concrete		
	(Additional Concrete for Heightening)		
	Area = 0.362 m^2		
	Length = 18.3 m		
	Volume = 0.362 x 18.3 =	6.625	
	Sub-total	6.625	
	(3) Wet Masonry		
	(Gravity Retaining Wall for Right Embankment)		
	Area = (1.0 + 1.7) x 3.5 / 2 = 4.725 m^2		
	Length = 4.6 m		
	Volume = 4.725 x 4.6 =	21.735	
	Min Area = (1.0 + 1.2) x 1.0 / 2 = 1.100 m^2		
	Aver. Area = (1.100 + 4.725) / 2 = 2.9125 m^2		
	Length = 2.8 m		
	Volume = 2.9125 x 2.8 =	8.155	
	Max Area = (1.0 + 3.1) x 3.5 / 2 = 7.175 m^2		
	Min Area = (1.0 + 1.6) x 1.0 / 2 = 1.300 m^2		
	Aver. Area = (7.175 + 1.300) /2 = 4.2375 m^2		
	Length = 8.5 + 40.0 = 48.5 m		
	Volume = 4.2375 x 48.5 =	205.519	
	Sub-total	235.409	
1.4	Headtank		
	(1) Excavation		
	a)		
	Area = 6.938 m2		
	Length = 6.7 m		
	Volume =6.938 x 6.7 =	46.485	
	b)		
	Area = 14.491 m2		
	Width = 2.4 m		
	Volume =14.491 x 2.4 =	34.778	
	Sub-total	81.263	
	(2) Concrete 		
	a)		
	Area = 9.387 m^2		
	Thickness = 0.2 m		
	Volume = 9.387 x 0.2 =	1.877	
	b)		
	Area = 2.173 m^2		
	Thickness = 2.0 m		
	Volume = 2.173 x 2.0 =	4.346	
	c)		
	Area = 2.096 + 1.132 = 3.228 m^2		
	Thickness = 0.2 m		
	Volume = 3.228 x 0.2 =	0.646	
	d)		
	Min Area = 0.510 m^2		
	Max Area = 0.788 m^2		
	Aver. Area = 0.649 m^2		
	Length = 3.0 m		
	Volume = 0.649 x 3.0 =	1.947	

Example of Cost Estimate

No.	Work Item	unit	Q'ty	unit price (US$)	Amount (US$)	Note
1.	Civil Works					
1.1	Intake Weir					
	Excavation-common	m^3	160.217	1.50	240	90% of Total Excavation
	Excavation-rock	m^3	17.802	4.50	80	10% of Total Excavation
	Concrete	m^3	6.625	220.00	1,457	Incl. Re-bar & Form work
	Wet Masonry	m^3	235.409	70.00	16,479	
	Sub-total				18,256	
1.2	Intake & De-silting Basin					
	Excavation-common	m^3	78.766	1.50	118	90% of Total Excavation
	Excavation-rock	m^3	8.752	4.50	39	10% of Total Excavation
	Concrete	m^3	29.296	220.00	6,445	Incl. Re-bar & Form work
	Sub-total				6,603	
1.3	Headrace Channel or Tunnel					
	Channel Excavation	m^3	1,265.593	2.00	2,531	
	Wet Masonry	m^3	282.579	70.00	19,781	
	Sub-total				22,312	
1.4	Headtank (Surge Tank)					
	Excavation-common	m^3	73.137	1.50	110	90% of Total Excavation
	Excavation-rock	m^3	8.126	4.50	37	10% of Total Excavation
	Concrete	m^3	11.582	220.00	2,548	Incl. Re-bar & Form work
	Sub-total				2,694	
1.5	Spillway Channel					
	Excavation-common	m^3	37.890	1.50	57	
	Wet Masonry	m^3	8.460	70.00	592	Incl. Re-bar & Form work
	Sub-total				649	
1.6	Penstock					
	Excavation-common	m^3	0.356	1.50	1	
	Concrete	m^3	1.674	220.00	368	Incl. Re-bar & Form work
	Sub-total				369	
1.7	Powerhouse					
	Excavation-common	m^3	45.009	1.50	68	70% of Total Excavation
	Excavation-rock	m^3	19.289	4.50	87	30% of Total Excavation
	Concrete	m^3	43.003	220.00	9,461	Incl. Re-bar & Form work
	Sub-total				9,615	
1.8	Tailrace					
	Excavation-channel	m^3	37.890	1.50	57	
	Wet Masonry	m^3	8.460	70.00	592	
	Sub-total				649	
1.9	Access Road	km	0.500	10,000.00	5,000	
1.10	Miscellaneous	%	35.000		23,151	
	Total of Civil Works				89,298	
2.	Steel Penstock	ton	9.318	3,000.00	27,954	
3.	Gate and Trashracks	ton	0.800	1,500.00	1,200	
4.	Turbine & Generator	L.S.				
	Turbine & Associated Equipment				15,000	
	Generator & Associated Equipment				8,000	
	Distribution panel				18,000	
	Transportation & Others				28,230	
5.	Transformer and Switchgears	L.S.				
	Main Transformer & 22 kV Switchgear				6,200	
	Transportation & Others				4,270	
6.	Distribution Lines	L.S			67,605	
7.	E&M Miscellaneous (2 ~ 6)	%	10.000		17,646	
	Total of E&M Works				194,105	283,403
8.	Administration & Engineering Fee	%	15.000		42,511	
	GRAND TOTAL				325,914	

7. ENVIRONMENTAL ASSESSMENT

Environmental Assessment (EA)



Environmental Assessment is the entire process accompanying a development project proposal that determines the likely environmental impacts due to construction, operation, and closing the project

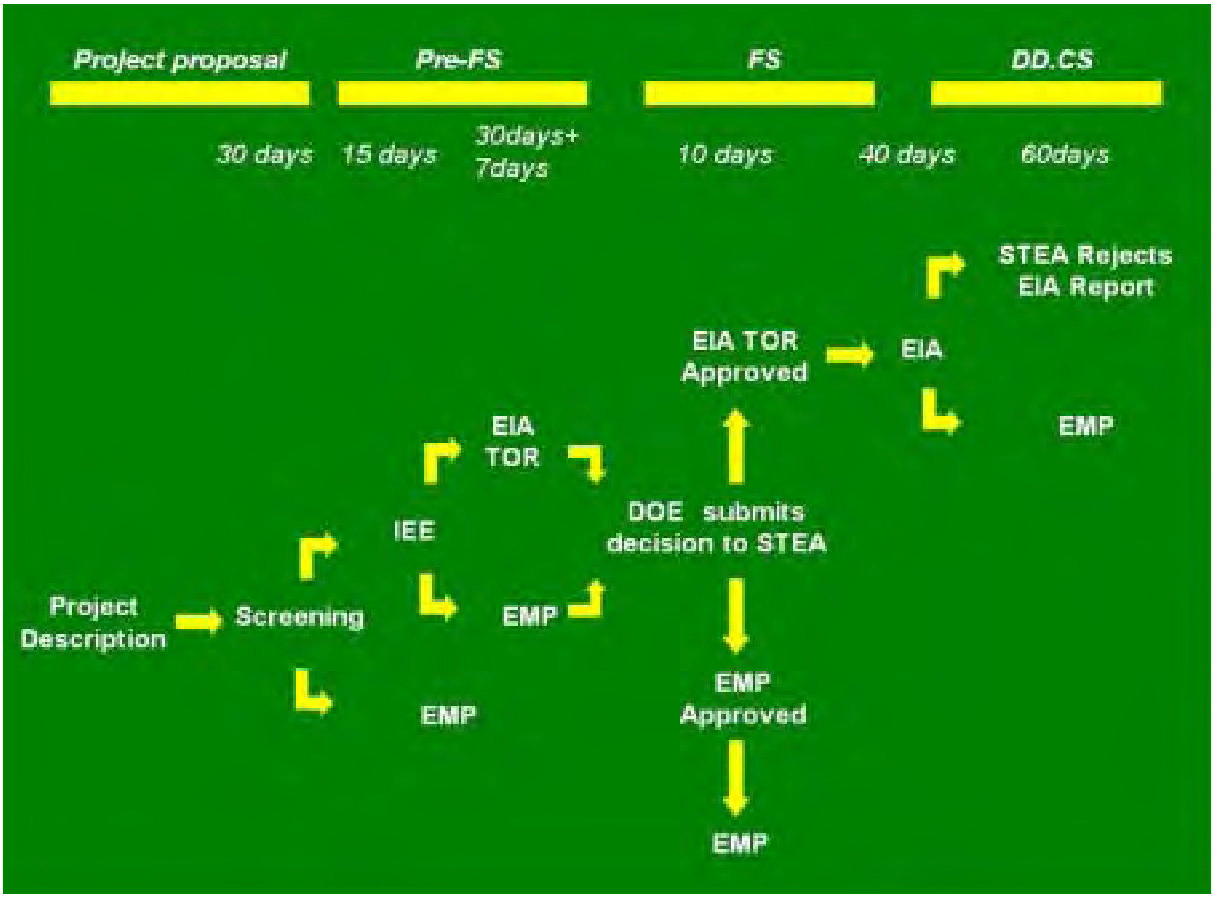
In order to make a decision whether the planned project shall be implemented or not, we should know in advance how much environmental impacts are expected to occur due to its implementation

Environmental Assessment Guidelines in Lao PDR

- Environmental Protection Law (2001)
- Decree on the Implementation of the Environmental Protection Law (2002)
- Regulation on Implementing the Environmental Assessment for the Electricity Projects in Lao PDR (2001)
- Environmental Management Standard for Electricity Projects (2003)

The procedure of the Environmental Assessment in Lao PDR should follow the Environmental Assessment Guidelines of Lao PDR. The Environmental Assessment guidelines for the energy development project are shown above

Environmental Assessment Procedure for Small Hydropower Project



According to the EA guidelines of Lao PDR, the Environmental Assessment shall comprise Project Description, Review of Project Description, Project Screening, Review and Approve of Project Screening , IEE (Initial Environmental Examination), EIA (Environmental Impact Assessment) and EMP (Environmental Management Plan). The procedural flow of the EA in Lao PDR is illustrated above

Examples of Environmental Assessment for Small Hydropower Project

1. Project Description : for All Project

<table>
<tr><td>Project Name</td><td colspan="4">Nam Ou Neau</td></tr>
<tr><td>Project Owner</td><td colspan="4">DOE/MIH</td></tr>
<tr><td>Project Type</td><td colspan="4">Hydro Power Project</td></tr>
<tr><td>Project Size</td><td colspan="4">Power Output:
Installed Capacity 383kW
Design Discharged 1.6 m^3/s
Access Road:0 km
22kV Transmission Line: 90 km</td></tr>
<tr><td>Project Objective</td><td colspan="4">Improvement of the electrification level, the poverty alleviation, and economic growth targeting Gnod district</td></tr>
<tr><td>Project Location</td><td colspan="4">Province: Phongsaly
District: Gnod
Village of Dam site: Nagnao
River: Nam Ou</td></tr>
<tr><td rowspan="5">Materials to be used in construction and operation</td><td rowspan="2">Weir</td><td rowspan="2">Concrete</td><td>Height (m)</td><td>6</td></tr>
<tr><td>Crest Length (m)</td><td>50</td></tr>
<tr><td rowspan="3">Waterway</td><td>Open Channel</td><td>Length (m)</td><td>2,300</td></tr>
<tr><td>Head tank</td><td>Length (m)</td><td>9</td></tr>
<tr><td>Penstock</td><td>Length (m)</td><td>100</td></tr>
<tr><td>Estimate of the quantity and quality of any solid, liquid or air-borne wastes resulting from construction and operation</td><td colspan="4">Solid waste: Cut Trees (construction phase)
Liquid waste: Murky Waters (construction phase)</td></tr>
<tr><td>Projects intended work force for both construction and operation (number and origin)</td><td colspan="4">Not decided</td></tr>
<tr><td>Anticipated positive and negative environmental (physical, biological, social, cultural and economic) impacts</td><td colspan="4">Positive impact:
Improvement of the electrification level
Negative impact:
Impact on fishing and irrigation in law water section caused by reduction of stream flow
The paddy area on the left bank of intake will be inundated partly or fully, depending on the design of the project. Its social impact as well as it compensation needs careful consideration.</td></tr>
<tr><td>Proposed environmental management measures that will be implemented through all stages of the project</td><td colspan="4">Not decided</td></tr>
<tr><td>Information used and assumptions made when determining the anticipated impacts</td><td colspan="4">Information collected by site visiting
Project design
GIS data and map</td></tr>
</table>

2. Project Summary : Installed Capacity more than 2,000 kW

Project Name		Nam Boun2		
Objective/Purpose of project		Improvement of the electrification level, the poverty alleviation, and economic growth targeting district		
Location		Province	Phomngsaly	
		District		
		Village of Dam site	Sentham	
Key Stakeholders and details of the PI activities undertaken to date		The Workshop was held for three (3) days during March 4 to 6, 2004 at an EDL hall in Vientiane, inviting participants from DOE, PDIH of the northern provinces and other concerned parties.		
Institutional Framework		Project Owner: DOE/MIH		
Project Area Main settlements including villages, households and estimated number of inhabitants and ethnic groups	Environmentally Sensitive Areas	No environmental sensitive area		
	Main vegetation and land use type	Forest and Paddy field		
	River/s, stream/s including discharge average and minimum, total head other major geographical features and their characteristics	River	Nam Boun2	
		Specific Discharge in Dry Season	-- litre/s/km^2	
		Discharge in Dry Season	-- m^3/s	
		Effected Head	-- m	
	Main commercial activities	--		
	Main subsistence activities	Agriculture		
	Main community infrastructure, services and facilities	Road Check dam in Nam Hoy river		
Generation Type Hydro/Thermal/ Other	Installed Capacity	850-3400kW		
	Source of Fuel	Hydro Power		
	Fuel, Chemical Storage	No fuel and chemical storage		
	Outputs/Wastes	Design Discharge: 1-4 m^3/s		
Other project Features	Power Station and Sub Stations	Power station will be constructed. Detail design has not decided yet.		
	Generators and Turbines(type, capacity, output)	Installed Capacity: 850-3400kW Design Discharge: 1-4 m^3/s		
	Dam weir including size (height, length), materials	Material	Concrete	
		Height	6 m	
		Crest Length	40 m	
	Reservoir including Surface area, maximum depth storage volume at FSL	--		
	Transmission line including size, length and proposed route	-- km		
	Access Road size, length and proposed route	-- km		
	Head race, Penstock, Tailrace (Type and length)	Open Channel	Length(m)	5,500
		Head tank	Length(m)	--
		Penstock	Length(m)	--
	Construction Workforce	--		

3. Screening

Project Type	Screening
Electricity project with an installed capacity of less than 100 kW	No further EA procedure
Electricity project with an installed capacity of more than 100 – 2,000 kW	Screening by the project description REVIEW
Electricity project with an installed capacity of more than 2,000 kW	Screening by VISITING the project site

4. IEE (Initial Environmental Examination)

Sample of Impact Matrix for Scoping (Nam Boun2 Project)

			Construction Phase			Operation Phase		
		Likely Impacts	dam, waterway & power facility	transmission line	access road	Water intake	Water discharge	Operation of power station
Social Environment: *Regarding the impacts on "Gender" and "Children's Right", might be related to all criteria of Social Environment.	1	Involuntary Resettlement						
	2	Local economy such as employment and livelihood, etc.				C	A	
	3	Land use and utilization of local resources				C	A	
	4	Social institutions such as social infrastructure and local decision-making institutions						
	5	Existing social infrastructures and services						
	6	The poor, indigenous and ethnic people						
	7	Misdistribution of benefit and damage				B	B	B
	8	Cultural heritage	C	C	C			
	9	Local conflict of interests						
	10	Water Usage or Water Rights and Rights of Common				A	A	
	11	Sanitation	B	B	B			
	12	Hazards (Risk) Infectious diseases such as HIV/AIDS	B	B	B			
Natural Environment	13	Topography and Geographical features						
	14	Groundwater	C					
	15	Soil Erosion	B	B	B			
	16	Hydrological Situation	B			A	A	
	17	Coastal Zone						
	18	Flora, Fauna and Biodiversity	B	B	B	A	A	
	19	Meteorology						
	20	Landscape						
	21	Global Warming						
Pollution	22	Air Pollution						
	23	Water Pollution	B	B	B		B	
	24	Soil Contamination						
	25	Waste	B	B	B			
	26	Noise and Vibration						
	27	Ground Subsidence						
	28	Offensive Odor						
	29	Bottom sediment	B	B	B		B	
	30	Accidents	B	B	B			

Note) Rating: A: Serious impact is expected / B: Some impact is expected / C: Extent of impact is unknown / No Mark: No impact is expected, EIA is not necessary.

5. EIA (Environmental Impact Assessment)

Required Items for EIA

No	Requirement	Example of EIA Report
1	Table of Contents	
2	Terms of Reference	
3	Executive Summary	
4	Introduction	
5	Institutional Framework(Including Policy, Legal and Administrative)	
6	Description of the Environment (Baseline condition: Physical, Biological, Social, Cultural and Economic Environment)	
	6.1 General	
	6.2 Environmental Study Area	
	6.3 Baseline Information	
	6.4 Visual Presentation	
7	Study of Alternative	
8	Environmental Impacts (Physical, Biological, Social, Cultural and Economic Impacts)	
9	Public Involvement	
10	Description of the Chosen Alternative	
11	Environmental Management Plan	
12	Conclusion	
13	Additional Information	
14	Annexes	
15	Glossary of Terms, Abbreviations and Acronyms	
16	References	

6. EMP (Environmental Management Plan)

Required Items for EMP

No	Requirement
1	Table of Contents
2	Executive Summary
3	Introduction
4	Institutional Framework(Including Policy, Legal and Administrative)
5	Management Arrangements
6	Environmental Management Measure
7	Monitoring
8	Contractor's Environmental Management Plan (CEMP)
9	Corrective Action
10	Public Involvement
11	Implementation Schedule
12	Costing
13	Glossary of Terms, Abbreviations and Acronyms
14	Review of EMP
15	References