

G E O L O G I C A L D A T A S H E E T

Region No.	I	I.D. No.	1-22-0-5	Scheme	S U P O	ILOCOS SUR	River Basin	A B R A	A B R A
Coordi- nates	17° 14' 42" N. LAT	120° 40' 36" E. LONG	DAM & RESERVOIR	Province	DAM & RESERVOIR	ROCK FILL	River Cross Section at Dam/Weir	River-El.	Stream
Topo. Map	No. 3171-IV	Geo. Map SCALE	Length of Water Way	Dam/Weir Type	Reservoir Area	37.2 km ²		204 m	
								122 m	

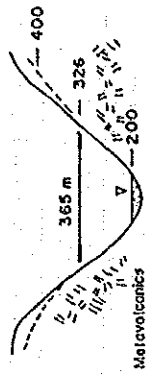
Geologic Formation and Age of the Site	Metavolcanics (Cretaceous-Paleogene) Metamorphosed submarine flows largely spilites and basalt, some Karatophyes and ondesite. Locally with intercalated chert, marble and sediments Ni (Lower Miocene) Conglomerate, wackes and shale	Major fault (N10°E) occur 500 m upstream of damsite	Major fault (N10°E) occur 1 Km. upstream of damsite	Geologic Structure	Major fault (N10°E) occur 1 Km. upstream of damsite	Province	ILOCOS SUR	River Basin	A B R A	A B R A
	Geologic Structure	Major fault (N10°E) occur 500 m upstream of damsite	Metavolcanics (Cretaceous-Paleogene)	Metavolcanics (Cretaceous-Paleogene)	DAM & RESERVOIR	ROCK FILL	River Cross Section at Dam/Weir	River-El.	Stream	
Rock Type and Age of Bed-rock	Metavolcanics (Cretaceous-Paleogene)	Metavolcanics (Cretaceous-Paleogene)	Metavolcanics (Cretaceous-Paleogene)	Rock Type & Age	Metavolcanics (Cretaceous-Paleogene)					
Rock Quality	Probably hard to very hard sound rock with some fractured zone due to effective fault	Hard to very hard (of left bank site)	Hard to very hard (of left bank site)	Rock Quality	Hard to very hard (of left bank site)					
Permeability	Probably watertight except fractured zone	Probably watertight except fractured zone	Probably watertight except fractured zone	Overburden	Terrace deposits and Talus deposits					
Overburden	Medium thickness of residual soil	Medium thickness of residual soil	Medium thickness of residual soil	Geologic Structure	Probably watertight except fractured zone					
	River bed filled with thick sand and gravel	River bed filled with thick sand and gravel	River bed filled with thick sand and gravel	Lithology & Age	Metavolcanics (Cretaceous-Paleogene) Conglomerate, Wackes, Shale (Lower Miocene)					
				Permeability and Ground-water	Probably watertight except fractured zone					
				Slope Stability	Mostly stable except slumping soils or rocks after impounding					
				Sedimentation	Common					

C O N S T R U C T I O N M A T E R I A L S

P R O F I L E O F D A M A X I S

G E N E R A L A S S E S S M E N T

Rock & Coarse Aggregates	Location	3.5 Km. south of damsite	Topographic Condition	V-Shaped
Sand	Location	Just upstream of damsite		
Material	Quality & Volume	River deposits (Sand and Gravel)	Not visited site	Elm
Earth Material	Location	1 Km. northwest of damsite		
	Soil Type	Residual soil of conglomerate, wackes and shale	Geologic Sketch	Elm
	Quality & Volume	Probably suitable		
Damsite			Geologic Sketch	Elm
Waterway/Power Tunnel				
Power House			Geologic Sketch	Elm
Reservoir				
Dam Construction Material			Geologic Sketch	Elm



GEOLOGICAL DATA SHEET

Region No.	I.D. No.	1-22-0-6	Scheme	E T E B		ILOCOS SUR	River Basin	A B R A	A B R A
Coordi- nates	17°10'42" N. LAT	120°40'22" E. LONG	Type of Development	D A M & R E S E R V O I R	Province	ROCK FILL	River Cross Section at Dam/ Weir	River- bed El.	273 m Width
Topo. Map No. 3171-IV	Geo. Map SCALE	1:250,000	Length of Water Way	— m	Dam Type	33.7 km	Dam Crest El.	337 m Height	104 m

GEOLOGIC FORMATION AND AGE OF THE SITE		CONSTRUCTION MATERIALS		PROFILE OF DAM AXIS		GENERAL ASSESSMENT	
Geologic Formation and Age of the Site	Metavolcanics (Cretaceous to Paleogene) interbedded with basic volcanic flows intercalated with clastic Ni (Lower Miocene) Conglomerate, wackes, shale and limestones associated with basic to intermediate flow and Pyroclastics	Geologic Structure	Major fault (N10°E) occur 1 Km. west of damsite	Topographic Condition	Not visited site	Damite	Good / Acceptable
Geologic Structure	Major fault (N10°E) occur 500m west of damsite	Rock Type & Age	Metavolcanics (Cretaceous - Paleogene)	Geologic Sketch		Waterway/Power Tunnel	Good
Rock Type and Age of Bed-rock	Metavolcanics (Cretaceous to Paleogene)	Rock Quality	Hard to very hard slightly weathered (at right bank site)	Earth Material	Residual soil of conglomerate, wackes and shale	Power House	Good
Rock Quality	Probably hard to very hard, indurated and compacted sound rock with some fractured zone due to effective of fault	Overburden	Terraca deposits and Talus deposits	Material	River deposits (Sand and Gravel)	Reservoir	Good
Permeability	Probably watertight except fractured zone	Geologic Structure	—	Material	3.5 Km. SE of damsite	Dam Construction Material	Excellent
Overall	Probably watertight except fractured zone	Rock Type & Age	—	Material	Probably suitable		
Bath Abutments	Thin residual soil	Rock Quality	—	Material	Probably suitable		
River Bottom	Riverbed filled with thick sand and gravel	Overburden	—	Material	Probably suitable		

G E O L O G I C A L D A T A S H E E T

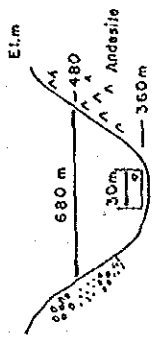
Region No.	I	I.D. No.	1-22-0-7	Scheme	BUCNIT	ILOCOS SUR	River Basin	ABRA	Stream	ABRA	
Coordi- nates	17°05'18" N. LAT	120°44'00" E. LONG		DAM & RESERVIOR			River bed	El.	330m	Width	30m
Topo. Map	No. 3171-III	Geo. Map SCALE 1:250,000		Province			Dam	El.	464 m	Height	134 m
				DAM TYPE	Reservoir		Section at Dam/ Weir				
				Length of Water Way	M	Km.					

Geologic Formation and Age of the Site	Licuan Formation (Eocene) Andesitic lava & its Pyroclastics Zigzag Formation (Miocene) Well bedded clastic sedimentary rocks Conglomerate, sandstone, wackes Intrusive rocks (Neogene) Quartz diorite		Zigzag Formation unconformably overlies Licuan Formation		CONSTRUCTION MATERIALS		2.5Km south-east of damsite	
	Geologic Structure	Licuan Formation and Zigzag Formation contact at Abra river	Geologic Structure		Rock & Coarse Aggregate	Location	Rock Type & Age	Andesite (Eocene)
Rock Type and Age of Bed-rock	Andesitic lava & its Pyroclastic (Eocene) on right abutment Conglomerate, sandstone, wackes (Miocene) on left abutment	Rock Type & Age	Andesitic lava & its Pyroclastics (Eocene)	Rock Quality	Hard to very hard, slightly weathered (at right bank site)	Location	Quality & Volume	Hard to very hard slightly weathered
Rock Quality	Right Abutment: Probably hard to very hard indurated with slightly closed joints, slightly weathered Left Abutment: Probably hard and compacted with closed joints, slightly weathered	Overburden	Terrace deposits and Talus deposit	Overburden		Location	Location	1-5Km downstream from damsite
Permeability	Probably watertight except geologic contact area under the river bed	Geologic Structure		Geologic Structure		Soil Type	Quality & Volume	Residual soil of Andesite
Overall		Overburden		Rock Type & Age		Topographic Condition	Quality & Volume	Probably suitable
Right Abutment		Geologic Structure	Major fault diagonally across the Abra River 8Km upstream from damsite	Rock Quality		Geologic Sketch	Topographic Condition	Wide V-Shape
Left Abutment		Lithology & Age	Andesite (Eocene), Conglomerate, Sandstone (Miocene), Quartz diorite (Neogene)	Overburden		Not visited site	Geologic Sketch	868m. El. 464 Andesite
Right Abutment		Permeability and Talus	Probably watertight	Slope Stability	Probably stable	Damite	Waterway/Power Tunnel	Acceptable
Left Abutment		Medium thickness of Residual soil		Sedimentation	Excessive silty problem due to bare of vegetation (Common-Much)	Power House	Reservoir	Good
River Bottom		Thick alluvial deposit				Dam Construction Material		Good

G E O L O G I C A L D A T A S H E E T

Region No.	I	I.D. No.	I-22-0-8	Scheme	UPPER BUCNIT		ILOCOOS SUR		River Basin	A B R A	Stream	A B R A
Coordi- nates	17°03'30" N. LAT	120°44'45" E. LONG	DAM & RESERVOIR Development		Province			River Cross Section at Dam/Weir	River-bed El.	360m Width	30m	
Popo. Map No. 1:50,000	No. 3171-III	Geo. Map SCALE	1:250,000	Length of Water Way	Reservoir Type	M		Reservoir	Dam Crest El.	480m Height	120m	

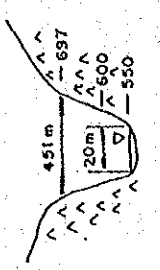
Geologic Formation and Age of the Site	Licuon Formation (Eocene) Andesitic lava & its Pyroclastic Zigzag Formation (Miocene) Well bedded elastic sedimentary rocks Conglomerate, sandstone, wackes Intrusive Rocks (Neogene) Quartz Diorite		Zigzag Formation unconformably overlies Licuon Formation		Zigzag Formation unconformably overlies Licuon Formation		Zigzag Formation unconformably overlies Licuon Formation		CONSTRUCTION MATERIALS		Location	2 Km. NE of damsite
	Geologic Structure	Licuon Formation		Licuon Formation		Licuon Formation		Licuon Formation		Rock & Coarse Aggre- gates	Rock Type & Age	Andesite (Eocene)
Rock Type and Age of Bed- rock	Andesitic lava & its Pyroclastic at right abutment (Eocene) Conglomerate, sandstone, wackes of left abutment		Andesite (Eocene)		Hard to very hard with fractured and weathered rock (at right bank site)		Telus deposits and Terrace deposits		Sand Material		Quality & Volume	Hard to very hard and weathered
Rock Quality	Right Abutment: Faulted and fractured andesite with slickenside, stable and smooth slope Left Abutment: Fractured and badly broken hard rock		Overburden		Overburden		Overburden		Earth Material		Location	1-5 Km. Upstream from damsite
Permeability	Overall: Probably high permeability of fractured zone		Geologic Structure		Geologic Structure		Geologic Structure		Topographic Condition		Quality & Volume	Broad alluvium filled valley, Sand and gravel
	Right Abutment: Stable bored and gentle smooth slope with medium residual soil Left Abutment: Residual soil over 20m at high elevation and slides occur along the galleries		Lithology & Age		Lithology & Age		Lithology & Age		Geologic Sketch		Soil Type	Residual soil of Andesite
Overburden	Probably high permeability of fractured zone		NE-SW trend faults intersect Abra River		NE-SW trend faults intersect Abra River		NE-SW trend faults intersect Abra River		Dam site		Location	2 Km. NE of damsite
	Probably high permeability of fractured zone		Andesite (Eocene) conglomerate sandstone, wackes, (Miocene) Quartz diorite (Neogene)		Andesite (Eocene) conglomerate sandstone, wackes, (Miocene) Quartz diorite (Neogene)		Andesite (Eocene) conglomerate sandstone, wackes, (Miocene) Quartz diorite (Neogene)		Waterway/Power Tunnel		Topographic Condition	Wide open U-Shape
Stable bored and gentle smooth slope with medium residual soil		Probably waterlight except fractured zone		Probably stable		Probably stable		Power House		Geologic Sketch	Not visited site	
Residual soil over 20m at high elevation and slides occur along the galleries		Excessive silty problem due to bare of vegetation Common - Much		Sediment- ation		Sediment- ation		Reservoir		Waterway/Power Tunnel	Acceptable	
								Dam Construction Material		Power House	Good	
										Reservoir	Good/Acceptable	
										Dam Construction Material	Good	



G E O L O G I C A L D A T A S H E E T

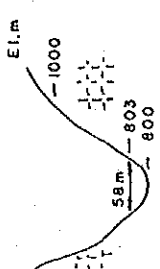
Region No.	1	I.D. No.	1-22-0-9	Scheme	DAYAPAN		Province	ILOCOS SUR	River Basin	A B R A	Stream	A B R A
Coordi- nates	16°55'10" N. LAT	120°44'12" E. LONG	Type of Development	DAM & RESERVOIR		Dam/Weir Type		River Cross Section at Dam/Weir	River bed El.	556 m	Width	20 m
Topo. Map No. 1:50,000	3170-IV	Geo. Map SCALE	Length of Water Way	m		Reservoir Area	km ²		Dam Crest El.	697 m	Height	141 m

Geologic Formation and Age of the Site	Licuan Formation (Eocene) Andesite lava & its Pyroclastics Intrusive Rocks (Neogene) Quartz diorite, Grenodiorite		M S D P O R H .	Geologic Structure	Major fault (N30°W) occurs on Power house site	CONSTRUCTION MATERIALS	Rock & Coarse Aggre- gates	Location	1.5 Km. south-east of damsite
	Rock Type and Age of Bed- rock	Andesite (Eocene)		Rock Type & Age	Andesite (Eocene) Quartz diorite (Neogene)		Rock Type & Age	Andesite (Eocene) Quartz diorite (Neogene)	Location
Rock Quality	Major fault (N30°W) intersect Malaya river at just downstream of damsite		M M M O R	Rock Quality	Probably hard and partially fractured	PROFILE OF DAM AXIS	Sand	Location	5-8 Km. downstream from damsite
	Abutments	Both Probably hard to very hard, partially faulted and fractured		Overburden	Talus deposits Residual soil		Material	Alluvial deposits (sand and gravel)	Quality & Volume
Permeability	Probably water tight except fractured zone		M M M F Y	Geologic Structure		GENERAL ASSESSMENT	Earth Material	Soil	Residual soil of Quartz diorite
	Overall	Probably water tight except fractured zone		Rock Quality			Topographic Condition	Open U-Shaped	Quality & Volume
Overburden	Medium thickness of residual soil		M K O Y H M S M	Lithology & Age	Andesite (Eocene)	Dam Site	Geologic Sketch	Topographic Condition	Open U-Shaped
	Abutments	Both Medium thickness of residual soil		Geologic Structure	No major fault in the reservoir area.		Geologic Sketch	Not visited site	Geologic Sketch
River Bottom	River bed filled with some sand and gravel		M K O Y H M S M	Permeability and Ground-Water	Probably water tight	Waterway/Pover Tunnel	Dam Site	Waterway/Pover Tunnel	Pover House
	Bottom	River bed filled with some sand and gravel		Slope Stability	Probably stable				
Overall	Excellent		M K O Y H M S M	Sedimentation	Common	Reservoir	Dam Construction Material	Waterway/Pover Tunnel	Pover House
	Overall	Excellent		Sedimentation	Common				



G E O L O G I C A L D A T A S H E E T

Region No.	I	I.D. No.	1-22-0-10	Scheme	A B R A	Province	BENGUET	River Basin	A B R A	Stream	A B R A	
Coordinates	16°50'44" N. LAT	120°43'52" E. LONG		Type of Development	RUN OF RIVER	/Weir Type	CONCRETE	River Cross Section	River bed El.	800m	River width	50m
Topo. Map No.	3170-IV	Geo. Map No.	1250,000	Length of Water Way	6360 m	Reservoir Area	—	Water	Crest El.	803 m	Max. Height	6 m
		SCALE	1:142,857									

G E O L O G I C A L	Geologic Formation and Age of the Site UV; Metavolcanics (Cretaceous-Paleogene) Metamorphosed andesite and basalt Ni (Early to Middle Miocene) Conglomerate, wacke Intrusive Rocks (Neogene) Quartz diorite, Grenodiorite	Geologic Structure Geologic contact of quartz diorite and Metavolcanics extend to N-S of the left bank side of the Abra river.	Geologic Structure East side of intrusive rocks in fault contact with Ni Formation Quartz diorite (Neogene) Hard to very hard, indurated and compacted Thin residual soil and Tolu deposits Fault (N30°W) occur 1km. eastside of tunnel route Quartz diorite (Neogene)	Construction Materials Rock & Coarse Aggregates Sand Material Earth Material Topographic Condition Geologic Sketch	Location Rock Type & Age Quality & Volume Location Quality & Volume Location Soil Type Quality & Volume Topographic Condition Geologic Sketch	Location 2km. north-east of weir Metavolcanics (Cretaceous-Paleogene) Hard to very hard 4-6 Km. downstream from power-house site River deposits (Sand and Gravel)
	M E M O R A N D U M	PROFILE OF DAM AXIS 				
G E N E R A L	GENERAL ASSESSMENT Dam Site: Excellent Waterway/Pover Tunnel: Good Pover House: Good Reservoir: Excellent Dam Construction Material: Excellent					

GEOLOGICAL DATA SHEET

Region No.	I	I.D. No.	I-22-I-II	Scheme	NAGLIBACAN	Province	A B R A	River Basin	A B R A	Stream	A N A Y A N
Coördi- nates	17°51'00" N. LAT	120°53'00" E. LONG	Type of Development	DAM & RESERVOIR	Dam/Weir Type		River- bed	River Cross Section at Dam/ Up- stream	El.	350m Width	10m
Topo. Map Scale	No. 3173-1	Geo. Map SCALE	Length of Water Way	M	Reservoir Area		Dam Crest	El.	498m	Height	148m

Geologic formation and Age of the Site	Tinea Formation (Oligocene) Dacitic Pyroclastic and lava Plutonic Rocks (Neogene) Chiefly Quartz diorite.		Geologic Structure	Fault (trend N45°E) occur on left bank site of the Anayan river 1Km. apart from damsite		A B R A	River Basin	A B R A	Stream	A N A Y A N
	Fault (trend N45°E) occur on left bank site of Anayan river 1Km. apart from damsite									
Rock Type and Age of Bed- rock	Dacitic Pyroclastic and lava (Oligocene)		Geologic Structure	Dacitic Pyroclastic and lava (Oligocene)		A B R A	River Basin	A B R A	Stream	A N A Y A N
	Both Abutments Probably hard to very hard, Moderately weathered joints are space			Hard to very hard and moderately weathered (at left bank site)						
Rock Quality	Overall Probably watertight		Geologic Structure	Some residual soil		A B R A	River Basin	A B R A	Stream	A N A Y A N
	Thick weathered of high elevation of abutments			Major fault occur on left bank site parallel to the Anayan river						
Perme- ability	Both Abutments		Geologic Structure	Dacite (Oligocene) Quartz diorite (Neogene)		A B R A	River Basin	A B R A	Stream	A N A Y A N
	Some river deposits on the river bed			Probably watertight; except fractured faults and geologic contact						
Over- burden	River Bottom		Geologic Structure	Probably chiefly stable except small slide on the residual soil		A B R A	River Basin	A B R A	Stream	A N A Y A N
	Some river deposits on the river bed			C o m m o n						

CONSTRUCTION MATERIALS

PROFILE OF DAM AXIS

GENERAL ASSESSMENT

Rock & Coarse Aggre- gates	Location	1.5Km. north-east of damsite
Sand	Rock Type & Age	Dacite (Oligocene)
Material	Quality & Volume	Hard to very hard
Earth Material	Location	3-6Km. Upstream from damsite
Quality & Volume	Quality & Volume	River deposits (Sand and gravel)
Topographic Condition	Location	1.5Km. west of damsite
Not visited site	Soil Type	Residual soil of Dacite
Probably suitable	Quality & Volume	Probably suitable
Open wide valley V-Shaped	Topographic Condition	
Geologic Sketch	Geologic Sketch	
Dam site	Dam site	Good
Waterway/Power Tunnel	Waterway/Power Tunnel	Good
Power House	Power House	Good
Reservoir	Reservoir	Good/Acceptable
Dam Construction Material	Dam Construction Material	Excellent

G E O L O G I C A L D A T A S H E E T

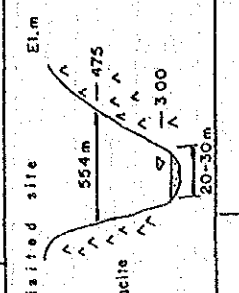
Region No.	1	I. D. No.	1-22-1-12	Scheme	TINEG-1		Province	A B R A	River Basin	A B R A	Stream	TINEG
Coordi- nates	17°47'00" N. LAT	120°47'00" E. LONG		Type of Development	DAM & RESERVOIR		Dam/Weir Type		River- bed	EL.	136m Width	50m
Topo. Map No. 1:50,000	No. 3173-II	Geo. Map SCALE	1:250,000	Length of Water Way	P		Reservoir Area		Dam Crest	EL.	330m Height	194m

Geologic formation and Age of the Site	Ting Formation (Oligocene) Andesite, dacitic pyroclastic & lava Kennon Formation (Miocene) Coral Limestones Plutonic rocks (Neogene) Rosario F. Granodiorite Tuffaceous sandstone, medstone	Limestone unconformably overlies Ting Formation	Limestone unconformably overlies Ting Formation	Limestone unconformably overlies Ting Formation	Limestone unconformably overlies Ting Formation	Limestone unconformably overlies Ting Formation	Limestone unconformably overlies Ting Formation	Limestone (Miocene)	Partly crystalline hard to very hard	4-5 Km. downstream from damsite	River deposit sand and gravel	6.5 Km. south-west of damsite																					
	Geologic Structure	Overburden	Overburden	Overburden	Overburden	Overburden	Overburden	Overburden	Overburden	Overburden	Overburden	Overburden																					
Rock Type and Age of Bed-rock	Andesite, dacitic pyroclastic & lava (Oligocene)	Andesite, dacitic (Oligocene)	Dacite (Oligocene)	Hard to very hard (at left bank site)	Normal residual soil	Normal residual soil	Normal residual soil	Normal residual soil	Normal residual soil	Normal residual soil	Normal residual soil	Normal residual soil																					
Rock Quality	Both Abutments Probably hard to very hard but broken by joints 0.4-0.6m. space and slightly to moderately weathered	Both Abutments Probably waterlight except weathered joints	Both Abutments Probably waterlight except weathered joints	Both Abutments Probably waterlight except weathered joints	Both Abutments Probably waterlight except weathered joints	Both Abutments Probably waterlight except weathered joints	Both Abutments Probably waterlight except weathered joints	Both Abutments Probably waterlight except weathered joints	Both Abutments Probably waterlight except weathered joints	Both Abutments Probably waterlight except weathered joints	Both Abutments Probably waterlight except weathered joints	Both Abutments Probably waterlight except weathered joints																					
Permeability	Both Abutments Slightly to moderately weathered with thin residual soil	Both Abutments Slightly to moderately weathered with thin residual soil	Both Abutments Slightly to moderately weathered with thin residual soil	Both Abutments Slightly to moderately weathered with thin residual soil	Both Abutments Slightly to moderately weathered with thin residual soil	Both Abutments Slightly to moderately weathered with thin residual soil	Both Abutments Slightly to moderately weathered with thin residual soil	Both Abutments Slightly to moderately weathered with thin residual soil	Both Abutments Slightly to moderately weathered with thin residual soil	Both Abutments Slightly to moderately weathered with thin residual soil	Both Abutments Slightly to moderately weathered with thin residual soil	Both Abutments Slightly to moderately weathered with thin residual soil																					
Overburden	River bed filled with some sand and gravel	River bed filled with some sand and gravel	River bed filled with some sand and gravel	River bed filled with some sand and gravel	River bed filled with some sand and gravel	River bed filled with some sand and gravel	River bed filled with some sand and gravel	River bed filled with some sand and gravel	River bed filled with some sand and gravel	River bed filled with some sand and gravel	River bed filled with some sand and gravel	River bed filled with some sand and gravel																					
CONSTRUCTION MATERIALS																																	
PROFILE OF DAM AXIS																																	
GENERAL ASSESSMENT																																	
<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 15%;">Topographic Condition</td> <td colspan="2">V-Shaped</td> </tr> <tr> <td>Geologic Sketch</td> <td colspan="2">Not visited site</td> </tr> <tr> <td>Damsite</td> <td colspan="2">Good</td> </tr> <tr> <td>Waterway/Power Tunnel</td> <td colspan="2">Good</td> </tr> <tr> <td>Power House</td> <td colspan="2">Good</td> </tr> <tr> <td>Reservoir</td> <td colspan="2">Good</td> </tr> <tr> <td>Dam Construction Material</td> <td colspan="2">Good</td> </tr> </table>													Topographic Condition	V-Shaped		Geologic Sketch	Not visited site		Damsite	Good		Waterway/Power Tunnel	Good		Power House	Good		Reservoir	Good		Dam Construction Material	Good	
Topographic Condition	V-Shaped																																
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Reservoir	Good																																
Dam Construction Material	Good																																

G E O L O G I C A L D A T A S H E E T

Region No.	I	I.D. No.	1-22-1-13	Scheme	TINEG-2		A B R A	River Basin	A B R A	Stream	TINEG
Coordi- nates	17°48'30"	E. LONG	120°52'00"	Type of Development	DAM & RESERVOIR			River- Cross Section at Dam/ Weir	River- bed El.	300m Width	20m
Topo. Map 1:50,000	No. 3173-II	Geo. Map SCALE	1:142,857	Length of Water Way	M				Dam Crest El.	475 m height	175 m

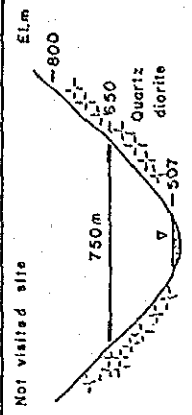
G E O L O G I C A L	Geologic formation and Age of the Site	Liquon Formation (Eocene) Andesitic pyroclastic and lava Tineg Formation (Oligocene) Dacitic pyroclastic and lava Plutonic rocks (Neogene) Chiefly Quartz diorite Kennon Formation (Miocene) Limestone and sandstone	Scheme	1-22-1-13	I	I.D. No.	1-22-1-13	Scheme	Type of Development	DAM & RESERVOIR	A B R A	River Basin	A B R A	Stream	TINEG
	Geologic Structure	A syncline (trend N-S) occur on 3.5 Km. upstream damsite. Several faults across the Tineg river 1-2 Km. upper stream of the damsite	Geologic Structure	Several faults across the Tineg river 1-2 Km upper stream of the powerhouse	Rock Type & Age	Dacitic pyroclastic and lava (Oligocene) Andesitic pyroclastic and lava (Eocene)	Rock Quality	Hard to very hard (at right bank site)	Overburden	Residual soil and talus deposits	Geologic Structure		Rock & Coarse Aggregate	Location	2.5 Km. ESE of damsite
Rock Type and Age of Bed-rock	Dacitic pyroclastic and lava (Oligocene) Andesitic pyroclastic and lava (Eocene)	Rock Type & Age		Overburden		Rock Quality		Geologic Structure		Earth Material		Soil Type		Dacite (Oligocene) Andesite (Eocene)	
Rock Quality	Probably hard to very hard, strong abutments shallow joints	Rock Quality		Overburden		Overburden		Geologic Structure		Topographic Condition		Quality & Volume		Hard to very hard It will be manufactured from rock from the quarry areas	
Permeability	Overall	Permeability	Probably watertight	Geologic Structure		Geologic Structure		Lithology & Age	Andesite (Eocene), Dacite (Oligocene) Quartz diorite (Neogene) Limestones (Miocene)	Geologic Sketch		Quality & Volume		Probably suitable	
Overburden	Both Abutments	Overburden	Weathered rock with bouldery talus, occurring mainly parts of gullies.	Permeability		Permeability		Slope Stability	Probably, chiefly watertight except faulted zone and limestone area	Damsite		Quality & Volume		Probably suitable	
	River Bottom	Overburden	River bed filled with thin river deposits	Sedimentation		Sedimentation			Mostly stable, residual soils cover upper part, the effect of impounding may cause local slumping of soils in some areas	Waterway/Power Tunnel		Quality & Volume		Probably suitable	
									Common	Power House		Quality & Volume		Probably suitable	
										Reservoir		Quality & Volume		Probably suitable	
										Dam Construction Material		Quality & Volume		Probably suitable	



G E O L O G I C A L D A T A S H E E T

Region No.	1	I.D. No.	I-22-1-14	Scheme	T I N E G - 3	Province	A B R A	River Basin	A B R A	Stream	T I N E G		
Coordi- nates	17°47'20" N. Lat	120°57'35" E. Long	Type of Dam/Weir			DAM/Weir Type		River Bed	El.	507 m	Width	50 m	
Popo. Map No.	3173-11	Geo. Map SCALE	1:142,857	Length of Water Way	RESERVOIR	Reservoir Area		Cross Section at Dam	Dam Crest	El.	651 m	Height	144 m

Geologic formation and Age of the Site	Tineg Formation (Oligocene)		Dacic pyroclastic and lava Plutonic Rocks (Neogene)		Chiefly quartz diorite		Long fault (trend NE-SW) occur 300m south-east of powerhouse		Quartz diorite (Neogene)		Hard to very hard and slightly to moderately weathered (at right bank site)		Thick loess deposits		Geologic Structure		Rock Type & Age		Rock Quality		Overburden		Geologic Structure		Rock Type & Age		Rock Quality		Overburden		Geologic Structure		Lithology & Age		Permeability and Ground-water		Slope Stability		Sedimentation	
	Several faults occur on near damsite, on fault (trend N 45° E) occur 400m east of damsite		Quartz diorite (Neogene)		Probably hard to very hard slightly to moderately weathered upper part and possible minor faults where geological contact		Probably water/light except upper part of basement rock		Probably thick residual soils		Riverbed filled with thin river deposits																													
Geologic Structure	Tineg Formation (Oligocene)		Dacic pyroclastic and lava Plutonic Rocks (Neogene)		Chiefly quartz diorite		Long fault (trend NE-SW) occur 300m south-east of powerhouse		Quartz diorite (Neogene)		Hard to very hard and slightly to moderately weathered (at right bank site)		Thick loess deposits		Geologic Structure		Rock Type & Age		Rock Quality		Overburden		Geologic Structure		Rock Type & Age		Rock Quality		Overburden		Geologic Structure		Lithology & Age		Permeability and Ground-water		Slope Stability		Sedimentation	
Rock Type and Age of Bed-rock	Quartz diorite (Neogene)		Probably hard to very hard slightly to moderately weathered upper part and possible minor faults where geological contact		Probably water/light except upper part of basement rock		Probably thick residual soils		Riverbed filled with thin river deposits																															
Rock Quality	Probably hard to very hard slightly to moderately weathered upper part and possible minor faults where geological contact		Probably water/light except upper part of basement rock		Probably thick residual soils		Riverbed filled with thin river deposits																																	
Permeability	Probably water/light except upper part of basement rock		Probably thick residual soils		Riverbed filled with thin river deposits																																			
Overburden	Probably thick residual soils		Riverbed filled with thin river deposits																																					



G E O L O G I C A L D A T A S H E E T

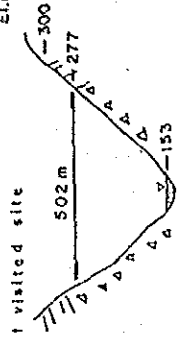
Region No.	1	I.D. No.	1-22-2-15	Scheme	BINONGAN-R	Province	A B R A	River Basin	A B R A	Stream	BINONGAN	
Coordi- nates	17°38'48" N. LAT	120°58'53" E. LONG	Type of Development			Dam/Weir TYPE		River bed	El.	516m	Width	100m
Topo. Map No.	3172-1	Geo. Map SCALE	Length of Water Way	17,700 m	Reservoir Area			Crest	El.	519m	Max. Height	6 m

Geologic formation and Age of the Site	Licuan Formation (Eocene) Andesitic lava & its pyroclastics Plutonic rock (Neogene) Quartz diorite		Geologic Structure	Quartz diorite is emplaced about 800m east of powerhouse site		CONSTRUCTION MATERIALS	Rock & Coarse Aggr- gates	Location	1 Km. south-east of damsite
	Geologic Structure	Andesite (Eocene)		Rock Type & Age	Probably hard to very hard sound rock		Material	Location	Andesite (Eocene)
Geologic Structure	Assumed fault (tend NW-SE) occur 2Km. north-east of damsite		Overburden	River terrace deposits and talus deposits		Earth Material	Location		
Rock Type and Age of Bed-rock	Andesite (Eocene)		Geologic Structure	Two faults (45°E & N 30°W) diagonally across the tunnel rout near geologic contact line		Topographic Condition	Soil Type		
Rock Quality	Both Abutments Probably hard to very hard sound rock, compacted and indurated		Rock Quality	Probably hard to very hard perthitely fractured due to effective of faults		Geologic Sketch	Quality & Volume		Open V-Shape d Not visited site Eim
Permeability	Overall Probably watertight		Overburden	Enough thickness			GENERAL ASSESSMENT	Damsite	
Overburden	Both Abutments Medium thickness of residual silt		Geologic Structure	No major fault in the reservoir area		Waterway/Power Tunnel		Power House	Good/Acceptable
	River Bottom The river bed filled with gravel and-cobble		Lithology & Age	Andesite (Eocene)		Reservoir	Excelsent		
			Permeability and Ground-water	Probably watertight		Dam Construction Material	Excelsent		
			Slope Stability	Stable					
			Sedimentation	Less to Common					

G E O L O G I C A L D A T A S H E E T

Region No.	I	I.D. No.	I-22-3-16	Scheme	PAGANAO	Province	ABRA	River Basin	ABRA	Stream	MALAMAS	
Coordinates	17°39'50"	E. LONG.	120°49'14"	Type of Development	DAM & RESERVOIR	Dam/Weir Type		River Bed	El.	153m	Width	10m
Topo. Map	No. 3172-1	Geo. Map SCALE	1:250,000	Length of Water Way	M	Reservoir Area		Dam Section at Dam/Weir	El.	277 m	Height	123 m

Geologic Formation and Age of the Site	Licuan Formation (Eocene) Andesitic lava & its pyroclastic Tingag Formation (Oligocene) Dacitic pyroclastics and lava		Licuan Formation unconformably overlies Tingag Formation		Rock & Coarse Aggr. gates	Location	2 Km. east of damsite		
	Geologic Structure	Licuan Formation and Tingag Formation contact by fault (N-S trend) each other occurs on 500m upstream from damsite		Rock Type & Age			Andesite (Eocene)		
Rock Type and Age of Bed-rock	Dacitic pyroclastics and lava (Oligocene)		Dacitic pyroclastics and lava (Oligocene)		Sand	Quality & Volume	Hard to very hard		
Rock Quality	Probably hard to very hard sound rock. Partly jointed and weakly cemented due to effectivity of faults		Hard to very hard sound rock (at left bank site)				Material	Quality & Volume	4 Km. downstream from damsite
Permeability	Overall		Probably watertight except weakly cemented joints zone		Earth Material	Quality & Volume			River deposits (sand and gravel)
	Both Abutments		Medium thickness of residual soil and Talags deposits				Topographic Condition	Quality & Volume	2 Km. east of damsite
Overburden	Both Abutments		Medium thickness of residual soil and Talags deposits		Geologic Sketch	Topographic Condition			V-Shaped
	River Bottom		Mostly Stable, except sliding soils after impounding				Not visited site		Elm
Dam		Dam		Dam		Dam		Dam	
Waterway		Waterway		Waterway		Waterway		Waterway	
Power House		Power House		Power House		Power House		Power House	
Reservoir		Reservoir		Reservoir		Reservoir		Reservoir	
Dam Construction Material		Dam Construction Material		Dam Construction Material		Dam Construction Material		Dam Construction Material	



G E O L O G I C A L D A T A S H E E T

Region No.	1	I.D. No.	11-22-3-17	Scheme	MALANAS (LICUANO)	Province	A B R A	River Basin	A B R A	Stream	KAWAYAN	
Coordi- nates	17°37'00" N, 120°54'00" E. LONG	Type of Development		DAM & RESERVOIR	Dam/Weir Type		River- bed	River Cross Section at Dam/ Weir	El.	331 m	Width	10m
Topo. Map No. 1:50,000	No. 3172-1	Geo. Map SCALE	1:250,000	Length of Water Way	M	Reservoir Area	Km ²	Dam Crest	El.	438 m	Height	107 m

Geologic formation and Age of the Site	Licuan Formation (Eocene) Andesitic lava & its pyroclastics Tineg Formation (Oligocene) Dachic pyroclastics and lava Plutonic rock (Neogene) Quartz diorite		Normal fault (trend N45°E) across the Kawayan river several hundred meters from powerhouse	Geologic Structure	Normal fault (trend N45°E) across the Kawayan river several hundred meters from powerhouse		CONSTRUCTION MATERIALS	Rock & Coarse Aggr- gates	Location	1 Km. north of damsite	
	Geologic Structure	Andesite (Eocene)			Rock Type & Age	Andesite (Eocene)				Quality & Volume	Hard to very hard
Geologic Structure	Normal fault (45°E) across the Kawayan river at the dam axis		Overburden	Some residual soil and talus deposits		PROFILE OF DAM AXIS	Sand	Location	1-4 Km. upstream from damsite.		
Rock Type and Age of Bed- rock	Andesite (Eocene) at the downstream side, and Quartz diorite (Neogene) at the upstream side contact on the dam axis			Geologic Structure					Material	River deposits (sand and gravel)	
Rock Quality	Both abutments cemented due to faulted and shared structure		Rock Type & Age			GENERAL ASSESSMENT	Earth Material	Soil Type	Residual soil of Andesite		
Permeability	Overall		Rock Quality						Quality & Volume	Probably suitable	
	Overburden	Probably slightly permeable especially high permeable in weakly cemented open joints		Overburden			Topographic Condition	V-Shaped		Geom. Sketch	
Both		Medium thickness of residual soil		Damsite	Acceptable			Waterway/Power Tunnel			
Both		Medium thickness of residual soil		Slope Stability	Mostly stable, except sliding soils after impending		Power House	Good			
Both		Medium thickness of residual soil		Sedimentation	Common		Reservoir	Good			
Both		Medium thickness of residual soil			Common		Dam Construction Material	Excellent			

G E O L O G I C A L D A T A S H E E T

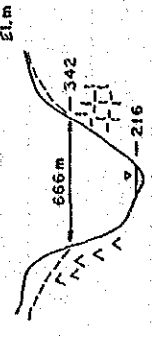
Region No.	1	I. D. No.	1-22-4-18	Scheme		T A P I N G	A B R A	River Basin	A B R A	Stream	B A A Y
Coordi- nates	17°33'55" N. LAT	120°46'50" E. LONG	DAM 8	Type of Development				River Cross Section at Dam/Weir	River-bed El.	107 m	Width 10 m
Topo. Map No.	3172-1	Geo. Map SCALE	1:250,000	Length of Water Way				Dam Crest El.		211 m	Height 104 m

Geologic formation and Age of the Site	Llivan Formation (Eocene) Andesitic lava and pyroclastics Tisag Formation (Oligocene) Dacitic pyroclastics and lava Zigzag Formation (Early Miocene) Andesitic pyroclastics with lava Kanon Formation (Middle Miocene) Limestone member, alternating SS and shale member		Geologic Structure	Assumed fault occur on near Powerhouse		CONSTRUCTION MATERIALS	Location	1.5 Km. west of damsite
	Geologic Structure	Assumed fault occur on damsite		Rock & Coarse Aggregates	Location Type & Age Quality & Volume		Limestone (Middle Miocene) Hard	
Rock Type and Age of Bed-rock	Dacitic pyroclastics and lava (Eocene)		Rock Type & Age	Dacitic pyroclastics and lava (Eocene)		Earth Material	Location	1-2 Km. east of damsite
Rock Quality	Both Abutments Probably hard and slightly to moderately weathered of fractured fault zone		Rock Quality	Hard and moderately weathered (at left bank site)			Soil Type	Quality & Volume
Permeability	Probably impermeable except fractured zone		Overburden	Thick residual soil		Topographic Condition	Quality & Volume	Probably suitable
Overburden	Weathered rock with talus occurring at gullies		Geologic Structure	No major fault occur in the reservoir area			Not visited site	Topographic Condition
River Bottom	The river bed filled with sand and gravel		Lithology & Age	Dacitic pyroclastics and lava (Eocene)		Geologic Sketch	Geologic Sketch	
			Permeability and Ground-water	Probably watertight			Geologic Sketch	
D A M			Slope Stability	Mostly stable, may be slumping soils in some areas after impounding		Dam Construction Material		Good
P O W E R H O U S E			Sedimentation	Common		Dam Construction Material		Good
R E S E R V O I R			Overall	Probably impermeable except fractured zone		Reservoir		Good
G E N E R A L			Both Abutments	Weathered rock with talus occurring at gullies		Waterway/Power Tunnel		Acceptable
A S S E S S M E N T			Overall	Probably impermeable except fractured zone		Power House		Good/Acceptable
P R O F I L E			Both Abutments	Weathered rock with talus occurring at gullies		Reservoir		Good
O F			River Bottom	The river bed filled with sand and gravel		Dam Construction Material		Good
D A M			Slope Stability	Mostly stable, may be slumping soils in some areas after impounding		Waterway/Power Tunnel		Acceptable
P O W E R H O U S E			Sedimentation	Common		Reservoir		Good
R E S E R V O I R			Overall	Probably impermeable except fractured zone		Dam Construction Material		Good

G E O L O G I C A L D A T A S H E E T

Region No.	I	I.D. No.	1-22-5-19	UPPER	Province	A B R A	River Basin	A B R A	Stream	BUCLOC
Coordinater	17°26'50" N. LAT	E. LONG	120°47'07"	DAM & RESERVOIR	Dam/Weir Type		River Cross Section (Dam)	River-bed El.	216m	Width 10m
Topo. Map No. 1:50,000	No. 3172-II	Geo. Map SCALE	1:250,000	M	Reservoir Area		Dam Crest	El.	342m	Height 126m

G E O L O G I C A L	Geologic Formation and Age of the Site	Licuan Formation (Eocene) Andesitic lava & its pyroclastics Plutonic Rocks (Neogene) Quartz diorite, Granodiorite Dikes (Neogene) Declite	Major fault (trend N45°E) just upstream of powerhouse site	Geologic Structure	Major fault (trend N45°E) just upstream of powerhouse site	Rock & Coarse Aggregate	Location	1 Km. west of damsite	
	Geologic Structure	Major fault (trend N 45° E) occur on the dam axis	Andesitic lava & its pyroclastics (Eocene), Quartz diorite Granodiorite (Neogene)	Rock Type & Age	Andesitic lava & its pyroclastics (Eocene)	Sand	Location	2-10 Km. downstream from damsite	
	Rock Quality	Both Abutments Probably hard and slightly to moderately weathered fractured zone occurred along the fault zone	Overburden	Rock Quality	Hard and slightly weathered (at left bank site)	Material	Material	Location	3-4 Km. downstream from damsite
	Permeability	Overall Probably high permeability at fractured zone	Geologic Structure	Overburden	Terrace deposits Talus deposits	Soil	Material	Location	Terrace deposits
	D A M	Overall	Probably high permeability at fractured zone	Geologic Structure	Several faults across the Bucloc river, each formation contact by fault	Topographic Condition	Material	Location	Probably suitable
				Lithology & Age	Andesite (Eocene), Quartz diorite, Granodiorite (Neogene)	Geologic Sketch	Not visited site	Quality & Volume	Probably suitable
				Permeability and Groundwater	Probably high permeability at fractured fault and geologic contact	Profile of Dam Axis	Topographic Condition	Quality & Volume	Probably suitable
				Slope Stability	Mostly stable, except slumping soils after impounding	Geologic Sketch	Not visited site	Quality & Volume	Probably suitable
	G E N E R A L	Overall	Probably high permeability at fractured zone	Permeability	Probably high permeability at fractured fault and geologic contact	GENERAL ASSESSMENT	Dam	Location	Acceptable/Poor
				Slope Stability	Mostly stable, except slumping soils after impounding	Waterway/Power Tunnel	Power House	Location	Acceptable
O V E R B U R D E N	Overall	Probably high permeability at fractured zone	Sedimentation	Common	Reservoir	Reservoir	Location	Acceptable	
			Overall	Probably high permeability at fractured zone	Dam Construction Material	Dam Construction Material	Location	Good	



G E O L O G I C A L D A T A S H E E T

Region No.	I	I.D. No.	1-22-5-20	Scheme	BUCLOC	Province	A B R A	River Basin	A B R A	Stream	SULOEN CREEK
Coordi- nates	17°26'34" N. LAT	120°52'04" E. LONG	DAM & RESERVIOR	Type of Development		Dam/Weir Type		River- bed El.	328m	Width	10m
Topo. Map 1:50,000	No. 3172-II	Geo. Map SCALE	1:250,000	Length of Water Way	m	Reservoir		Dam Crest El.	440m	Height	112m

Geologic formation and Age of the Site	Licuan Formation (Eocene) Andesitic lava & its pyroclastics Plutonic rocks (Neogene) Quartz diorite, Granodiorite Dikes (Neogene) Quartz diorite porphyry		Assumed fault occur on the Bucloc river		Assumed fault occur on the Bucloc river		Assumed fault occur on the Bucloc river		Assumed fault occur on the Bucloc river		Assumed fault occur on the Bucloc river	
	Geologic Structure	Assumed fault occur on the Bucloc river		Assumed fault occur on the Bucloc river		Assumed fault occur on the Bucloc river		Assumed fault occur on the Bucloc river		Assumed fault occur on the Bucloc river		Assumed fault occur on the Bucloc river
Rock Type and Age of Bed- rock	Quartz diorite, Granodiorite (Neogene)		Quartz diorite, Granodiorite (Neogene)		Quartz diorite, Granodiorite (Neogene)		Quartz diorite, Granodiorite (Neogene)		Quartz diorite, Granodiorite (Neogene)		Quartz diorite, Granodiorite (Neogene)	
Rock Quality	Both Abutments Probably hard to very hard and rich jointed due to effected assumed fault		Probably hard to very hard and rich jointed due to effected assumed fault		Probably hard to very hard and rich jointed due to effected assumed fault		Probably hard to very hard and rich jointed due to effected assumed fault		Probably hard to very hard and rich jointed due to effected assumed fault		Probably hard to very hard and rich jointed due to effected assumed fault	
Perme- ability	Overall		Probably rather permeable specially bottom of river due to assumed fault		Probably rather permeable specially bottom of river due to assumed fault		Probably rather permeable specially bottom of river due to assumed fault		Probably rather permeable specially bottom of river due to assumed fault		Probably rather permeable specially bottom of river due to assumed fault	
Over- burden	Both Abutments River Bottom		Probably moderately thick residual soil The river filled with thick sand and gravel with clay		Probably moderately thick residual soil The river filled with thick sand and gravel with clay		Probably moderately thick residual soil and terrace deposits		Probably moderately thick residual soil and terrace deposits		Probably moderately thick residual soil and terrace deposits	

C O N S T R U C T I O N M A T E R I A L S

P R O F I L E O F D A M A X I S

G E N E R A L A S S E S S M E N T

Rock & Coarse Aggre- Gates	Location	4.5Km. east of damsite
Sand	Location	4.5Km. east of damsite
Material	Quality & Volume	River deposits (sand and gravel)
Earth Material	Location	4.5Km. east of damsite
	Soil Type	Residual soil of Granodiorite
	Quality & Volume	Probably suitable
Topographic Condition		Open wide Dish type
Geologic Sketch	Not visited site	
		El.m 541m 440 328 Quartz diorite Granodiorite
Damsite		Acceptable
Waterway/Power Tunnel		
Power House		Good
Reservoir		Good
Dam Construction Material		Good

G E O L O G I C A L D A T A S H E E T

Region No.	I	I.D. No.	1-22-5-21	Scheme	DAGUOMAN		Province	A B R A	River Basin	A B R A	Stream	BUCLOC
Coordi- nates	17°27'25" N. LAT	120°55'00" E. LONG		Type of Development	DAM & RESERVIOR		Dam/Weir Type		River Cross Section at Dam/ Weir	River- bed El.	440m Width	10 m
Topo. Map Scale	No.3172-II 1:50,000	Geo. Map SCALE	1:250,000	Length of Water Way	M		Reservoir Area			Dam Crest El.	529 ± flight	89 m

Geologic formation and Age of the Site	Plutonic rocks (Neogene) Quartz diorite Granodiorite Dikes (Neogene) Quartz diorite porphyry. Liuwan Formation (Eocene) Andesitic lava & its pyroclastics		Geologic Structure	Assumed fault occur on the Bucloc river		Geologic Structure	Assumed fault occur on the Bucloc river		Rock & Coarse Aggre- gates	Location		2 Km. south of damsite	
	Geologic Structure	Assumed fault occur on the Bucloc river		Geologic Structure	Assumed fault occur on the Bucloc river		Rock Type & Age	Quartz diorite (Neogene)		Rock Type & Age	Granodiorite (Neogene)		
Rock Type and Age of Bed- rock	Quartz diorite, Granodiorite (Neogene)		Rock Type & Age	Hard and slightly weathered (at right bank site)		Rock Quality	Hard and slightly weathered (at right bank site)		Sand Material	Location		2 Km. south of damsite	
Rock Quality	Probably hard to vary hard and rich jointed due to effected assumed fault		Overburden	Residual soil and Terrace deposits		Overburden	Residual soil and Terrace deposits		Earth Material	Location		2 Km. south of damsite	
Perme- ability	Probably rather permeable specially bottom of river due to assumed fault		Geologic Structure	Several faults (trend mostly N40-45°E) occur in the reservoir area		Geologic Structure	Several faults (trend mostly N40-45°E) occur in the reservoir area		Topographic Condition	Not visited site		Open wide Dish Type	
Overall	Probably rather permeable specially bottom of river due to assumed fault		Lithology & Age	Quartz diorite, Granodiorite (Neogene) Andesitic lava & its pyroclastics (Eocene)		Lithology & Age	Quartz diorite, Granodiorite (Neogene) Andesitic lava & its pyroclastics (Eocene)		Geologic Sketch	Geologic Sketch			
Both Abutments	Probably moderately thick residual soil		Permeabi- lity and Ground- water	Probably watertight except geological contact and fault		Permeabi- lity and Ground- water	Probably watertight except geological contact and fault		Damsite	Damsite		Acceptable	
River Bottom	The river filled with thick sand and gravel with clay		Slope Stability	Mostly stable, may be slumping, soils in some areas after impounding		Slope Stability	Mostly stable, may be slumping, soils in some areas after impounding		Waterway/Power Tunnel	Waterway/Power Tunnel		Good	
Over- burden			Sediment- ation	Common		Sediment- ation	Common		Power House	Power House		Good	
									Reservoir	Reservoir		Good	
									Dam Construction Material	Dam Construction Material		Good	

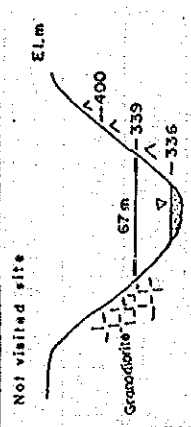
GEOLOGICAL DATA SHEET

Region No.	I	I.D. No.	1-22-5-23	Scheme	BOYAN		Province	ABRA	River Basin	ABRA	Stream	IKMIN
Coordinates	17°24'47" N. LAT	E. LONG	120°46'36"	Type of Development	DAM & RESERVOIR		Dam/Weir Type		River bed	El.	243 m	Width 10 m
Topo. Map No.	3172-II	Geo. Map SCALE	1:250,000	Length of Water Way	m		Reservoir Area		Dam Crest	El.	358 m	Height 115 m

Geologic formation and Age of the Site	Licuan Formation (Eocene) Andesitic lava & its pyroclastics Plutonic rock (Neogene) Granodiorite, Quartz diorite		The powerhouse site located between the two faults		Geologic Structure		The powerhouse site located between the two faults		CONSTRUCTION MATERIALS		Location 1.5 Km. south-east of damsite	
	Geologic Structure	The damsite located between the two parallel faults		Rock Type & Age of Bed-rock		Quartz diorite (Neogene)		Rock Type & Age Quartz diorite (Neogene)		Rock & Coarse Aggr-Gates		Rock Type & Age Granodiorite (Neogene)
Rock Quality	Both Abutments Probably hard sound rock slightly to moderately weathered at left abutment		Overburden		Thin residual soil and Talus		Hard sound rock slightly weathered		Sand		Location 1-3 Km. downstream from damsite	
Permeability	Overall Probably watertight except shallow weathered weakly jointed part		Geologic Structure		Several faults occur in the reservoir area		Hard sound rock slightly weathered		Earth Material		Location 1.5 Km. south-east of damsite	
Overburden	Right Abutments Thin residual soil		Rock Quality		Mostly stable, except stumping soils offer impending		Hard sound rock slightly weathered		Topographic Condition		V-Shape d	
	Left Abutments Rather thick to thick residual soil		Slope Stability		C o m m o n		Hard sound rock slightly weathered		Geologic Sketch		Not visited site E.l.m 807 m 400 358 243	
River Bottom		The river bed (filled with core sediments)		Sedimentation		C o m m o n		Dam Construction Material		Excellent		

G E O L O G I C A L D A T A S H E E T

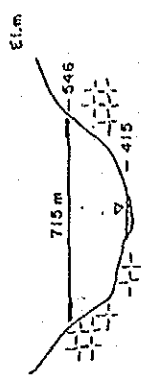
Region No.	I	I.D. No.	1-22-5-23	IKMIN	Province	ABRA	River Basin	ABRA	Stream	IKMIN
Coordi- nates	17°22'48"	120°48'25"	Type of Development	RUN OF RIVER	Dam/Weir Type		River Cross Section	River- bed	336 m	Width 10 m
Topo. Map 1:50,000	No. 3172-II	Geo. Map SCALE	Length of Water Way	11,000 M	Reservoir Area		Water Area	Crest El.	339 m	Height 6 m

Geologic formation and Age of the Site	Llucan Formation (Eocene) Andesitic lava & its pyroclastics Plutonic rocks (Neogene) Granodiorite, Quartz diorite Dikes (Neogene) Quartz diorite porphyry		Geologic Structure	Assumed fault (trend NE-SW) occur 1.5 Km south west of powerhouse	CONSTRUCTION MATERIALS	Rock & Course	Location	1.5 Km. north-east of damsite
	Geologic Structure	Geologic contact of andesite and granodiorite occur at the damsite	Rock Type & Age	Andesite (Eocene)		Rock Type & Age	Andesite (Eocene)	
Rock Type and Age of Bed- rock	Geologic contact of andesite and granodiorite occur at the damsite	Overburden	Residual soils and talus deposits	Material	Material	Quality & Volume	Hard to very hard	
Rock Quality	Both Abutments Probably hard to very hard compacted slightly weathered	Geologic Structure	Two faults (N45°E) across the tunnel route at the geologic contact of Quartz diorite	Sand	Sand	Quality & Volume	0.5-2 Km. upstream from damsite	
Permea- bility	Overall	Rock Type & Age	Intake and Outlet consists of Andesite (Eocene) upper stream side area consists of Granodiorite. after middle point it composed of Quartz-diorite	Material	Material	Quality & Volume	River deposits (sand and gravel)	
	Both Abutments	Rock Quality	Probably hard to very hard fractured, due to faulted zone	Earth	Earth	Quality & Volume		
Over- burden	Overall	Overburden	Chiefly enough but some places thin due to several cracks intersected to the tunnel route	Topographic Condition	Topographic Condition		Open V-Shaped	
	Both Abutments	Overburden	Quartz diorite intrudes into the granodiorite about 3 Km. upstream of damsite	Geologic Sketch	Geologic Sketch		Not visited site 	
				GENERAL ASSESSMENT				
				Damsite				Good
				Waterway/Power Tunnel				Good/Acceptable
				Power House				Good
				Reservoir				Good
				Dam Construction Material				Excellent

G E O L O G I C A L D A T A S H E E T

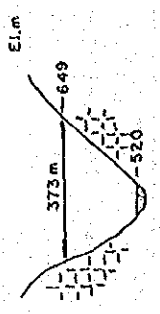
Section No.	1	I.D. No.	1-22-5-23	Scheme	TOQUEUNG	Province	ABRA	River Basin	ABRA	Stream	K.M.I.N	
Coordi- nates	17°22'46"	120°49'53"		DAM & RESERVOIR		Dam/Weir Type		River-bed	El.	416m	Width	10m
Topo. Map No. 1:50,000	No. 3172-II	Geo. Map SCALE	1:250,000	Length of Water Way	m	Reservoir Area	km ²	Section at Dam/Weir	Crest El.	546 m	Height	130 m

Geologic formation and Age of the Site	Plutonic rocks (Neogene) Quartz diorite, Granodiorite Dikes (Neogene) Dacite	Scheme Development Type of Length of Water Way	I.D. No. 1-22-5-23	TOQUEUNG	Province ABRA	DAM & RESERVOIR	Dam/Weir Type	RIVER BASIN	ABRA	Stream	K.M.I.N
	Geologic Structure										
Geologic Structure	Dacite dike across the dam axis diagonally	Geologic Structure		Geologic Structure		Rock Type & Age	Granodiorite (Neogene)	Rock & Coarse Aggre- gates	Location	3km. east of damsite	
Rock Type and Age of Bed- rock	Granodiorite and Dacite (Neogene)	Rock Type & Age		Rock Type & Age		Rock Quality	Hard and sound rock (at right bank site)	Sand	Location	1-3km. downstream from damsite	
Rock Quality	Both Abutments Probably hard sound rock partially jointed and cracked weakly cemented	Rock Quality		Rock Quality		Overburden	Talus deposits and terrace deposits	Material	Quality & Volume	River and terrace deposits	
Permeability	Overall	Permeability		Permeability		Overburden	Probably waterlight except weakly cemented joints and cracks	Earth Material	Location	3km. east of damsite	
	Both Abutments	Both Abutments		Both Abutments		Overburden	Thick to slightly thick residual soil occur on high elevation of abutments	Topographic Condition	Quality & Volume	Probably suitable	
Overburden	River Bottom	River Bottom		River Bottom		Overburden	The river bed filled with sand, gravel and cobble	Geologic Sketch	Not visited site	Open wide	
						Overburden		Geologic Sketch	Topographic Condition	Dish Type	



G E O L O G I C A L D A T A S H E E T

Region No.	1	I.D. No.	1-22-5-25	Scheme	1-22-5-25	DANAC	ABRA	River Basin	ABRA	Stream	IKMIN
Coordinates	17°23'05" N. LAT	120°52'38" E. LONG		Type of Development	DAM & RESERVOIR	Province	Dam/Weir Type	River Cross Section of Dam/Weir	River-bed El.	520m Width	10 m
Topo. Map	No. 3172-II	Geo. Map SCALE	1:250,000	Length of Water Way	m	Reservoir Area	km ²		Dam Crest El.	649m Height	129m

G E O L O G I C A L	Geologic formation and Age of the Site	Liasan Formation (Eocene) Andesitic lava & its pyroclastics Plutonic rocks (Neogene) Quartz diorite, Granodiorite	MSDOH	Major fault (trend N45°E) across the left abutment	CONSTRUCTION MATERIALS	Location	2 Km. EW of damsite
	Geologic Structure	Major fault (trend N45°E) across the left abutment			Rock & Coarse Aggr. Gases	Rock Type & Age	Quartz diorite (Neogene)
	Geologic Structure	Granodiorite (Neogene)			Sand	Quality & Volume	Hard-very hard partially weathered
	Rock Type & Age	Hard and slightly weathered (at right bank site)			Material	Location	1-6km. upstream from damsite
	Rock Quality	Slightly thick residual soil			Sand	Quality & Volume	River and terrace deposits
	Overburden				Material	Location	2 Km. EW of damsite
	Geologic Structure				Earth Material	Soil Type	Residual soil of Quartz diorite
	Rock Type & Age					Quality & Volume	Probably suitable
	Rock Quality				Topographic Condition		V - Shaped
	Overburden				Geologic Sketch		Not visited site Elm. 
	Geologic Structure	Two major faults (trend N40°-45°E) across the Ikmin River			Damsite		Acceptable / Poor
	Lithology & Age	Chiefly quartz diorite and Granodiorite (Neogene) Andesite (Eocene)			Waterway/Power Tunnel		
	Permeability and Ground-water	Probably watertight except fault and geologic contact			Power House		Good
	Slope Stability	Probably stable			Reservoir		Acceptable
	Sedimentation	Less so common			Dam Construction Material		Good

G E O L O G I C A L D A T A S H E E T

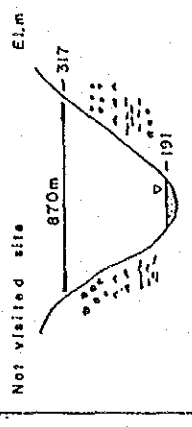
Region No.	I	I.D. No.	I-22-6-26	Scheme	AMLUAGAN		Province	A B R A	River Basin	A B R A	Stream	DAMANIT	
Coordinates	17°18'35" N. LAT	120°43'00" E. LONG		Type of Development	DAM & RESERVIOR		Dam/Weir Type		River bed	El.	191m	Width	20m
Topo. Map	No. 3171-IV	Geo. Map	1:250,000	Length of Water Way	m		Reservoir Area		Dam Crest	El.	317m	Height	125m
Scale		SCALE							at Dam/Weir				

Geologic Formation and Age of the Site	Metavolcanics (Cretaceous-Paleogene) Metamorphosed submarine flows largely spilites and basalt, some Karatophytes and andesite. Locally with interbedded silt, marble and sediments. Ni (Lower-Middle Miocene) Conglomerate, wackes, shales and reef limestone Intrusive rocks (Naegene) Quartz diorite, Granodiorite		Assuming fault (N45°E) occur 2km. upstream of damsite		Assuming fault (N45°E) occur 2km. upstream from powerhouse		Conglomerate, wackes, shales (Lower-Middle Miocene)		Hard and compacted (at left bank site)		Terrace deposits and talus deposits		Geologic Structure	
	Geologic Structure		Rock Type and Age of Bed-rock		Rock Quality		Overburden		Geologic Structure		Rock Type and Age		Rock Quality	
	Both Abutments		Probably hard, indurated, well cemented and compacted		Overall		Probably watertight		Both Abutments		Medium thickness of residual soil		River Bottom	
	River Bottom		River bed filled with some gravel with sand		Overall		Probably watertight		Both Abutments		Medium thickness of residual soil		River Bottom	
	Overburden		River bed filled with some gravel with sand		Overall		Probably watertight		Both Abutments		Medium thickness of residual soil		River Bottom	
	Permeability		Probably watertight		Overall		Probably watertight		Both Abutments		Medium thickness of residual soil		River Bottom	
	Slope Stability		Probably watertight		Overall		Probably watertight		Both Abutments		Medium thickness of residual soil		River Bottom	
	Sedimentation		Less to common		Overall		Probably watertight		Both Abutments		Medium thickness of residual soil		River Bottom	
	Geologic Structure		Conglomerate, wackes, shales (Lower-Middle Miocene)		Rock Quality		Hard and compacted (at left bank site)		Overburden		Terrace deposits and talus deposits		Geologic Structure	
	Rock Type and Age of Bed-rock		Conglomerate, wackes, shales (Lower-Middle Miocene)		Rock Quality		Probably hard, indurated, well cemented and compacted		Overburden		Terrace deposits and talus deposits		Geologic Structure	
	Rock Quality		Probably hard, indurated, well cemented and compacted		Overall		Probably watertight		Both Abutments		Medium thickness of residual soil		River Bottom	

CONSTRUCTION MATERIALS

PROFILE OF DAM AXIS

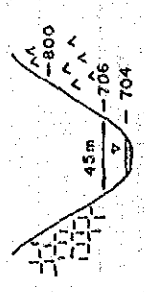
GENERAL ASSESSMENT



G E O L O G I C A L D A T A S H E E T

Region No.	I	I.D. No.	I-22-6-27	DAMANIT	A B R A	River Basin	A B R A	Stream	DAMANIT
Coordinates	17°20'31"	120°49'39"	Scheme	Province	A B R A	River Cross Section at Dam/Weir	River-bed El.	704m	40m
Topo. Map	No-3172-II	Geo. Map SCALE	1:250,000	Dam/Weir Type	Reservoir Area	Reservoir	Dam Crest El.	706m	5m
				Length of Water Way	5040 m				

Geologic formation and Age of the Site	Liluan Formation (Eocene) Andesitic lava & its pyroclastics Plutonic rocks (Neogene) Granodiorite, Quartz diorite		Geologic contact of andesite and quartz diorite make fault line	Geologic Structure	M S D O M	Geologic Structure	M S D O M	Geologic contact of andesite and quartz diorite make fault line	A B R A	River Basin	A B R A	Stream	DAMANIT
	Geologic Structure	Geologic Structure											
Rock Type and Age of Bed-rock	Andesite (Eocene) Quartz diorite (Neogene)		Probably hard to very hard compacted slightly weathered	Rock Type & Age	M S D O M	Rock Type & Age	M S D O M	Granodiorite (Neogene)	A B R A	River Basin	A B R A	Stream	DAMANIT
Rock Quality	Probably hard to very hard compacted slightly weathered												
Permeability	Probably rather permeable on the faulted fractured zone		Medium thickness of residual soil and talus deposits	Overburden	M S D O M	Overburden	M S D O M	Medium thickness of residual soil and talus deposits	A B R A	River Basin	A B R A	Stream	DAMANIT
Overburden	Both Abutments Probably hard to very hard sound rock with faulted fractured zone												
	Overall		Intake side consists of Andesite, Outlet side consists of Granodiorite (Eocene & Neogene)	Rock Type & Age	M S D O M	Rock Type & Age	M S D O M	Intake side consists of Andesite, Outlet side consists of Granodiorite (Eocene & Neogene)	A B R A	River Basin	A B R A	Stream	DAMANIT
	Both Abutments												
	Overall		Good, enough thickness	Overburden	M S D O M	Overburden	M S D O M	Good, enough thickness	A B R A	River Basin	A B R A	Stream	DAMANIT
	Both Abutments												
	Overall		Quartz diorite (Neogene) Andesite (Eocene)	Lithology & Age	M S D O M	Lithology & Age	M S D O M	Quartz diorite (Neogene) Andesite (Eocene)	A B R A	River Basin	A B R A	Stream	DAMANIT
	Both Abutments												
	Overall		Stable	Slope Stability	M S D O M	Slope Stability	M S D O M	Stable	A B R A	River Basin	A B R A	Stream	DAMANIT
	Both Abutments												
	Overall		Excellent	Dam Construction Material	M S D O M	Dam Construction Material	M S D O M	Excellent	A B R A	River Basin	A B R A	Stream	DAMANIT



GEOLOGICAL DATA SHEET

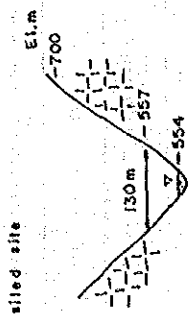
Region No.	I	I.D. No.	1-22-6-28	Scheme		N A I N A	A B R A	River Basin	A B R A	Stream	U T I P
Coordi- nate	17°15'37"	E. LONG	120°43'20"	Type of Development	DAM & RESERVOIR			River Cross Section at Dam/ Weir	River- Bed Dam Crest [E.L.]	275m Width	20 m
Topo. Map Scale	No. 3171-IV	Geo. Map SCALE	1:250,000	Length of Water Way	M					393 m Weight	118 m

Geologic formation and Age of the Site	Metavolcanics (Cretaceous-Paleogene) Metamorphosed submarine flows, largely spilites, locally with intercalated chert, marble and sediments. Intrusive Rocks (Neogene) Quartz diorite, Granodiorite		No major fault on the powerhouse site		No major fault on the damsite		1.5 Km. east of damsite		
	Geologic Structure		Geologic Structure		Geologic Structure		Geologic Structure		
Rock Type and Age of Bed- rock	Metavolcanics (Cretaceous-Paleogene)		Rock Type & Age	Metavolcanics (Cretaceous-Paleogene)	Rock Type & Age		Rock Type & Age	Metavolcanics (Cretaceous-Paleogene)	
Rock Quality	Both Abutments Probably hard to very hard sound rock, indurated and tough		Rock Quality	Hard to very hard (at right bank site)	Rock Quality		Rock Quality	Hard to very hard	
Perme- ability	Overall Probably watertight		Overburden	Terrace deposits and Talus deposits	Overburden		Overburden	1-4 Km. downstream from damsite	
Over- burden	Both Abutments Medium thickness of residual soil		Geologic Structure		Geologic Structure		Geologic Structure		
	River Bottom River bed filled with sand and gravel		Rock Type & Age		Rock Type & Age		Rock Type & Age		
			Slope Stability	Probably stable	Slope Stability		Slope Stability		
			Sediment- ation	Less to common	Sediment- ation		Sediment- ation		
CONSTRUCTION MATERIALS					PROFILE OF DAM AXIS				
Rock & Coarse Aggre- gates					Topographic Condition				
Sand					Not visited site				
Material					Elm				
Earth Material					739m				
Quality & Volume					393				
Probably suitable					275				
Open wide V-Shaped					Metavolcanics				
Excellent					Metavolcanics				
Waterway/Pover Tunnel					Excellent				
Pover House					Good				
Reservoir					Good				
Dam Construction Material					Excellent				

GEOLOGICAL DATA SHEET

Region No.	I	I.D. No.	1-22-6-29	UTIP	A B R A	River Basin	A B R A	Stream	UTIP
Coordinates	17°15'17" N. LAT	120°49'32" E. LONG	Province	Province	Province	River Cross Section	River-bed	554 m	70 m
Topo. Map No. 1:50,000	No. 3171-1	Geo. Map SCALE	7870 M	7870 M	7870 M	Reservoir Area	Creast EL.	557 m	6 m
Scheme		Type of Development		RUN of RIVER		Dam/Weir Type		Max. Height	
Length of Water Way		7870 M		Reservoir		Reservoir		6 m	

Geologic formation and Age of the Site	Metavolcanics (Cretaceous-Paleogene) Metamorphosed submarine flows largely spilites and basalt some Keratophyes and andesite. Locally with intercalated chert, marble and sediments. Intrusive rocks (Neogene) Quartz diorite, Granodiorite	Geologic Structure	No major fault on the powerhouse site	CONSTRUCTION MATERIALS	Rock & Coarse Aggregate	Location	3 Km. north-east of damsite
Geologic Structure	No major fault on the damsite	Rock Type & Age	Metavolcanics (Cretaceous-Paleogene)	Sand	Location	Quartz diorite, Granodiorite (Neogene)	
Rock Quality	Both Abutments - Probably, hard to very hard indurated	Rock Quality	Hard to very hard	Material	Location	Hard to very hard	
Permeability	Overall - Probably watertight	Overburden	Terreza deposits and Talus deposits	Earth Material	Location	5-8 Km. downstream from Powerhouse site	
Overburden	Both Abutments - Medium thickness of residual soil River Bottom - The river bed filled with some cobbles and boulder	Geologic Structure	No major fault on the water way	Topographic Condition	Location	River deposits (sand and gravel)	
Profile of Dam Axis		Rock Type & Age	Metavolcanics (Cretaceous-Paleogene) at Outlet side Quartz diorite, Granodiorite (Neogene) at inlet side	Geologic Sketch	Soil Type		
General Assessment		Rock Quality	Hard to very hard, indurated and tough	Topographic Condition			
Dam		Overburden	Mostly enough thickness for tunnel excavation	Geologic Sketch			
Abutments		Geologic Structure	No major fault in the reservoir area	Topographic Condition			
River Bottom		Lithology & Age	Quartz diorite, Granodiorite (Neogene)	Geologic Sketch			
Slope Stability		Permeability and Ground-water	Probably watertight	Topographic Condition			
Sedimentation		Slope Stability	Probably stable	Geologic Sketch			
Foundation		Sedimentation	Common	Topographic Condition			



G E O L O G I C A L D A T A S H E E T

Region No.	1	I.D. No.	J-22-7-30	Scheme	A B R A	Province	A B R A	River Basin	A B R A	Stream	D I T O N G
Coordi- nates	17°11'10" N. LAT	E. LONG	120°43'24"	DAMB RESERVOIR	Dam/Weir Type	Reservoir		River bed	El.	326 m	Width 10m
Topo. Map No.	S/71-IV	Geo. Map SCALE	1:250,000	Length of Water Way	M	Area	Km ²	Section at Dam/Weir	El.	432 m	Height 106m

	Geologic formation and Age of the Site	Metavolcanics (Cretaceous-Paleogene) Metamorphosed submarine flows largely spilites and basalt some keratophyres and andesite - Locally with intercalated chert marble and sediments. Intrusive Rocks (Neogene) Quartz diorite, granodiorite	Geologic Structure	Quartz diorite and granodiorite intrudes into metavolcanics	Rock & Coarse Aggregate	Location	2.5 Km. east of damsite
	Geologic Structure	Quartz diorite and granodiorite intrudes into metavolcanics	Rock Type & Age	Quartz diorite, granodiorite (Neogene)	Location	Location	Metavolcanics (Cretaceous-Paleogene)
	Rock Type and Age of Bed-rock	Quartz diorite, granodiorite (Neogene)	Rock Quality	hard to very hard (at right bank site)	Location	Location	Hard to very hard
	Rock Quality	Probably hard to very hard indurated compacted and tough	Overburden	Terrace deposits and talus deposits	Location	Location	1-3 Km. downstream from damsite
	Permeability	Overall Probably watertight	Geologic Structure		Material	Material	River deposits sand and gravel
	Overburden	Both Abutments elevation of higher	Rock Type & Age		Location	Location	1 Km. east of damsite
			Rock Quality		Earth Material	Earth Material	Residual soil of quartz diorite
			Overburden		Topographic Condition	Topographic Condition	Probably suitable
					Geologic Sketch	Geologic Sketch	Open V-Shape
					<p style="text-align: center;">GENERAL ASSESSMENT</p>		
					Damsite	Damsite	Good
					Waterway/Power Tunnel	Waterway/Power Tunnel	Good
					Power House	Power House	Good
					Reservoir	Reservoir	Good
					Dam Construction Material	Dam Construction Material	Excellent

G E O L O G I C A L D A T A S H E E T

Region No.	1	I.D. No.	I-22-7-31	Scheme			S U Y S U Y A N	I L O C O S S U R	R i v e r B a s i n	A B R A	S t r e a m	B A L A S I A N
Coordi- nates	17°07'30" N. LAT.	120°44'20" E. LONG.		Type of Development	D A M & R E S E R V O I R				River- bed	EL-386	m Width	20 m
Topo. Map Scale	No. 3171-III	Geo. Map Scale	1:250,000	Length of Water Way	m				Dam Creat	EL.	512 m Height	126 m

Geologic Formation and Age of the Site	Metavolcanics (Cretaceous to Paleogene). Metamorphosed submarine flows largely spilites and basalt, some Keratophyres and andesite. Locally with intercalated chert, marble and sediments											
Geologic Structure	Major fault (trend N-S) occur 1km downstream of damsite											
Rock Type and Age of Bed- rock	Metavolcanics (Cretaceous to Paleogene)											
Rock Quality	Both Abundant Probably hard to very hard indurated sound rock, slightly weathered											
Permea- bility	Overall Probably watertight except weathered jointed zone											
Over- burden	Both Abundant Medium thickness of Residual soil Riverbed filled with thick sand and gravel											
CONSTRUCTION MATERIALS												
Rock & Coarse Aggre- gates	Location	3 Km. east of damsite										
Sand	Material	Metavolcanics (Cretaceous-Paleogene)										
Material	Quality & Volume	Hard to very hard slightly weathered										
Earth Material	Location	2-5 Km. downstream from damsite										
Topographic Condition	Soil Type	River deposits (sand and gravel)										
Geologic Sketch	Quality & Volume	3 Km. east of damsite										
PROFILE OF DAM AXIS												
Not visited site												
GENERAL ASSESSMENT												
Damsite	Good											
Waterway/Power Tunnel	Good											
Power House	Good											
Reservoir	Good											
Dam Construction Material	Good											

G E O L O G I C A L D A T A S H E E T

Region No.	I	I.D. No.	I-37-01	Scheme	DINGRAS	ILOCOS NORTE	River Basin	LAOAG	Stream	MADONGAN
Coordi- nates	N. LAT 18° 00' 29" E. LONG 120° 45' 39"		Type of Development		DAM & RESERVOIR	Province Dam/Weir Type		River bed	El. 125 m	Width 30 m
Topo. Map No. 3174-II	Geo. Map SCALE 1:250,000		Length of Water Way		M	Reservoir Area	Dam Section at Dam/Weir	Dam Crest	El. 220 m	Height 95 m

Geologic formation and Age of the Site	Plutonic rocks (Neogene) Quartz diorite, Gabbro Licoen Formation (Eocene) Andesite lava & ls. Pyroclastics		Geologic Structure		Geologic contact of Licoen Formation and quartz diorite occur near powerhouse		Rock & Coarse Aggre- Gates	Location	2 Km. S.E. of Damsite	
	Geologic Structure	Normal fault trend N 45° E occur 2 km. south east of damsite		Quartz diorite (Neogene) probably hard to very hard and slightly to moderately weathered (at right bank site)		Gabbro (Neogene) hard to very hard				
Rock Type and Age of Bed- rock	Quartz diorite (Neogene)		Overburden		Talus deposits		Location		1 km. downstream from dam site	
Rock Quality	Both Abutment and slightly to		Geologic Structure				Quality & Volume		Aluvial deposits	
	Moderately weathered		Rock Type & Age				Location		2 km. S.E. of dam site	
Permeability	Overall		Lithology & Age		Quartz diorite, Gabbro (Neogene)		Soil Type		Residual Soil of Gabbro	
	Probably water tight, except moderately weathered zone		Permeability and Ground- water		probably water tight, except moderately weathered zone and geological contact		Quality & Volume		Probably suitable	
Overburden	Both Abutment elevation		Slope Stability		Mostly stable except sliding rock debris		Topographic Condition		Open V-shaped	
	Thick residual soil in higher		Sediment- ation		Common		Geologic Sketch			

C O N S T R U C T I O N M A T E R I A L S

P R O F I L E O F D A M A X I S

G E N E R A L A S S E S S M E N T

G E O L O G I C A L D A T A S H E E T

Region No.	1	I.D. No.	1-39-0-1	Scheme	VINTAR	ILOCOS NORTE	River Basin	VINTAR	Stream	VINTAR
Coordi- nates	18°22'08" N. LAT	120°44'32" E. LONG	Type of Development	DAM & RESERVOIR	Province Dam/Weir Type		River Cross Section at Dam/ Weir	River- bed El.	70 m Width	30 m
Topo. Map 1:50,000	No. 3175-II	Geo. Map SCALE	Length of Water Way	M	Reservoir Area	km ²		Dam Crest El.	119 m	Height 49 m

Geologic formation and Age of the Site	Sedimentary and volcanic rock (Ni) (Early to Middle Miocene) Sedimentary rocks are unstratified Conglomerate with interbeds of sandstone and shale Volcanic rock are essentially porphyritic andesite		Thrust fault (NNE trend) occur 1.5 Km. west of dam site		Thrust fault (NNE trend) occur 1.7 Km. west of powerhouse		CONSTRUCTION MATERIALS		Location	2.5 Km. ENE of dam site	
	Geologic Structure			Geologic Structure			Rock & Coarse Aggre- gates	Rock Type & Age	Conglomerate or andesite	Quality & Volume	Rather hard to hard
Rock Type and Age of Bed- rock	Unstratified conglomerate with interbeds of sandstone and shale porphyritic andesite (Early to Middle Miocene)				Rather hard (at left bank site)		Sand	Location	3.0 Km. north-east of dam site	Location	2.5 Km. north of dam site
Rock Quality	Poorly indurated rock hard to rather hard well cemented and compacted				Thick river deposits and terrace deposits		Material	Quality & Volume	River deposits (Sand and Gravel)	Location	2.5 Km. north of dam site
Perme- ability	Overall						Earth Material	Soil Type	Residual soil of Conglomerate and/or andesite	Quality & Volume	Probably suitable
	Overall		Probably low permeability except deeply weathered rock at shallow part				Topographic Condition		V-Shaped	Not visited site	
Over- burden	Both Abutments		Thick residual soil and deeply weathered rock		Probably low permeability		Geologic Sketch				
	Riverbed		Riverbed is filled with thick sand and gravel deposits		Less		GENERAL ASSESSMENT		Dam site	Acceptable	
								Waterway/Power Tunnel			
								Power House		Good/Acceptable	
								Reservoir		G o o d	
								Dam Construction Material		Good/Acceptable	

G E O L O G I C A L D A T A S H E E T

Region No.	1	I.D. No.	1-39-0-2	Scheme	TAM D A G A N	ILOCOS NORTE	River Basin	V I N T A R	Stream	T A M D A G A N	
Coordi- nates	10°18'05" N. LAT	E. LONG	120°47'20"	Type of Development	DAM & RESERVOIR	Dam/Weir Type	River bed	EL.	95 m	Width	80 m
Topo. Map No.	3174-1	Geo. Map SCALE	1:500,000	Length of Water Way	M	Reservoir Area	Dam Crest	EL.	213 m	Height	118 m

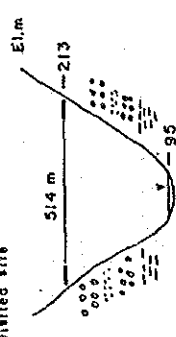
G E O L O G I C A L F O R M A T I O N a n d A g e o f t h e S i t e	Geologic Formation and Age of the Site	Sedimentary and volcanic rocks (N) (Early to Middle Miocene) Sedimentary rocks are unsorted conglomerate with interbeds of sandstone and shale Volcanic rocks are essentially porphyritic andesite	Geologic Structure	Thrust fault (NNE trend) occur 8Km north-west of dam site	Province	ILOCOS NORTE	River Basin	V I N T A R	Stream	T A M D A G A N		
	Geologic Structure	Sedimentary and volcanic rocks unconformably overlies the metasedimentary and metavolcanic rocks	Geologic Structure	Overburden	Dam/Weir Type	DAM & RESERVOIR	River bed	EL.	95 m	Width	80 m	
	Rock Type and Age of Bed-rock	Unsorted conglomerates with interbeds of sandstone and shale porphyritic andesite (Early to Middle Miocene)	Rock Type and Age	Overburden	Reservoir Area	M	Reservoir	Dam Crest	EL.	213 m	Height	118 m
	Rock Quality	Poorly indurated rock hard to rather hard well cemented and compacted	Rock Quality	Overburden	Area							
	Permeability	Probably low permeability except deeply weathered rock at shallow depth	Geologic Structure	Overburden								
	Overburden	Both Abutments Thick residual soil and deeply weathered rock Riverbed is filled with sand and gravel	Lithology and Age	Overburden								
			Permeability and Ground-water	Overburden								
			Slope Stability	Overburden								
			Sedimentation	Overburden								
				Overburden								

C O N S T R U C T I O N M A T E R I A L S

P R O F I L E O F D A M A X I S

G E N E R A L A S S E S S M E N T

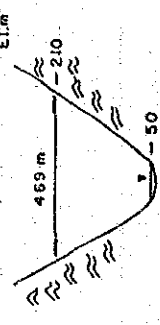
Rock & Coarse Aggregate	Location	1.5Km north-south of dam site
Sand	Location	1-4Km downstream of dam site
Material	Quality & Volume	River deposits (Sand and Gravel)
Earth Material	Location	2.5Km west of dam site
	Soil Type	Residual soil of conglomerate and/or andesite
	Quality & Volume	Probably suitable
Topographic Condition		V-Shaped
Geologic Sketch		Not visited site
Dam Site		Good
Waterway/Power Tunnel		Good
Power House		Good
Reservoir		Good
Dam Construction Material		Good/Acceptable



G E O L O G I C A L D A T A S H E E T

Region No.	1	I.D. No.	1-47-0-1	B U L U		ILOCOS NORTE	River Basin	B U L U	Stream	B U L U
Coordi- nates	18°31'08" N. LAT	120°50'52" E. LONG	Scheme		DAM & RESERVOIR	Province	River Cross Section at Dam/ Water	River- bed	50 m Width	40 m
Topo. Map Scale	No. 3175-1 1:50,000	Geo. Map Scale	1:500,000	Type of Development	Reservoir Area	Dam/ Weir Type	Dam Crest	EL.	210m Height	160 m

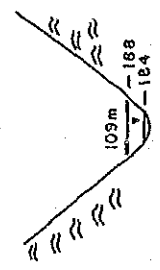
G E O L O G I C A L D A T A S H E E T		G E O L O G I C A L D A T A S H E E T		G E O L O G I C A L D A T A S H E E T		G E O L O G I C A L D A T A S H E E T		G E O L O G I C A L D A T A S H E E T	
Geologic formation and Age of the Site	Undifferentiated metasedimentary and meta- volcanic rocks (Kpg) (Cretaceous - Paleogene) Indurated shale, graywacks and conglomerate Laocaog Formation (Pliocene) inter bedded sandstone and silty shale with limestone	Major thrust fault (NE-SW trend) occur about 1.6 Km. downstream of powerhouse site	Indurated shale, graywacks and conglomerate. Andesitic composition (Cretaceous - Paleogene)	Hard to very hard (at right bank site)	Terrace deposits and debris	Rock & Coarse Aggregate Gates	Location 1-2 Km. downstream of damsite	1 Km. south of damsite	Shale, graywacks, conglomerate and andesite (Cretaceous - Paleogene) Hard to very hard
	Geologic Structure	Thrust fault (NE-SW trend) occur about 2 Km. downstream of dam site which is characterized by strong folding and crushed zone with east to southeast dipping	Indurated shale, graywacks and conglomerate. Andesitic composition (Cretaceous - Paleogene)	Hard to very hard (at right bank site)	Terrace deposits and debris	Sand Material	Location 1-2 Km. downstream of damsite	1 Km. south of damsite	
Rock Type and Age of Bed- rock	Indurated, and highly silicified shale, gray- wacks and conglomerate. Andesitic composition (Cretaceous - Paleogene)	Indurated shale, graywacks and conglomerate. Andesitic composition (Cretaceous - Paleogene)	Indurated shale, graywacks and conglomerate. Andesitic composition (Cretaceous - Paleogene)	Hard to very hard (at right bank site)	Terrace deposits and debris	Earth Material	Location 2-3 Km. downstream of damsite	1 Km. south of damsite	Shale, graywacks, conglomerate and andesite (Cretaceous - Paleogene) Hard to very hard
Rock Quality	Overall Hard to very hard, indurated, partly folding and fractured, slightly, weathered along the joints	Indurated shale, graywacks and conglomerate. Andesitic composition (Cretaceous - Paleogene)	Indurated shale, graywacks and conglomerate. Andesitic composition (Cretaceous - Paleogene)	Hard to very hard (at right bank site)	Terrace deposits and debris	Topographic Condition	Quality & Volume	1 Km. south of damsite	Shale, graywacks, conglomerate and andesite (Cretaceous - Paleogene) Hard to very hard
Perme- ability	Overall Probably low permeability except strong folding fractured zone	Indurated shale, graywacks and conglomerate. Andesitic composition (Cretaceous - Paleogene)	Indurated shale, graywacks and conglomerate. Andesitic composition (Cretaceous - Paleogene)	Hard to very hard (at right bank site)	Terrace deposits and debris	Geologic Sketch	Quality & Volume	1 Km. south of damsite	Shale, graywacks, conglomerate and andesite (Cretaceous - Paleogene) Hard to very hard
Over- burden	Residual soil and slightly weathered rock at top of abutments, debris at top of abutments	Indurated shale, graywacks and conglomerate. Andesitic composition (Cretaceous - Paleogene)	Indurated shale, graywacks and conglomerate. Andesitic composition (Cretaceous - Paleogene)	Hard to very hard (at right bank site)	Terrace deposits and debris	Damsite	Quality & Volume	1 Km. south of damsite	Shale, graywacks, conglomerate and andesite (Cretaceous - Paleogene) Hard to very hard
	Riverbed and gravel	Riverbed is filled with sand and gravel	Indurated shale, graywacks and conglomerate. Andesitic composition (Cretaceous - Paleogene)	Hard to very hard (at right bank site)	Terrace deposits and debris	Waterway/Pover Tunnel	Quality & Volume	1 Km. south of damsite	Shale, graywacks, conglomerate and andesite (Cretaceous - Paleogene) Hard to very hard



G E O L O G I C A L D A T A S H E E T

Region No.	I	I.D. No.	I-47-O-2	Scheme	B U L U	Province	ILOCOS NORTE	River Basin	B U L U	Stream	B U L U
Coordinates	18° 28' 48" N. Lat	120° 52' 54" E. Long		Type of Development	RUN OF RIVER	Dam/Weir Type		River Cross Section	River-bed EL.	184 m Width	100 m
Topo. Map No.	3175-II	Geo. Map SCALE	1:500,000	Length of Water Way	5120 m	Reservoir Area		Weir	Great EL.	188 m Height	7 m

Geologic Formation and Age of the Site	Undifferentiated metasedimentary and mafic volcanic rocks (Kpg) (Cretaceous - Paleogene)		Indurated shale, graywacke, conglomerate, Andesitic composition		Intrusive rock (Middle Miocene) Quartz diorite	
	Major thrust fault (NNE-SSW) and right lateral fault (WNW-ESE) occur 1 Km. east of damsite.		Quartz diorite intruded the Kpg			
Geologic Structure	Indurated and highly silicified shales, graywacke and conglomerate, Andesitic composition (Cretaceous - Paleogene)		Hard to very hard indurated partly folding and fractured, slightly weathered along the joints			
Rock Type and Age of Bedrock	Overall		Probably low permeability except strong folding fracture zone			
Permeability	Overall		Residual soil and slightly weathered rock at top of abutments, bedris at toe of abutments			
Overburden	Overall		Riverbed filled with sand and gravel			
CONSTRUCTION MATERIALS						
Rock & Coarse Aggregates	Location	0-3 Km. north east of damsite (tunnel route)	Rock Type & Age	Indurated shale, graywacke conglomerate, Andesite (Cretaceous - Paleogene)	Quality & Volume	Hard to very hard (Cullings from tunnel)
Sand	Location	2-3 Km. downstream of damsite	Material	River deposits (sand and gravel)	Quality & Volume	
Earth Material	Location		Geologic Structure	No major fault along the water way	Rock Quality	
Topographic Condition	Topographic Condition	V - Shape	Rock Quality	Probably hard to very hard and partly strong folding and crushed zone occur	Overburden	Enough thickness of tunnel excavation
Geologic Sketch	Geologic Sketch	Not visited site	Geologic Structure	Major thrust fault across the Bulu river about 1.5 Km. upstream of damsite	Lithology & Age	Indurated shale, graywacke and conglomerate, Andesite (Cretaceous - Paleogene) Quartz diorite (Middle Miocene)
Dam Site	Dam Site	Good	Permeability and Groundwater	Probably low permeability	Slope Stability	Probably stable
Waterway/Power Tunnel	Waterway/Power Tunnel	Good	Sedimentation	L e s s		
Power House	Power House	Good				
Reservoir	Reservoir	Good				
Dam Construction Material	Dam Construction Material	Excellent				



G E O L O G I C A L D A T A S H E E T

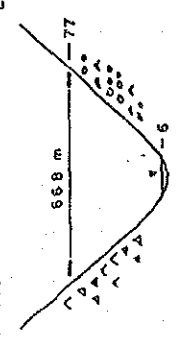
Region No.	II	I.D. No.	2-5-0-1	Scheme	LUNA	Province	(CAGAYAN?) KALINGA APAYAO	River Basin	GATTU	Stream	ZIWANAN
Coordi- nates	18°26'50" N, 121°14'00" E. LONG			Type of Development	DAMS	Dam/Weir TYPE		River bed	El.	10 m	Width 60 m
Topo. Map No. 1:50,000	No. 3275-III	Geo. Map SCALE 1:1,000,000		Length of Water Way	RESERVOIR	Reservoir ARCH		Dam Section at Dam/Weir	Crest El.	106 m	Height 96 m

G E O L O G I C A L D A T A S H E E T		G E O L O G I C A L D A T A S H E E T		G E O L O G I C A L D A T A S H E E T		G E O L O G I C A L D A T A S H E E T		G E O L O G I C A L D A T A S H E E T		G E O L O G I C A L D A T A S H E E T		
Geologic formation and Age of the Site	N: (Early - Middle Miocene) Conglomerate, wackes and shales Intrusive rocks (Neogene) Quartz diorite, granodiorite UV (Cretaceous - Paleogene) Metamorphosed submarine flows Quaternary volcanics (Quaternary) Dacite and andesite	Geologic Structure	No major fault of powerhouse site	Geologic Structure	No major fault of powerhouse site	Rock & Coarac Aggre- gates	Location	4 Km. WNW from damsite	Rock Type & Age	Metamorphosed basalt	Quality & Volume	Hard to very hard
Geologic Structure	Assumed fault (ENE - WSW) occur 5 Km. west of damsite. Quartz diorite intrusive into NI and UV Formation	Geologic Structure		Rock Quality	Rather hard (at right bank site)	Sand	Location	0-2 Km. upstream from damsite	Material	River deposits (sand and gravel)	Quality & Volume	
Rock Type and Age of Bed- rock	Conglomerate, wackes and shales (Early - Middle Miocene)	Geologic Structure		Overburden	Terrace deposits and debris	Earth Material	Location	3.5 Km. north-east of damsite	Soil Type	Residual soil of Metamorphosed basalt	Quality & Volume	Probably suitable
Rock Quality	Poorly indurated rock hard to rather hard well cemented and compacted	Geologic Structure		Geologic Structure		Topographic Condition	Not visited site	Elm	V-Shaped			
Permeability	Probably low permeability except deeply weathered rock at shallow part	Geologic Structure		Rock Quality		Geologic Sketch						
Boh Abutments	Thick residual soil	Lithology & Age	Assumed fault (ENE - WSW) occur along the Ziwanan river Conglomerate, wackes and shales (Early - Middle Miocene) Metamorphosed basalt (Cretaceous - Paleogene) Quartz diorite (Neogene)	Overburden		Damsite						
Riverbed	Riverbed is filled with thick sand and gravel deposits	Permeability and Ground-water	Probably low permeability except folded and fractured zone	Geologic Structure		Waterway/Power Tunnel						
		Slope Stability	Probably stable	Lithology & Age		Power House						
		Sedimentation		Permeability and Ground-water		Reservoir						
				Permeability and Ground-water		Dam Construction Material						Excellent

G E O L O G I C A L D A T A S H E E T

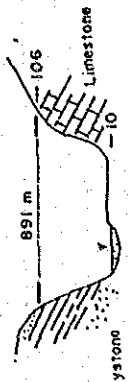
Region No.	11	I.D. No.	2-5-0-2	Scheme	Z I M I G U I		River Basin	G A T T U	Stream	Z I M I G U I
Coordinates	18° 24' 45" N. LAT.	121° 12' 06" E. LONG.	Type of Development	Province	(CAGAYAN ?)		River Cross Section & Dam/Weir	River-bed	6 m Width	40 m
Topo. Map No. 1:50,000	No. 3275-11	Geo. Map No. 1:250,000	Length of Water Way	DAM & RESERVOIR Type	RESERVOIR		Section of Dam/Weir	Dam Crest	77 m Height	71 m
		SCALE	1:1,000,000		km ²					

Geologic formation and Age of the Site	N. (Early-Middle Miocene) Conglomerate, wackes, shales and reef limestone Intrusive rocks (Neogene) Quartz diorite, granodiorite Quaternary volcanics (Quaternary) Dacite and Andesite		No major fault at powerhouse site		CONSTRUCTION MATERIALS		Location		1.5 Km. north of damsite
	Geologic Structure	The Mount Maloqui Babui consist of dacite and andesite plug crop out in area of about 6 Km ² at the left bank dam site		Geologic Structure	Conglomerate, wackes and shales (Early-Middle Miocene)		Rock & Coarsc Aggie-gates	Rock Type & Age	Dacite and Andesite (Quaternary)
Rock Type and Age of Bed-rock	Conglomerate, wackes and shales (Early-Middle Miocene) Dacite and andesite (Neogene)		Rock Quality	Rather hard (of right bank site)		Overburden	Sand	Quality & Volume	.Hard to very hard
Rock Quality	Right Abutment: Poorly indurated rock hard to rather hard Left Abutment: Hard to very hard, fresh indurated and massive		Overburden	Terrace deposits and Talus deposits		Material	Material	Location	0-3 Km. upstream from damsite
Permeability	Right Abutment: Probably low permeability Left Abutment: Probably low permeability to watertight		Geologic Structure	Conglomerate, wackes and shales conformably overlies limestone		Earth Material	Earth Material	Quality & Volume	River deposits (sand and gravel) 2.5 Km. north-east of damsite
	Riverbed: Probably low permeability		Lithology & Age	Conglomerate, wackes and limestones (Miocene) Dacite and andesite (Quaternary)		Topographic Condition	Topographic Condition	Soil Type	Residual soil of Conglomerate and wackes
Overburden	Right Abutment: Thick residual soil Left Abutment: Thin residual soil		Permeability and Age	Very high permeability due to limestone caves and fissures		Geologic Sketch	Geologic Sketch	Quality & Volume	Probably suitable
	Riverbed filled with sand and gravel		Slope Stability	Probably stable		Not visited site		Geomorphologic	V-Shaped
			Sedimentation	L e s s		Elm			
			GENERAL ASSESSMENT		Waterway/Power Tunnel		Damsite		Good
					Power House		Waterway/Power Tunnel		Good
					Reservoir		Reservoir		Poor
					Dam Construction Material		Dam Construction Material		Excellent



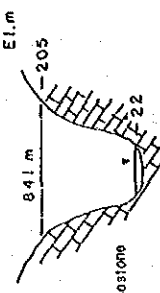
G E O L O G I C A L D A T A S H E E T

Region No.	II	I.D. No.	2-6-0-1	Scheme	S I S I R I T A N	Province	KALINGA-APAYAO	River Basin	ABULOG	Stream	ABULOG		
Coordi- nates	18°09'42" N. LAT	121°21'00" E. LONG		Type of Displacement	DAM & RESERVOIR	Dam/ Type	ROCK FILL	River- bed	El.	10m	Width	150m	
Topo. Map No. 3274-II		Geo. Map SCALE 1:50,000	1:50,000	Length of Water Way	—	Reservoir Area	72.2 km ²	Section at Dam	Dam Crest	El.	106m	Height	96m

G E O L O G I C A L D A T A		C O N S T R U C T I O N M A T E R I A L S		P R O F I L E O F D A M A X I S		G E N E R A L A S S E S S M E N T	
Geologic Formation and Age of the Site	Ibuco Limestone (Early-Middle Miocene) Cabagan Formation (Late Miocene) Sandstone, siltstone and claystone Calico limestones (Late Miocene) Alluvial deposits	Geologic Structure	General fault occur 4Km. west of powerhouse	Geologic Structure	General fault occur 4Km. west of powerhouse	Rock & Coarse Aggre- gates	Location 7 Km. SW of damsite
Geologic Structure	General fault trend NS occur 4Km. west of damsite	Rock Type & Age	Sandstone, siltstone, claystone and limestone (Late Miocene)	Rock Type & Age	Residual soil, claystone and limestone (Late Miocene)	Location Type & Age	Limestone (Early-Middle Miocene)
Rock Quality	Probably rather hard to soft, partially deeply weathered of shallow part.	Rock Quality	Either hard to soft (at the right bank site)	Rock Quality	Residual soil, River deposits	Quality & Volume	Hard to very hard
Permeability	Probably water tight except limestone zone	Overburden	Residual soil, River deposits	Overburden	Residual soil, River deposits	Location	2-4 Km. S of damsite
Overburden	The riverbed filled with sand and gravel	Geologic Structure	Common to much	Geologic Structure	Common to much	Quality & Volume	River and terrace deposits
		Rock Type & Age		Rock Type & Age		Location	2.5 Km. south west of damsite
		Rock Quality		Rock Quality		Soil Type	Residual soil of sandstone and claystone
		Abutment		Abutment		Quality & Volume	Probably suitable
		Abutment		Abutment		Topographic Condition	U-Shaped
						Not visited site	
						Geologic Sketch	
						Damsite	Acceptable/Poor
						Waterway/Power Tunnel	
						Power House	Good
						Reservoir	Poor
						Dam Construction Material	Good

G E O L O G I C A L D A T A S H E E T

Region No.	11	I.D. No.	2-6-0-2	Scheme	BUBULAYAN		KALINGA-APAYAO	ABULOG		ABULOG	
Coordi- nate	18°06'18" N. LAT	121°18'18" E. LONG	Type of Derivoment	DAM & RESERVOIR	Province	DAM/Weir Type	River Basin	River- bed	Stream	ABULOG	
Topo. Map No. 1:50,000	No. 3274-II	Geo. Map SCALE	Length of Water Way	_____ M	Reservoir	_____ M	Cross Section at Dam/ Year	El.	22 m	Width	100 m
					91.9 km ²			Dam Crest	205 m	Height	183 m

Geologic formation and Age of the Site	M S D O M		Geologic Structure	K E R M A		P R O F I L E O F D A M A X I S		G E N E R A L A S S E S S M E N T		
	Ibucao Formation (Early Miocene) Limestone Cenozoic Group (Cretaceous-Eocene) Basaltic rocks, pyroclastics and lava flows			Gened Fault (N-S direction) occur on just upstream of damsite		Geologic Sketch Not visited site 		Rock & Coarse Aggr- gates Sand Material Earth Material Topographic Condition Geologic Sketch Dam-site Waterway/Pover Tunnel Pover House Reservoir Dam Construction Material		4 Km. south of damsite Limestone Hard and slightly weathered (at right bank site) Thin residual soil and Talus deposits Wide U-Shaped Probably available Residual soil of sandstone and claystone Probably available Wide U-Shaped
Rock Type and Age of Bed- rock	M S D O M		Gened Fault (N-S direction) occur on just upstream of damsite		Gened Fault occur along the Abulug river		Dam-site		4 Km. south of damsite	
	Limestone (Early Miocene)		Limestone		Limestone Basaltic rock and Agglomerate		Limestone		Limestone	
Rock Quality	M S D O M		Probably hard and rich joints and veins slightly weathered		Probably high permeability due to cracks and cave of limestone		Topographic Condition		Limestone	
	Probably hard and rich joints and veins slightly weathered		Probably high permeability due to cracks and cave of limestone		Probably high permeability due to limestone		Wide U-Shaped		Probably available	
Perme- ability	M S D O M				Thick residual soil at high elevation of abutments		Waterway/Pover Tunnel		Residual soil of sandstone and claystone	
	Overall		Probably high permeability due to cracks and cave of limestone		Probably high permeability due to limestone		Pover House		River deposits (sand and gravel)	
Over- burden	M S D O M		Thick residual soil at high elevation of abutments		Probably stable		Reservoir		River deposits (sand and gravel)	
	River Bottom		The riverbed filled with medium thick gravel and cobble		Common		Dam Construction Material		2-3 Km. downstream of damsite	

GEOLOGICAL DATA SHEET

Region No.	II	I.D. No.	2-6-0-3	Scheme	BULU	Province	KALINGA-APAYAO	River Basin	ABULOG	Stream	ABULOG
Coordinates	18°02'30" N, 121°13'00" E	LONG	121°13'00"	Type of Declaration	DAM & RESERVOIR	Dam/Type	ROCK FILL	River Cross Section at Dam	River-bed El.	78 m	Width 60 m
Topo. Map No.	3274-II	Geo. Map No.	1:250,000	Length of Water Way	—	Reservoir Area	97.4 km ²	Dam Crest	El.	226 m	Height 148 m
Scale	1:50,000	SCALE	1:250,000								

Geologic formation and Age of the Site	Licuan Formation II (Eocene) Andesitic Rocks Plutonic Rocks (Miocene) Diorite		Geologic Structure	Assumed fault occur on powerhouse site		Rock & Coarse Aggregates	Location		2.5 Km. south-west of damsite	
	Geologic Structure	Several faults (N10-20°W) intersect the abutog river including damsite. Macroscopic Fault occur on the 2 Km. upstream from damsite.		Rock Type & Age	Andesite Rock		Rock Type & Age	Diorite (Neogene)		
Rock Type and Age of Bed-rock	Diorite (Neogene) at left abutment; Andesitic rock (Eocene) at right abutment		Rock Type & Age	—		Earth Material	Soil Type		Residual soil of diorite	
Rock Quality	Both Abutments Probably, hard to very hard sound and fresh massive rock but along the faults zone showing fractured zone with weathered rocks		Rock Quality	—		Topographic Condition	Not visited site		Wide V-Shaped Elm	
Permeability	Probably thick high permeability zone occur due to faulted fractured zone		Geologic Structure	Several faults and geologic contact intersect the Abulog river		Geologic Sketch			Acceptable/poor	
Overburden	The riverbed filled with thick sand and gravel		Lithology & Age	Diorite (Neogene), Andesite		Damsite	Waterway/Power Tunnel		—	
	Medium thickness of residual soil at top of the abutments		Permeability and Ground-water	Probably impermeable		Power House	Reservoir		Good/Acceptable	
Overburden	River Bottom		Slope Stability	Probably, none vegetation area is not stable after impounding		Dam Construction Material	—		Acceptable	
			Sedimentation	C o m m o n					Excellent	

G E O L O G I C A L D A T A S H E E T

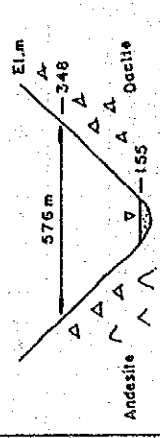
Region No.	II	I.D. No.	2-6-1-4	Scheme	NABABARAYAN	Province	KALINGA-APAYAO	River Basin	ABULOG	Stream	APAYAO
Coordinates	18°02'00" N. LAT	121°08'00" E. LONG	Type of Development	DAM & RESERVOIR	Dam/Weir Type	ROCK FILL	River bed	101 m Width	130 m		
Topo. Map No.	3274 III	Geo. Map SCALE	Length of Water Way	42.6 Km	Reservoir Area		Dam Section at Dam/Weir	246 m Height	145 m		

Geologic formation and Age of the Site	Andesite Rock (Liquan Formation II) - Eocene - Diorite (Plutonic rock) Tertiary Dacite (Tineg Formation) Oligocene Kabugao Fault run at 2 Km. east of the Apayao River. This Fault is active and capable of causing an earthquake on the occasion of earthquake		Geologic Structure	Assumed fault pass the powerhouse site		Rock & Coarse Aggregates	Location		Rock Hill 2 Km. NW of damsite and Riverbed within 5 Km from damsite	
	Geologic Structure	Assumed fault run of the left bank abutment and upper stream of damsite		Rock Type & Age	Andesite (Eocene) River deposits (Andesite Rock)		Rock Type & Age	Andesite (Eocene) River deposits (Andesite Rock)		
Rock Type and Age of Bed-rock	Andesite Rock (Eocene)		Rock Quality	Probably hard to rather hard (of left bank site)		Aggregates	Quality & Volume		Hard	
Rock Quality	Both Abutments Probably hard to rather hard, partially weathered and rich joint and cracks		Overburden	Alluvial deposits, terrace deposits		Sand	Location		Within 2 Km. from damsite	
Permeability	Overall		Geologic Structure			Material	Quality & Volume		River and Terrace deposits	
	Probably, high permeability of shallow part		Rock Type & Age			Earth Material	Location		1 Km. south-east of damsite	
Overburden	Both Abutments		Geologic Structure			Topographic Condition	Quality & Volume		Probably suitable	
	Probably, high permeability of shallow part		Rock Quality			Geologic Sketch	Topographic Condition		V-Shaped	
M E M O R A N D U M			Geologic Structure		Damsite		Geologic Sketch		Not visited site	
K E Y			Geologic Structure		Waterway/Power Tunnel		Geologic Sketch		Elm 704 m - 246 101	
P R O F I L E OF DAM AXIS			Geologic Structure		Power House		Geologic Sketch		Good	
G E N E R A L A S S E S S M E N T			Lithology & Age		Reservoir		Geologic Sketch		Good/Acceptable	
S L O P E S T A B I L I T Y			Permeability and Ground-water		Dam Construction Material		Geologic Sketch		Good	
S E D I M E N T A T I O N			Slope Stability				Geologic Sketch		Acceptable	
O V E R B U R D E N			High possibility of rock slide especially after impounding				Geologic Sketch		Good	
C O M M O N T O M O R P H O L O G I C A L F E A T U R E S			Common to much				Geologic Sketch		Good	

G E O L O G I C A L D A T A S H E E T

Region No.	II	I.D. No.	2-6-1-5	Scheme	DIBAGAT		KALINGA-APAYAO	River Basin	ABULOG	Stream	APAYAO	
Coordi- nates	18°05'20" N. LAT	121°07'17" E. LONG	Type of Development		DAM & RESERVOIR		ROCK FILL	River Cross Section	River- bed El.	155 m	Width	60 m
Topo. Map Scale	No. 3274-III 1:50,000	Geo. Map Scale	1:250,000	Length of Water Way	—	—	44.4 km ²	Dam Height	348 m	—	—	193 m

Geologic formation and Age of the Site	Andesite Rock (Lican Formation II) Eocene Diorite (Tineg Formation) Oligocene Diorite (Plutonic Rock) Miocene "Kabugao Fault" run NW-SE direction about 3 Km. north-east of Apayao River		No special fractured zone		CONSTRUCTION MATERIALS		Location Within 1 Km. upstream from damsite	
	Geologic Structure	Wide fractured zone (500m in width) located at 2.5 Km southwest of damsite. Normal fault exists at behind the right abutment.	Geologic Structure	Andesite Rock (Eocene) Diorite (Oligocene)	Rock & Course Aggre- gates	Rock Type & Age	River deposits (Andesite Rock) Diorite (Oligocene)	
Rock Quality	Probably hard to rather hard with joint and cracks	Rock Quality	Probably hard to rather hard and fractured (at left bank site)	Earth Material	Soil Type	Quality & Volume	Hard	
Perma- bility	Probably, moderately pervious at shallow part	Overburden	Residual soil	Material	Quality & Volume	Location	4-9 Km. downstream from damsite	
Abutment	Right Abutment	Geologic Structure	—	—	Topographic Condition	—	—	
	Left Abutment	Rock Quality	—	—	—	—	—	
Overall	Right Abutment	Overburden	—	—	Geologic Sketch	—	—	
	Left Abutment	Geologic Structure	—	—	—	—	—	
Profile of Dam Axis		Geologic Structure	Fault exists 2 Km upstream from damsite	GENERAL ASSESSMENT		Damsite		
Waterway/Power Tunnel		Lithology & Age	Andesite Rock (Eocene) Diorite (Oligocene) Diorite (Miocene)	Waterway/Power Tunnel		6000		
Power House		Permeabi- lity and Ground- water	Low permeability except fractured faulted zone	Power House		6000		
Reservoir		Slope Stability	High possibility of rock slide especially after impending	Reservoir		6000		
Dam Construction Material		Sediment- ation	Common to much	Dam Construction Material		6000		



GEOLOGICAL DATA SHEET

Region No.		I.D. No.	2-6-1-6	Scheme		A G U B U L U	Province	KALINGA-APAYAO	River Basin	ABULOG	Stream	A P A Y A O	
Coordinates	18°08'20" N. LAT	121°05'00" E. LONG	Type of Development	DAM & RESERVOIR	Province	KALINGA-APAYAO	Dam/Type	CONCRETE GRAVITY	River Cross Section at Dam/Weir	River bed El.	185 m	Width	40 m
Top. Map No. 1:50,000	No. 3274-III	Geo. Map Scale	Length of Water Way	M	Reservoir Area	37.7 Km ²	Reervoir		Dam Crest El.	352.2	Height	167 m	

Geologic formation and Age of the Site		Geologic Structure		Geologic Structure		Geologic Structure		Geologic Structure		Geologic Structure		Geologic Structure		Geologic Structure		Geologic Structure		Geologic Structure		Geologic Structure		Geologic Structure	
Andesite (Lucban Formation) Eocene Dacite (Ting Formation) Oligocene Diorite (Plutonic Rock) Miocene Andesite (Maboco Formation) Miocene		Assumed faults occur along the right abutment of the damsite		Assumed fault occur along the right abutment of damsite		Assumed fault occur along the right abutment of damsite		Assumed fault occur along the right abutment of damsite		Assumed fault occur along the right abutment of damsite		Assumed fault occur along the right abutment of damsite		Assumed fault occur along the right abutment of damsite		Assumed fault occur along the right abutment of damsite		Assumed fault occur along the right abutment of damsite		Assumed fault occur along the right abutment of damsite		Assumed fault occur along the right abutment of damsite	
Geologic Structure		Geologic Structure		Geologic Structure		Geologic Structure		Geologic Structure		Geologic Structure		Geologic Structure		Geologic Structure		Geologic Structure		Geologic Structure		Geologic Structure		Geologic Structure	
Rock Type and Age of Bed-rock		Rock Type and Age		Rock Type and Age		Rock Type and Age		Rock Type and Age		Rock Type and Age		Rock Type and Age		Rock Type and Age		Rock Type and Age		Rock Type and Age		Rock Type and Age		Rock Type and Age	
Rock Quality		Rock Quality		Rock Quality		Rock Quality		Rock Quality		Rock Quality		Rock Quality		Rock Quality		Rock Quality		Rock Quality		Rock Quality		Rock Quality	
Permeability		Permeability		Permeability		Permeability		Permeability		Permeability		Permeability		Permeability		Permeability		Permeability		Permeability		Permeability	
Overburden		Overburden		Overburden		Overburden		Overburden		Overburden		Overburden		Overburden		Overburden		Overburden		Overburden		Overburden	
River Bottom		River Bottom		River Bottom		River Bottom		River Bottom		River Bottom		River Bottom		River Bottom		River Bottom		River Bottom		River Bottom		River Bottom	
Dam Construction Material		Dam Construction Material		Dam Construction Material		Dam Construction Material		Dam Construction Material		Dam Construction Material		Dam Construction Material		Dam Construction Material		Dam Construction Material		Dam Construction Material		Dam Construction Material		Dam Construction Material	

380 m

Andesite

352

185

Not visited site

ELM

G E O L O G I C A L D A T A S H E E T

Region No.	11	I.D. No.	2-6-1-7	Scheme	A O A N		Province	KALINGA-APAYAO	River Basin	ABULOG	Stream	APAYAO	
Coordinates	16°15'30" N. LAT	E. LONG	120°00'20"	Type of Development	DAM & RESERVOIR		Dam/Weir Type		River bed	EL.	320m	Width	40m
Topo. Map	No. 3274-IV	SCALE	1:250,000	Length of Water Way	M		Reservoir Area	km ²	Dam Crest	EL.	528m	Height	208m

Geologic formation and Age of the Site	Quartz diorite/Diorite (Neogene) Metavolcanics, largely spilites and basalts. (Paleogene to Cretaceous) Limestones (Late Miocene)		MSD OH	Geologic Structure	Assumed fault occur about 2km east of power house		CONSTRUCTION MATERIALS	Rock & Coarse Aggregate	Location	Within 5km. from damsite		
	Geologic Structure	Metavolcanics (Paleocene to Cretaceous)			Metavolcanics (Paleocene to Cretaceous)	Rock Type & Age					Metavolcanics (Paleocene to Cretaceous)	Quality & Volume
Rock Type and Age of Bed-rock	Quartz diorite and diorite intrudes into metavolcanics		R M O R	Geologic Structure	Probably hard to rather hard (at the left bank site)		PROFILE OF DAM AXIS	Sand Material	Location	Within 4km. upstream from damsite		
	Geologic Structure	Residual soil Alluvial deposits			Residual soil Alluvial deposits	Rock Type & Age						Quality & Volume
Rock Quality	Both Abutments Probably, hard to rather hard partially weathered with joint and cracks		M A F M	Geologic Structure	No major fractured fault in the reservoir		GENERAL ASSESSMENT	Earth Material	Topographic Condition	Open V-Shaped		
	Rock Quality	Probably, high permeability at shallow part			Probably, water-tightness	Soil Type					Residual soil	Quality & Volume
Permeability	Overall		M A F M	Geologic Structure	Metavolcanics (Paleocene to Cretaceous) Quartz diorite (Neogene)		Dam Site	Geologic Sketch	Not visited site	713m	El. m	-528
	Permeability	Probably, high permeability at shallow part			Probably, water-tightness	Lithology & Age						
Overburden	Both Abutments		M A F M	Geologic Structure	Probably, water-tightness		Waterway/Power Tunnel	Dam Site	Topographic Condition	Open V-Shaped		
	Overburden	Residual soil			Probably, water-tightness	Permeability and Ground-water					Probably, water-tightness	Waterway/Power Tunnel
River Bottom	The river bed filled with boulders, cobbles, pebbles, and sand		M A F M	Slope Stability	Stable		Reservoir	Power House	Topographic Condition	Open V-Shaped		
	Overburden	The river bed filled with boulders, cobbles, pebbles, and sand			Slope Stability	Stable					Reservoir	Power House
			M A F M	Sedimentation	Common		Dam Construction Material	Power House	Topographic Condition	Open V-Shaped		
					Sedimentation	Common					Dam Construction Material	Power House

G E O L O G I C A L D A T A S H E E T

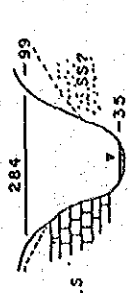
Region No.	II	I.D. No.	2-6-1-8	Scheme	A P A Y A O	Province	KALINGA-APAYAO	River Basin	ABULOG	Stream	A P A Y A O
Coordi- nates	18°19'18" N. LAT	E. LONG	120°58'53"	Type of Development	RUN OF RIVER	Dam/Weir Type	CONCRETE	River Cross Section	River-bed	EL. 422m	Width 70 m
Topo. Map No. 3174-1	Geo. Map SCALE 1:50,000	Length of Water Way	8295 M	Reservoir Area	Reservoir	Reservoir Area	—	Section	Crest	EL. 425 m	Max. Height 6 m

Geologic formation and Age of the Site	Metavolcanics (Cretaceous to Paleogene) largely spilites and basalts. Limestones (Late Miocene) Quartz diorite / Diorite (Neogene)		Geologic Structure	Assumed fault (N-S trend) at 2 Km. east		Rock & Coarse Aggrer- gaten	Location		1.5 Km. south of weir		
	Geologic Structure	Metavolcanics (Cretaceous to Paleogene)		Rock Type & Age	Probably hard to very hard and slightly weathered		Location	Quartz diorite, Diorite (Neogene)			
Geologic Structure	Assumed fault (NE-SW trend) occur south east of damsite		Rock Quality	Terrace deposits		Sand	Location		4 Km. downstream from weir		
Rock Type and Age of Bed- rock	Quartz diorite / Diorite (Neogene)		Overburden	Assumed fault across the tunnel route of 5 Km. from intake		Material	Location		River deposits (sand and gravel)		
Rock Quality	Both Abutments Probably hard to rather hard partially weathered with joints and cracks		Geologic Structure	Trend of fault is NE-SW		Earth Material	Soil Type		—		
Permeability	Overall Probably high permeability of shallow part		Rock Type & Age	Quartz diorite, Diorite (Neogene)		Topographic Condition	Quality & Volume		V-Shape d		
	Probably high permeability of shallow part		Rock Quality	Probably hard to rather hard and may be fractured or faulted zone			Geologic Sketch	Not visited site			
Slope Abutments	Probably rather thick residual soil in the high elevation		Overburden	Generally even thickness for tunnel excavation 3.5 Km. from intake at EL. 390m		Damsite	Waterway/Pover Tunnel		Excellent		
	Probably rather thick residual soil in the high elevation		Geologic Structure	No major fault			Waterway/Pover Tunnel	Pover House		Good	
River Bottom	The riverbed filled with cobbles and boulder		Lithology & Age	Quartz diorite, Diorite (Neogene)		Reservoir	Dam Construction		Excellent		
	The riverbed filled with cobbles and boulder		Permeability and Ground- WATER	Probably waterflight			Dam Material	Reservoir		Excellent	
Overburden			Slope Stability	Stable							
			Sediment- ation	Less to common							

G E O L O G I C A L D A T A S H E E T

Region No.	II	I.D. No.	2-8-1-1	Scheme	ZINUNDUNGAN	Province	CAGAYAN	River Basin	ZINUNDUNGAN	Stream	ZINUNDUNGAN	
Coordi- nates	17°59'45" N, 121°27'25" E	LONG	121°27'25" E	Type of Development	DAM & RESERVIOR	Dam/Wear Type		River-bed	EL.	35m	Width	40m
Topo. Map No.	3273-1	Geo. Map SCALE	1:600,000	Length of Water Way		Reservoir Area		Section of Dam	EL.	99m	Height	64m

Geologic Formation and Age of the Site	(Isiao Formation (Early Miocene) Limestone, Cebangan Formation (Late Miocene-Pliocene) Sandstone, siltstone, Conglomerate)		Geologic Structure	Bedding: N45°E/SE		CONSTRUCTION MATERIALS	Location	3 Km. south-east of damsite		
	Rock Type and Age of Bed-rock	Limestone (Early Miocene)		Rock & Coarse Aggre- gates	Limestone (Early Miocene)		Rock Type & Age	Quality & Volume		Hard
Rock Quality	Bedding: 45° E, Dip: SE, Cueta, Karat		Rock Quality	Hard with some joints and cracks (at left bank site)		PROFILE OF DAM AXIS	Location	1-10 Km. upstream from damsite		
	Limestone (Early Miocene) at left abutments, Sandstone, siltstone, Conglomerate (Late Miocene-Pliocene) at right abutment		Overburden	Talus and terrace deposits			Material	River deposits (sand and gravel)		
Permeability	Left Abutments	Probably hard consolidated and jointed with open cracks slightly weathered		Geologic Structure		GENERAL ASSESSMENT	Location	3 Km. south-east of damsite		
	Right Abutments	Probably soft to rather hard and deeply weathered at shallow part		Rock Type & Age			Earth Material	Residual soil of Limestones		
Overburden	Left Abutments	Probably high permeability at open cracks and jointed area		Rock Quality		DAMSKETCH	Location	3 Km. south-east of damsite		
	Right Abutments	Probably high permeability at weathered zone		Overburden			Topographic Condition	Gorge U-Shaped		
River Bottom	Left Abutments	Medium thickness of residual soil		Lithology & Age	Limestones (Early Miocene) at left damsite, Sandstone, siltstone (Late Miocene Pliocene) at right bank site		Geologic Sketch	Not visited site		
	Right Abutments	Thick residual soil and deeply weathered zone		Permeability and Ground-water	Probably high permeability at left bank site due to limestones			Damite	Poor/Acceptable	
River Bottom	Left Abutments	The river bottom filled with sand and gravel		Slope Stability	Probably stable		Waterway/Pover Tunnel		Good	
	Right Abutments	The river bottom filled with sand and gravel		Sedimentation	Common			Reservoir	Acceptable	
						Dam Construction Material	Good			



G E O L O G I C A L D A T A S H E E T

Region No.	II	I.D. No.	2-8-2-2	CAPISAYAN	Province	CAGAYAN	River Basin	DUMMON	Stream	DUMMON
Coordinates	18°03'06" N. Lat.	121°51'15" E. Long.	DAM 8 RESERVOIR	Dam/Weir Type	Reservoir Area		River bed El.	54m Width	50m	
Topo. Map Scale	No. 3374-II	Geo. Map Scale	1:50,000	Length of Water Way			Dam Crest El.	106m Height	52m	

		CONSTRUCTION MATERIALS		PROFILE OF DAM AXIS		GENERAL ASSESSMENT	
G E O L O G I C A L f o r m a t i o n a n d a g e o f t h e s i t e	Geologic formation and Age of the Site	Two assumed faults (trend ENE, one occur 2.5 Km. NW of damsite, the other 3 Km. south of powerhouse)	Two assumed faults (trend ENE, one occur 2.5 Km. NW of damsite, the other 3 Km. S of damsite)	Topographic Condition	Dish-Shaped Not visited site.	Damite	Acceptable
	Geologic Structure	Magan Formation (Pliocene) SS, Conglomerates Cagayan Formation (Late Miocene) calcareous SS, Siltstone, claystone Meliavolcanics (Cretaceous-Paleogene) Limestones (Late Miocene), calhao Formation	SS, Conglomerate (Pliocene) SS, Siltstone (Late Miocene)	Geologic Structure	Aluvial deposits Deep weathered Sandstone/Conglomerate	Waterway/Power Tunnel	
	Rock Type and Age of Bedrock			Rock Type & Age		Power House	Acceptable
	Rock Quality	Right Abutment Probably rather hard slightly compacted and consolidated Left Abutment Probably rather hard to soft		Rock Quality		Reservoir	Acceptable
	Permeability	Both Abutments Probably, high permeability at shallow part River Bottom Probably high permeability of thick river deposits		Overburden		Dam Construction	Good
	Overburden	Right Probably rather hard slightly compacted and consolidated Left Probably rather hard to soft		Geologic Structure	Two assumed parallel faults (trend ENE) occur along the Dummon river		
				Lithology & Age	Aluvial deposits Sandstone, Conglomerate (Pliocene) Sandstone, siltstone (Late Miocene)		
				Permeability and Groundwater	Probably waterlightness except weathered rim		
			Slope Stability	Possibility land slide, especially after impending			
			Sedimentation	Common			

889m
Elm
106

G E O L O G I C A L D A T A S H E E T

Region No.	II	I.D. No.	2-8-3-3	Scheme	B A S A O	KALINGA-APAYAO	River Basin	CHICO	Stream	CHICO
Coordi- nates	17°14'32" N. LAT	E. LONG	121°07'30"	Type of Development	DAM & RESERVOIR	Province Dam/Weir Type	River Cross Section at Dam/ Weir	River- bed El.	510m	Width 30 m
Topo. Map 1:50,000	No. 3271-IV	Geo. Map SCALE	1:50,000	Length of Water Way	RESERVOIR	Reservoir Area		Dam Crest El.	715 m	Height 205 m

Geologic formation and Age of the Site	Limon Formation (Eocene) Massive basalt and basaltic agglomerate		Geologic Structure	Fault zones and small shear planes occurring at the powerhouse site		Rock & Coarse Aggr-gated	Location		Within 5km. upstream from damsite	
	Basalt series is intensely folded and faulted, fault zones and small shear planes occurring frequently in the area of both valley bottoms			Basaltic agglomerate (Eocene)			Rock Type & Age		Basalt, Agglomerates (Eocene)	
Geologic Structure	Basalt series is intensely folded and faulted, fault zones and small shear planes occurring frequently in the area of both valley bottoms		Rock Type and Age of Bed-rock	Hard (at the right bank site)		Earth Material	Location		2km. downstream of damsite	
	Massive basalt and basaltic agglomerate (Eocene) Mostly dark-red, iron containing basalts			Terrace deposits and stony lean (thick)			Quality & Volume		Hard to very hard	
Rock Quality	Both Abutments Probably hard to very hard and loosened in the upper layer of the slope		Rock Quality			Topographic Condition	Soil Type		Residual Soil	
	Overall The distribution of loosened rock with rather high permeability is estimated rather deep			Overburden			Quality & Volume		Probably suitable	
Permeability	Loamy slope deposits on the steeper slopes		Slope Stability	Water tight except damsite and fault zone		Geologic Sketch	Topographic Condition		Not visited site	
	Terrace deposits, mainly sandy gravel and boulders			Slides occur generally only where the slope is oversteep			Geologic Sketch		V-Shaped	
Overburden	Sandy gravels, broken rock and huge blocks		Sedimentation	Common to much		Dam Construction Material	Quality & Volume		Probably suitable	
							Geologic Sketch		Not visited site	

G E O L O G I C A L D A T A S H E E T

Region No.	II	I.D. No.	2-8-3-4	Scheme	CHICO-1R	Province	MT. PROVINCE	River Basin	CHICO	Stream	CHICO
Coordi- nates	17° 11' 10"	121° 03' 53"	E. LONG	Type of Development	RUN OF RIVER	Dam/Weir Type	CONCRETE	River Cross Section	River- bed	EL.	617 m Width
Topo. Map Scale	No. 3274-IV	Geo. Map Scale	1:250,000	Length of Water Way	3065 m	Reservoir Area	— km ²	at Weir	Crest	EL.	621 m Height
Geologic formation and Age of the Site	Limon Formation (Eocene) Basalt flow, diabase, basic agglomerate, welded tuff, andesitic lava										
Geologic Structure	Assumed wide fault zone N10°W occur 2Km. west of damsite										
Rock Type and Age of Bed- rock	Basalt, Agglomerate (Eocene)										
Rock Quality	Both Probably hard to very hard sound rock, partially slightly to moderately weathered										
Perme- ability	Probably waterlight, except weathered joints										
Over- burden	Thin residual soil and some talus deposits										
	Limited river deposits gravel and cobble										

CONSTRUCTION MATERIALS											
Rock & Coarse AGGREGATE	Location	Rock Type & Age	Quality & Volume								
Sand	Location	Quality & Volume	Material	1.5Km. north-east of weir Basalt, Agglomerate (Eocene) Hard to very hard sound rock							
Material	Location	Quality & Volume	Material	5-8Km. upstream from weir River and Terrace deposits (Sand and gravel)							
Earth Material	Location	Soil Type	Quality & Volume								
Topographic Condition	V-Shape & Not visited site										
Ceologic Sketch											
GENERAL ASSESSMENTS											
Damsite	G o o d										
Waterway/Power Tunnel	G o o d										
Power House	G o o d										
Reservoir	G o o d										
Dam Construction Material	Excellent										

G E O L O G I C A L D A T A S H E E T

Region No.	II	I.D. No.	2-8-3-5	Scheme	SADANGA		Province	MT. PROVINCE	River Basin	CHICO	Stream	CHICO	
Coordinates	17°08'53" N, 107°08'53" E	121°03'08" E. LONG		Type of Development	DAM & RESERVOIR		Dam/Type	CONCRETE GRAVITY	River bed	CHICO	676m	Width	30 m
Topo. Map No.	3271-III	Geo. Map SCALE	1:5,000 1:250,000	Length of Water Way	—		Reservoir Area	13.5 km ²	Dam Crest	CHICO	853m	Height	177 m

Geologic formation and Age of the Site	Licuan Formation (Eocene) Basaltic lava and Pyroclastics, Agglomerate intrusives (Neogene) Granodiorite Quaternary volcanics (Quaternary) Dacitic to Andacitic rocks		W G D O H K M A R	Sheet jointing surface	Geologic Structure	Basalt, Agglomerate (Eocene)	Rock Type & Age	Basalt, Agglomerate (Eocene)	Rock Quality	Hard to rather hard (at the right bank site)	Overburden	Residual soil (loam)	Geologic Structure	Rock Type & Age	Rock Quality	Overburden	Geologic Structure	Lithology & Age	Basalt, Agglomerate (Eocene)	Permeability and Groundwater	Probably water tight	Slope Stability	Generally stable, some sliding rock of faulted basalt series	Sedimentation	C o m m o n	Geologic Sketch	Topographic Condition	V - Shaped	Not visited site	462 m	El.m	-853	-700	Basalt & Agglomerates	-570	30 m	(Overflight site)	Probably suitable	Residual soil of basalt and Agglomerate	3.5 Km. south-east of damsite	Location	3 Km. south of damsite
	Geologic Structure	Sheet jointing surface																																								
Geologic Structure	Sheet jointing surface, slightly jointed intensely fragmented, Both flanks are traversed by fault and shear planes.		K A K	Geologic Structure	Basalt, Agglomerate (Eocene)	Rock Type & Age	Basalt, Agglomerate (Eocene)	Rock Quality	Hard to rather hard (at the right bank site)	Overburden	Residual soil (loam)	Geologic Structure	Rock Type & Age	Rock Quality	Overburden	Geologic Structure	Lithology & Age	Basalt, Agglomerate (Eocene)	Permeability and Groundwater	Probably water tight	Slope Stability	Generally stable, some sliding rock of faulted basalt series	Sedimentation	C o m m o n	Geologic Sketch	Topographic Condition	V - Shaped	Not visited site	462 m	El.m	-853	-700	Basalt & Agglomerates	-570	30 m	(Overflight site)	Probably suitable	Residual soil of basalt and Agglomerate	3.5 Km. south-east of damsite	Location	3 Km. south of damsite	
Rock Type and Age of Bedrock	Agglomerates and Basalt (Eocene)																																									K A K
Rock Quality	Unweathered, generally slightly jointed sound bedrock. The deep weathering is to be expected in fault and shear zones.		K A K	Geologic Structure	Basalt, Agglomerate (Eocene)	Rock Type & Age	Basalt, Agglomerate (Eocene)	Rock Quality	Hard to rather hard (at the right bank site)	Overburden	Residual soil (loam)	Geologic Structure	Rock Type & Age	Rock Quality	Overburden	Geologic Structure	Lithology & Age	Basalt, Agglomerate (Eocene)	Permeability and Groundwater	Probably water tight	Slope Stability	Generally stable, some sliding rock of faulted basalt series	Sedimentation	C o m m o n	Geologic Sketch	Topographic Condition	V - Shaped	Not visited site	462 m	El.m	-853	-700	Basalt & Agglomerates	-570	30 m	(Overflight site)	Probably suitable	Residual soil of basalt and Agglomerate	3.5 Km. south-east of damsite	Location	3 Km. south of damsite	
Permeability	Probably water tight except fault zone (Branch of Hapao Fault) at upper part of left abutments																																									K A K
Overburden	Thin loam (0-1m thick) Strong weathered zone, 1 to 2m deep partly very deep (10m)		K A K	Geologic Structure	Basalt, Agglomerate (Eocene)	Rock Type & Age	Basalt, Agglomerate (Eocene)	Rock Quality	Hard to rather hard (at the right bank site)	Overburden	Residual soil (loam)	Geologic Structure	Rock Type & Age	Rock Quality	Overburden	Geologic Structure	Lithology & Age	Basalt, Agglomerate (Eocene)	Permeability and Groundwater	Probably water tight	Slope Stability	Generally stable, some sliding rock of faulted basalt series	Sedimentation	C o m m o n	Geologic Sketch	Topographic Condition	V - Shaped	Not visited site	462 m	El.m	-853	-700	Basalt & Agglomerates	-570	30 m	(Overflight site)	Probably suitable	Residual soil of basalt and Agglomerate	3.5 Km. south-east of damsite	Location	3 Km. south of damsite	
River Bottom	River Bottom																																									K A K

G E O L O G I C A L D A T A S H E E T

Region No.	II	I.D. No.	2-8-3-6	Scheme	CHICO-2R		Province	MT. PROVINCE	River Basin	CHICO	Stream	CHICO
Coordinates	17°06'56" N. LAT	121°01'30" E. LONG	Type of Development		RUN of RIVER		/Weir Type	CONCRETE	River Cross Section at Weir	River-bed EL.	773m	Width 60m
Topo. Map No.	3271-III	Geo. Map SCALE	1:250,000	Length of Water Way	6225 m	Reservoir Area	Reservoir	—	at	Great EL.	777m	Max. Height 6m

G E O L O G I C A L	Geologic Formation and Age of the Site	Licuan Formation (Eocene) Basalt flow, diabase, basic agglomerate welded tuff, andesitic lava intrusives (Neogens) Granodiorite	Geologic Structure	Assumed wide fault zone occur at the powerhouse and outlet of tunnel site	Geologic Structure	Assumed wide fault zone occur at the powerhouse and outlet of tunnel site	Rock Type & Age	Basalt, agglomerate (Eocene)	Rock Coarse Aggregates	Basalt (Eocene)	Location	1 Km. east of weir
	Geologic Structure	Assumed fault (trend NE-SW) occur 2Km of damsite	Geologic Structure	Assumed wide fault zone across the outlet site	Geologic Structure	Assumed wide fault zone across the outlet site	Rock Type & Age	Basalt, agglomerate (Eocene)	Sand Material	Hard to very hard (Massive sound rock)	Location	4-5 Km. upstream from weir
	Rock Type and Age of Bed-rock	Basalt, agglomerate (Eocene)	Geologic Structure	Thin residual soil and some talus deposits	Geologic Structure	Thin residual soil and some talus deposits	Rock Type & Age	Basalt, agglomerate (Eocene)	Earth Material	Large scale river deposits (Sand and Gravel)	Location	—
	Rock Quality	Both Abutments slightly weathered and jointed	Geologic Structure	Enough thickness for tunnel excavation	Geologic Structure	Enough thickness for tunnel excavation	Rock Quality	Probably hard to very hard sound rock, but brittle and fractured at the outlet site	Topographic Condition	V-Shaped	Topographic Condition	Not visited site
	Permeability	Overall Probably watertight, except weathered joints	Geologic Structure	No major fractured faults	Geologic Structure	No major fractured faults	Rock Quality	Probably hard to very hard sound rock, but brittle and fractured at the outlet site	Geologic Sketch	Basalt & Agglomerate	Geologic Sketch	
	D A M	Assessment	Overall	Probably watertight, except weathered joints	Lithology & Age	Basalt, agglomerate (Eocene) Granodiorite (Neogene)	Lithology & Age	Basalt, agglomerate (Eocene)	Dam Site	Excellent	Dam Site	Excellent
			Both Abutments	Thin residual soil and some talus deposits	Permeability and Ground-water	Probably watertight	Permeability and Ground-water	Probably watertight	Waterway/Power Tunnel	Acceptable	Waterway/Power Tunnel	Acceptable
			River Bottom	Limited river deposits gravel and cobble	Slope Stability	Mostly stable except some sliding rock of basalt	Slope Stability	Mostly stable except some sliding rock of basalt	Power House	Acceptable	Power House	Acceptable
					Sedimentation	Common	Sedimentation	Common	Reservoir	Good	Reservoir	Good
									Dam Construction Material	Excellent	Dam Construction Material	Excellent

GEOLOGICAL DATA SHEET

Region No.	II	I.D. No.	2-8-3-7	Scheme	CHICO-3R		Province	MT. PROVINCE	River Basin	CHICO	Stream	CHICO
Coordination	17°06'01" N. LAT	120°59'27" E. LONG	Type of Development	4025 M	Province /Weir Type	CONCRETE		River bed	863 M	Width	60 M	
Topo. Map No.	3171-11	Geo. Map SCALE	Length of Water Way	4025 M	Reservoir Area	--- KM ²		Crest at Weir	866 M	Height	6 M	

Geologic Formation and Age of the Site	Licuan Formation (Eocene) Basalt flow, diabase, basalt agglomerate welded tuff, andesitic intrusives (Neogene) Granodiorite Quaternary volcanic (Quaternary) Dacitic to Andesitic pyroclastic & lava	
	The Granodiorite Intrusive crop out around the Sontoc clivial basin	
	Granodiorite (Neogene)	
Geologic Structure	Assumed fault (trend N45°E) occur 2 Km. south-east of power house site	
Rock Type and Age of Bed-rock	Basalt and agglomerate (Eocene)	
Rock Quality	Probably hard to very hard partially slightly weathered	
Permeability	Thin residual soil and talus deposits	
	Geologic contact of granodiorite and basalt/agglomerate occur at 700m from intake site	
	Intake consists of granodiorite mostly part and outcrops consist of basalt and agglomerate (Eocene)	
Overburden	Probably hard and very hard sound rock	
	Enough thickness for tunnel excavation	
	The clivial deposits underlie most of reservoir area and overflow stream-dissected bedrock	
Dam Construction Materials	Granodiorite (Neogene) Basalt and agglomerate (Eocene)	
	Probably watertight except weathered zone	
	Probably watertight	
Profile of Dam Axis	Both Abutments Thick residual soil in high elevation and talus deposits of toe of abutments	
	River Bottom Large deposits of sand and gravel	
	C o m m o n	
GENERAL ASSESSMENT		
Dam Construction Material		
Excellent		

G E O L O G I C A L D A T A S H E E T

Region No.	11	I.D. No.	2-8-3-8	Scheme	B O N T O C		Province	MT. PROVINCE	River Basin	C H I C O		Stream	C H I C O	
Coordi- nates	17° 04' 18" N. LAT		120° 56' 30" E. LONG		DAMA RESERVOIR		Dam/Weir Type		River Cross Section at Dam	River- bed El.	908 m	Width	20 m	
Topo. Map 1:50,000	No 3171-11		Geo. Map SCALE 1:250,000		Length of Water Way km		Reservoir Area		Year	Dam Crest El.	1049 m	Height	141 m	

Geologic formation and Age of the Site	Tined formation (Oligocene) Dacitic lava and Pyroclastic and limestones Licuan formation (Eocene) Massive fossil and fossiliferous agglomerate		Geologic Structure	Assumed fault (trend N-S) occur 1 km. east of powerhouse site		CONSTRUCTION MATERIALS	Rock & Course	Location		Topographic Condition	2.5 Km. NE of dam site, Left bank site of chico river		
	Geologic Structure	Tined formation unconformably overlies Licuan Formation		Rock Type & Age	Dacitic lava and Pyroclastics (Oligocene)		Rock Type & Age	Agglomerates, basalts and Andesites (Eocene)			Geologic Sketch		
Rock Type and Age of Bed- rock	Dacitic lava and Pyroclastics (Oligocene)		Rock Quality	Hard to rather hard (at the left bank site)		PROFILE OF DAM AXIS	Sand Material	Location		GENERAL ASSESSMENT	1-4 Km. upstream of dam site		
Rock Quality	Both Abutments Probably hard to rather hard and loosened in the upper layer of the slope		Overburden	Residual soil			Earth Material	Location			Waterway/Power Tunnel		Good
Permea- bility	Overall Probably watertight except permeable fault zones		Geologic Structure	Two faults trend NS along the both side of chico river		DAM SITE	Damsite	Location		Power House		Good	
Over- burden	Both Abutments Residual soil (medium thickness) Loamy slope talus		Lithology & Age	Dacitic lava and Pyroclastics, limestone (Oligocene) Basalt and agglomerate (Eocene)			Reservoir	Location		Dam Construction Material		Excellent	

G E O L O G I C A L D A T A S H E E T

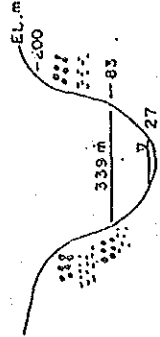
Region No.	11	I.D. No.	2-8-3-9	Scheme	CHICO-4R	Province	MT. PROVINCE	River Basin	CHICO	Stream	CHICO
Coordinates	17°01'46" N. LAT	120°56'23" W. LONG		Type of Development	RUN OF RIVER	/Weir Type	CONCRETE	River-bed	EL. 990 m	Width	60 m
Topo. Map No.	3171-II	Geo. Map SCALE	1:250,000	Length of Water Way	6620 m	Reservoir AREA		Crest EL.	993 m	Max. Height	6 m

Geologic formation and Age of the Site	Licuan Formation (Eocene) Basalt flow, diabase, basic agglomerate welded tuff, Andelsitic lava Tinas Formation (Oligocene) Dacitic pyroclastic & lava, limestone intrusives (Neogene) Granodiorite	Probably wide spaced joints occur in the fresh granodiorite Granodiorite (Neogene) Probably hard to very hard portially moderately weathered Weathered rock and talus deposit	Geologic Structure Rock Type & Age Rock Quality Overburden	M S P O M R K K F O R M A K A M K A M K A M R I O K M M S M M M M M M M M	Geologic Structure Rock Type & Age Rock Quality Overburden Geologic Structure Rock Type & Age Rock Quality Overburden Geologic Structure Lithology & Age Permeability and Groundwater Slope Stability Sedimentation	CONSTRUCTION MATERIALS Rock & Coarse Aggregate Sand Material Earth Material Topographic Condition Geologic Sketch Dam Site Waterway/Power Tunnel Power House Reservoir Dam Construction Material	Profile of Dam Axis Not visited site Decile 71m -1300 V -1200 V -1100 V -993 V < Basalt -990 V Elm	GENERAL ASSESSMENT Excellent Good Good Good Excellent
Geologic Structure	Generally rock is folded Several assumed faults (trend N-S) occur along the Chico river	Assumed fault (N-S trend) across the middle part of tunnel route Intakes and mostly part consists of basalt and agglomerate (Eocene) Outlet site consists of granodiorite Probably hard to very hard and faulted Enough thickness for tunnel excavation Several faults intersect to the reservoir area Dacitic pyroclastics and lava (Oligocene) Probably watertight except permeable fault zones Mostly stable except sliding mass consists of loose debris Common	Geologic Structure Rock Type & Age Rock Quality Overburden Geologic Structure Rock Type & Age Rock Quality Overburden Geologic Structure Lithology & Age Permeability and Groundwater Slope Stability Sedimentation	M S P O M R K K F O R M A K A M K A M K A M R I O K M M S M M M M M M M M	Geologic Structure Rock Type & Age Rock Quality Overburden Geologic Structure Lithology & Age Permeability and Groundwater Slope Stability Sedimentation	CONSTRUCTION MATERIALS Rock & Coarse Aggregate Sand Material Earth Material Topographic Condition Geologic Sketch Dam Site Waterway/Power Tunnel Power House Reservoir Dam Construction Material	Profile of Dam Axis Not visited site Decile 71m -1300 V -1200 V -1100 V -993 V < Basalt -990 V Elm	GENERAL ASSESSMENT Excellent Good Good Good Excellent

GEOLOGICAL DATA SHEET

Region No.	11	I.D. No.	2-8-4-10	Scheme	MATALAG	CAGAYAN	River Basin	MATALAG	MATALAG
Coordi- nates	N. 147 17° 49' 53" E. LONG	121° 24' 17"	DAM & RESERVOIR	Province			River bed	Stream	
Topo. Map No. 1:50,000	No. 3273-II	Geo. Map SCALE 1:600,000	Length of Water Way	Dam/Weir Type			Dam Crest		
				Reservoir Area					

Geologic formation and Age of the Site	Cobangon Formation (Late Miocene - Pliocene) Sandstone, Conglomerate, siltstone Hogan Formation (Pliocene - Pleistocene) Coarse sandstone, conglomerates, tufaceous sandstone and claystone TBK (late Pleistocene) Terrace gravels	Geologic Structure	Beeding: N 40° E Dip: 10° - 50° SE	Geologic Sketch	2.5 Km. west of damsite	Location	2.5 Km. west of damsite
Geologic Structure	Bedding N 40° E damsite trend N 40° - 50° E Guesia	Rock Type & Age	Sandstone Conglomerate (Late Miocene - Pliocene)	Geologic Sketch	Sandstone, Conglomerate (Late Miocene - Pliocene)	Rock Type & Age	Sandstone, Conglomerate
Rock Type and Age of Bedrock	Sandstone, Conglomerate (Late Miocene - Pliocene)	Rock Quality	Rather hard to soft (at right bank site)	Geologic Sketch		Quality & Volume	Rather hard
Rock Quality	Probably low permeability except weathered	Overburden	Medium thickness of residual soil and Talus deposits	Geologic Sketch		Location	1-6 Km. downstream from damsite
Permeability	Probably low permeability except weathered rock	Geologic Structure		Geologic Sketch		Quality & Volume	River and Terrace deposits
Overburden	The riverbed filled with thick to moderately river deposits	Rock Type & Age		Geologic Sketch		Location	2.5 Km. west of damsite



G E O L O G I C A L D A T A S H E E T

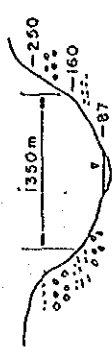
Region No.	II	I.D. No.	2-8-4-II	Scheme	N A B U A N G A N	Province	K A L I N G A - A P A Y A O	River Basin	M A T A L A G	Stream	N A B U A N G A N	
Coordi- nates	K. LAT	17° 42' 15" N	121° 13' 41" E	Type of Development	R U N O F R I V E R	Dam/Weir Type		River bed	El.	350 m	Width	50 m
Topo. Map No. 3273-III	Geo. Map SCALE	1:250,000	1:250,000	Length of Water Way	4100 m	Reservoir Area		Crest at Weir	El.	353 m	Max. Height	6 m

Geologic formation and Age of the Site	Liquan Group (Eocene) Andesite Tingng Formation (Oligocene) Dolomite Intrusives (Neogene) Granite-diorite		Geologic Structure	Fault (NE-SW) occur 1 km west of damsite		CONSTRUCTION MATERIALS	Rock & Coarse Aggre- gates	Location	2 km east of damsite
	Geologic Structure	Andesite (Eocene)		Rock Type & Age	Probably hard to very hard indurated and compacted		Material	Quality & Volume	Hard to very hard
Rock Quality	Fault across the damsite		Overburden	Thin residual soil and slight weathered andesite		PROFILE OF DAM AXIS	Sand	Location	2-5 km down stream from damsite
	Geologic Structure	Andesite (Eocene)	Rock Quality	Probably hard to very hard indurated and compacted	Material		Quality & Volume	River deposits (sand and gravel)	
Permeability	Both Abutments Probably hard to very hard indurated and compacted however weathered and fractured in fault zone		Geologic Structure	Fault (NE-SW) occur along the water way		GENERAL ASSESSMENT	Earth Material	Location	
	Overall	Probably low permeability except fractured and jointed zone	Rock Type & Age	Andesite (Eocene)	Material		Quality & Volume	Topographic Condition	V-shaped
Overburden	Both Abutments Thin residual soil (medium thickness)		Overburden	Generally even thickness for tunnel excavation except 3.3 km. from intake at EL. 400 m.		Damsite	Geologic Sketch	Not visited site	
	River Bottom	The river filled with sand and gravel	Lithology & Age	Andesite (Eocene)	Waterway/Pover Tunnel		Acceptable		
	Both Abutments	Thin residual soil (medium thickness)	Permeability and Groundwater	Probably watertight except fracture fault zone		Pover House			Good
	River Bottom	The river filled with sand and gravel	Slope Stability	Stable		Reservoir		Good	
			Sedimentation	Less to common		Dam Construction Material		Excellent	

G E O L O G I C A L D A T A S H E E T

Region No.	II	I.D. No.	2-8-5-12	Scheme	PINUKPUK		KALINGA-APAYAO	River Basin	SALTAN	Stream	SALTAN
Coordi- nates	17°37'25" N. Lat	121°22'58" E. Long	Type of Development	DAM B RESERVOIR			River Cross Section at Dam/ Weir	River- bed	EL.	87 m Width	100 m
Topo. Map No. 1:50,000	No. 3272-1	Geo. Map SCALE	Length of Water Way	M	Reservoir Area	km ²		Dam Crest	EL.	160 m Height	73 m

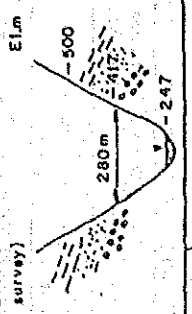
Geologic formation and Age of the Site	Cabangon Formation (Late Miocene-Pliocene) Conglomerate, Sandstone, Siltstone Hogan Formation (Pliocene-Pleistocene) Coarse sandstone, Conglomerate Tuffaceous sandstone and Claystone		Assumed fault located at 1 km. east of powerhouse		Geologic Structure		CONSTRUCTION MATERIALS		Rock & Coarse Aggr- gates		Location		2 Km. South-west of damsite	
	Bedding (N-S-N30E) Dip SE Two assumed faults intersect the Saltan river at lower and upper stream side of damsite Gusala		Conglomerate, Sandstone (Late Miocene - Pliocene)		Rock Type & Age		Talus deposits and terrace deposits		Sand		Rock Type & Age		Conglomerate, Sandstone (Late Miocene - Pliocene)	
Geologic Structure	Both Abutments Probably rather hard to soft slightly weathered rock		Hard to rather hard (at left bank site)		Rock Quality				Material		Quality & Volume		Rather hard	
Rock Type and Age of Bed- rock	Conglomerate, Sandstone (Late Miocene - Pliocene)		Probably stable except slumping clay and rocks after impoundings		Overburden				Earth Material		Location		4-6 Km. downstream from damsite	
Rock Quality	Probably low permeability		Common		Geologic Structure						Quality & Volume		River deposits (Sand and Gravel)	
Permea- bility	Overall		Probably watertight		Lithology & Age		Bedding (N-S-N30E)		Topographic Condition		Soil Type		2 Km. south-west of damsite	
Over- burden	Both Abutments		Probably stable after impoundings		Permeability and Ground- water		Probably watertight		Not visited site (Over/light survey)		Quality & Volume		Probably suitable	
	River Bottom		The river bed filled with very thick. river deposits		Slope Stability		Probably stable except slumping clay and rocks after impoundings		Geologic Sketch		Topographic Condition		Wide Dish - Shaped	
				Sediment- ation		Common		Dam Construction Material		Geologic Sketch		Elm		



G E O L O G I C A L D A T A S H E E T

Region No.	II	I.D. No.	2-8-5-13	Scheme	A D A G A	Provinces	KALING-APAYAO	River Basin	SALTAN	Stream	SALTAN
Coordi- nates	17°30'15" N, 121°16'20" E	LONG	121°16'20"	Type of Development	DAM & RESERVOIR	Dam/Weir Type		River Cross Section at Dam/Weir	River-bed El.	247 m	Width 40 m
Topo. Map No. 1:50,000	3271-1	Geo. Map SCALE	1:50,000	Length of Water Way	m	Reservoir Area	km ²		Dam Crest El.	417 m	Height 170 m

Geologic formation and Age of the Site	Cabaon Formation (Late Miocene) Shale, Sandstone, Conglomerate Lubacon Formation (Early-Middle Miocene) Volcanic wackes, Micro breccia, Shale, Conglomerate Calleo limestone Formation (Miocene)		Geologic Structure	Bedding N-NE / S-SE steep		CONSTRUCTION MATERIALS	Rock & Coarse Aggregate	Location	3Km. east from damsite
	Geologic Structure	Shale, Sandstone, Conglomerate (Late Miocene)		Rock Type & Age	Shale, Sandstone, Conglomerate (Late Miocene)		Rock Type & Age	Limestones (Miocene)	
Rock Type and Age of Bed-rock	Shale, Sandstone, Conglomerate (Late Miocene)		Rock Quality	Rather hard (at the right bank)		PROFILE OF DAM AXIS	Soil	Location	1-3Km. downstream from damsite
Rock Quality	Probably hard to rather hard slightly compacted and consolidated with widely spaced cross joint		Overburden	Residual soil (thin) Terrace deposits			Geologic Sketch	Soil Type	Quality & Volume
Permeability	Overall		Permeability and Ground-water	Probably water tightness		GENERAL ASSESSMENT	Topographic Condition	Quality & Volume	1-3Km. east from damsite
Overburden	Probably, high permeability at shallow part		Slope Stability	Stable, but some possible of land slide after impounding			Damite	Topographic Condition	Quality & Volume
	Both Abutments		Sedimentation	L e s s		Waterway/Power Tunnel	Not visited site (Overflight survey)	Quality & Volume	Probably suitable



G E O L O G I C A L D A T A S H E E T

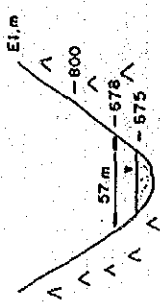
Region No.	II	I.D. No.	2-8-5-14	Scheme	SALTAN - 4	Province	KALINGA-APAYAO	River Basin	SALTAN	Stream	SALTAN
Coordination	17°30'30" N. LAT	12°11'00" E. LONG		Type of Development	DAM & RESERVOIR	Dam/Weir Type		River Cross Section at Dam	River-bed El.	510m Width	10m
Topo. Map No. 1:50,000	No. 3272-IV	Geo. Map No. 1:250,000	SCALE	Length of Water Way	M	Reservoir Area			Dam Crest El.	677 m	Height 167 m

	Alava Formation (Miocene) Sandstone, Mudstone, Conglomerate Alava Limestone Mabaco Formation (Early Miocene) Andesitic Pyroclastics Tinas Formation (Oligocene) Dacitic Pyroclastic and lava Licuan Formation (Eocene) Andesite rock	Alava Formation unconformably overlies Tinas Formation with faulting	Sandstone, Mudstone, Conglomerate (Miocene) Hard to rather hard (at the right bank)	Thin residual soil	Within 10Km from damsite	3-4 Km. north-east from damsite Dacitic pyroclastics and lava (Oligocene) Hard to very hard 1-2 Km. upstream from damsite
G E O L O G I C A L	Geologic Formation and Age of the Site	Geologic Structure	Rock Type and Age of Bed-rock	Rock Quality	Topographic Condition	Location
D A M	Geologic Structure	Overburden	Both Abutments Probably hard to rather hard indurated and compacted with widely spaced joints	Thin residual soil	V-Shaped	Rock & Coarse Aggregate
S I T E	Rock Quality	Overburden	Probably high permeability at shallow part	Leakage is remote, except faults	Not visited site (Overflight survey)	Location
E N V I R O N M E N T	Permeability	Overburden		Possibility of land slip, especially after impending	Elm	Rock Type & Volume
G E N E R A L	Overburden	Sedimentation		Less is common	Geologic Sketch	Quality & Volume
A S S E S S M E N T						Location Quality & Volume Location Quality & Volume Location Quality & Volume
GENERAL ASSESSMENT						

G E O L O G I C A L D A T A S H E E T

Region No.	II	I.D. No.	2-8-5-15	Scheme	SALTAN	Province	KALINGA-APAYAO	River Basin	SALTAN	Stream	SALTAN	
Coordi- nates	17° 30' 14" N. LAT	121° 07' 50" E. LONG	Type of Development	CONCRETE	River-bed	El. 675 m	Width	50 m				
Topo. Map No.	3272-III	Geo. Map SCALE	Length of Water Way	7480 m	Reservoir Area	—	Reservoir	—	Crest El.	678 m	Max. Height	6 m

Region No.	I.D. No.	Scheme	SALTAN	Province	KALINGA-APAYAO	River Basin	SALTAN	Stream	SALTAN	CONCRECTION MATERIALS		PROFILE OF DAM AXIS		GENERAL ASSESSMENT	
										Geologic Formation and Age of the Site	Geologic Structure	Rock Type and Age of Bed-rock	Rock Quality	Geologic Structure	Rock Type and Age
										1.5 Km. east of main weir	Location	Topographic Condition	Not visited site		
										Decitic pyroclastics and lava (Oligocene)	Rock Type & Age	Geologic Sketch	Andesite		
										Hard to very hard, sound and indurated	Quality & Volume				
										0-2 Km. downstream from main weir	Location				
										River deposits (Sand and Gravel)	Quality & Volume				
											Location				
											Soil Type				
											Quality & Volume				
											Topographic Condition				
											Geologic Sketch				
											Dam Site				
											Waterway/Power Tunnel				
											Power House				
											Reservoir				
											Dam Construction Material				



Region No.	II	I.D. No.	2-8-5-16	SALTAN-5	Province	KALINGA-APAYAO	River Basin	SALTAN	Stream	SALTAN		
Coordi- nates	17°30'04" N. LAT	121°07'00" E. LONG	DAM A RESERVIOR	DAM/Wafr Type			River- bed	EL.	735 m	Width	10 m	
Topo. Map	No. 3272-IV	Geo. Map	1:250,000	Reservoir	M	kms	Section of Dam/ Weir	Crest	EL.	849 m	Height	114 m
		SCALE										

Geologic formation and Age of the Site	Alava Formation (Miocene) SS, Mudstone, Conglomerate Tineg Formation (Oligocene) Dacitic pyroclastic, lava Licuan Formation (Eocene) Andesite Quartz diorite (Plutonic Rock)	Geologic Structure	No major fault of powerhouse site	CONSTRUCTION MATERIALS	Rock & Coarse Aggre- gates	Location	2-4 Km WNW from damsite.
Geologic Structure	A fault trend NE cross the Saligan river of damsite	Rock Type & Age	Andesite (Miocene)	Geologic Structure	Sand	Rock Type & Age	Andesite (Eocene) Quartz diorite (Tertiary)
Rock Type and Age of Bed- rock	Andesite (Eocene)	Rock Quality	Hard to rather hard (at the left bank)	Rock Type & Age	Material	Quality & Volume	Hard to very hard
Rock Quality	Both Abutments Probably, hard to rather hard indurated and compacted with widely spaced joints	Overburden	Thin residual soil	Geologic Structure	Earth Material	Location	5-8 Km. upstream from damsite
Permeability	Overall Probably high permeability at shallow part	Rock Quality		Rock Type & Age		Quality & Volume	River and Terrace deposits
Overburden	Both Abutments Residual soil (Medium to thin thickness) River Bottom Huge boulder and gravel	Overburden		Geologic Structure		Topographic Condition	5-8 Km. west from damsite
		Geologic Structure	A fault trend NE cross the Saligan river at 5 Km. west (upstream) of damsite	Geologic Structure		Geologic Sketch	Aluvial deposits Residual soil Probably suitable
		Lithology & Age	Andesite (Eocene) Quartz diorite (Tertiary)	Geologic Structure		Geologic Sketch	V-Shaped Not visited site E1.m 312 m 841 735
		Permeability and Ground-water	Leakage is remote except fault (NE direction)	Geologic Structure		Damsite	G o o d
		Slope Stability	Possibility of land slip, especially after impending	Geologic Structure		Waterway/Power Tunnel	Excellent
		Sedimentation	Common	Geologic Structure		Reservoir	G o o d
				Geologic Structure		Dam Construction Material	Excellent

G E O L O G I C A L D A T A S H E E T

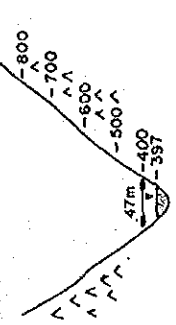
Region No.	II	I.D. No.	2-8-5-17	Scheme	BABACA-R	Province	KALINGA-APAYAO	River Basin	SALTAN	Stream	BABACA
Coordi- nates	17°35'48" N. LAT	121°19'06" E. LONG	Type of Development	DAM & RESERVOIR	Dam/Weir Type		River bed	River- bed	El.	127m Width	50m
Topo. Map No. 3272-1	1:50,000	Geo. Map SCALE	Length of Water Way	M	Reservoir Area		Section at Dam/Weir	Dam Crest	El.	220m Height	93m

Geologic Formation and Age of the Site	Lubbagan Formation (Middle Miocene) Conglomerata, Sandstone, Shale Cobagan Formation (Late Miocene to Pliocene) Sandstone, Siltstone, Conglomerate		Bedding N45°E, Dip SE Moderately		CONSTRUCTION MATERIALS		Location		5Km. west of damsite		
	Geologic Structure			Rock Type & Age	Sandstone, Siltstone, Conglomerate		Rock & Coarse Aggre- gates	Rock Type & Age	Conglomerate (Middle Miocene)		
Geologic Structure	Bedding N45°E, Dip SE moderately Syncline trends NE, occur 5Km. east of damsite		Rock Quality	Medium hard (at right bank site)		Sand Material	Sand	Quality & Volume	Hard, indurated		
Rock Type and Age of Bed- rock	Sandstone, Siltstone, Conglomerate		Overburden	Residual soil Talus deposits		Earth Material	Earth Material	Location	4Km. west of damsite		
Rock Quality	Both Abutments compacted and consolidated with fractured joints widely spaced		Geologic Structure			Topographic Condition		Soil Type	Residual soil		
Overall zone	Probably watertight except fractured zone		Rock Quality			Geologic Sketch	Quality & Volume		Probably suitable		
Permeability	Probably watertight except fractured zone		Overburden			Profile of Dam Axis	Topographic Condition		Open V-Shaped		
Both Abutments	Probably thick residual soil in higher elevation		Geologic Structure	No major fault in the reservoir area		Geologic Sketch		Not visited site			
River Bottom	The river bed filled with sand and gravel		Lithology & Age	Conglomerate, Sandstone, Shale (Middle Miocene) Sandstone, Siltstone, Conglomerate (Late Miocene to Pliocene)		Damsite		Waterway/Power Tunnel		Good/Acceptable	
Overburden			Permeability and Ground-water	Probably watertight except geological contact		Power House		Reservoir		Good	
			Slope Stability	Generally stable, partially occur small scale landslide		Dam Construction Material				Good	
			Sedimentation	Common						Good	

G E O L O G I C A L D A T A S H E E T

Region No.	II	I.D. No.	2-8-5-18	Scheme	BABACA	Province	KALINGA-APAYAO	River Basin	SALTAN	Stream	BABACA	
Coordi- nates	17°35'06" N. LAT	121°13'23" E. LONG		Type of Development		Dam/Weir Type		River bed	El.	397 m	Width	40m
Topo. Map No. 1:50,000	No. 3272-IV	Geo. Map SCALE	1:250,000	Length of Water Way	4800 M	Reservoir Area		Crest	El.	400 m	Height	6 m

Geologic formation and Age of the Site	Tines Formation(Oligocene)Dacitic rock Zigzag Formation(Early Miocene) Andesite Ibuloo Formation(Early Miocene)Limestone Lubuqaan Formation.(Middle Miocene) Sandstone, Conglomerate		Geologic Structure	Fault occur at right bank side of Babaco River		CONSTRUCTION MATERIALS	Rock & Coarse Aggre- gates	Location	2km. south-east of damsite
	Geologic Structure	Bedding NE-SW Fault occur 3Km. south of damsite trend NE-SW		Sand	Location		5-10Km. downstream from damsite		
Rock Type and Age of Bed- rock	Andesite (Early Miocene)		Rock Type & Age	Andesite (Early Miocene) is overlain by Limestone overites andesite		PROFILE OF DAM AXIS	Earth Material	Soil Type	
Rock Quality	Both Abutments compacted		Rock Quality	Hard to very hard indurated and compacted			Topographic Condition	Not visited site	V-Shaped
Permeability	Overall		Overall	Probably watertight		GENERAL ASSESSMENT	Geologic Sketch	Damsite	Excellent
	Probably watertight		Geologic Structure	No major fractured zone					Waterway/Power Tunnel
Overburden	Both Abutments		Lithology & Age	Andesite (Early Miocene)		Power House	Reservoir	Dam Construction Material	Good
	Residual soil (Medium thickness)		Permeability and Ground-water	Probably watertight					Good
	River Bottom		Slope Stability	Stable					Good
	River bed filled with gravel and sand		Sedimentation	Loss to common					Good



G E O L O G I C A L D A T A S H E E T

Region No.	II	I.D. No.	2-8-6-19	Scheme	NANENG		KALINGA-APAYAO	River Basin	TANUDAN	SStream	TANUDAN
Coordi- nates	17°23'15" N. LAT	121°10'41" E. LONG		Type of Development	DAM & RESERVOIR			River Cross Section at Dam/ WEIR	River- bed El.	302m	Width 20 m
Topo. Map Scale	No. 3272-II	Geo. Map SCALE	1:100,000	Length of Water Way	m		Reservoir AREA		Dam Crest El.	439m	Height 137m

Geologic formation and Age of the Site	Zioxog Formation (Early Miocene) SS, Conglomerate, Agglomerate Lubagan Formation (Middle Miocene) SS, Conglomerate Cabagan Formation (Late Miocene) Siltstone and Sandstone		Assumed fault occur 1km. south-west of damsite		Geologic Structure	Assumed fault occur 1km. south-west of damsite		CONSTRUCTION MATERIALS	Rock & Coarse Aggre- gates	Location	15km. ENE of damsite
	Geologic Structure	Assumed fault trend inferred 1km. upstream of damsite, joints widely spaced not persistent		Rock Type & Age		Sandstone, Conglomerate and Agglomerate (Early Miocene)			Rock Type & Age	Agglomerate (Miocene)	
Rock Type and Age of Bed- rock	Sandstone, Conglomerate and Agglomerate (Early Miocene)		Rock Quality	Hard with joints widely spaced not persistent (the left bank site)		Overburden	Residual soil and slope wash		Sand	Location	Along the chico river 3-6 Km. from damsite
Rock Quality	Both Abutments Probably, hard and partially slightly weathered with joints widely spaced not persistent		Overburden	Residual soil and slope wash		Geologic Structure			Material	Quality & Volume	River and Terrace deposits
Perme- ability	Overall		Geologic Structure	Assumed faults cut a cross Tanudan river at 1km. and 5km. from damsite		Rock Type & Age			Earth Material	Location	2 Km. MNW of damsite
	Probably, low permeability except at shallow part		Lithology & Age	Sandstone, Conglomerate and Agglomerate (Early Miocene), Sandstone (Middle-Miocene)		Rock Quality			Topographic Condition	Soil Type	Probably suitable
Over- burden	Both Abutments		Permeabi- lity and Ground- water Slope Stability	Possible leakage due to faults		Overburden			Geologic Sketch	Topographic Condition	V-Shape d
	Residual Soil and slope wash		Sediment- ation	Unstable		Geologic Structure			Geologic Sketch	Not visited site	El.m
The river bed is filled with gravel and boulder		Common		Damsite				Geologic Sketch			
		Damsite		Waterway/Power Tunnel				Damsite		Good	
		Power House		Unstable				Waterway/Power Tunnel		Good	
		Reservoir		Common				Reservoir		Good/Acceptable	
		Dam Construction Material		Common				Dam Construction Material		Good	

Region No.	II	I.D. No.	2-8-6-20	Scheme	MI. BOLONTOC	Province	KALINGA-APAYAO	River Basin	TANUDAN	Stream	PASIL
Coordi- nates	17°23'15" N. LAT	121°09'30" E. LONG		Type of Development	DAM & RESERVOIR	Dam/Weir Type		River bed	River- bed	443 m	Width
Topo. Map No. 3272-III		Geo. Map SCALE 1:100,000		Length of Water Way		Reservoir Area		Dam Crest	El.	607 m	Height
									El.	164 m	

G E O L O G I C A L D A T A S H E E T		KALINGA-APAYAO		MI. BOLONTOC		Province		KALINGA-APAYAO		River Basin		TANUDAN		Stream		PASIL		
Geologic Formation and Age of the Site	Avidan Mesa Formation (Late Pleistocene)		Dacitic welded tuff		Lubugan Formation/Balaban member, Sandstone (Miocene)		Alaga member - Alternation of claystone/siltstone		Basement Complex (Licuan G./Eocene) Andesitic lava and its pyroclastics		Inferred vertical fault (trend NE-SW) occur 1.5 Km. south east of damsite		5 Km. SW of damsite		Andesitic lava and its pyroclastics (Eocene)		Hard to very hard sound	
	Inferred vertical fault (trend NE-SW) occur 1.5 Km. south east of damsite		Moderately hard (the left bank site)		Residual soil		Alternation of claystone and siltstone (Miocene)		Residual soil		River deposits (sand and gravel)		4 Km. SW of damsite		Residual soil		Probably suitable	
Geologic Structure	Both Abutments		Probably, rather hard and partially slightly weathered and rich joint and cracks								Topographic Condition		V-Shaped					
	Overall		Probably, weightiness except at shallow part								Geologic Sketch		Not visited site					
Permeability	Both Abutments		Residual Soil (thick)								Damite		Acceptable					
	River Bottom		The river bed is filled with gravel, boulder and sand								Waterway/Power Tunnel							
Overburden	Both Abutments		Residual Soil (thick)								Power House		Good					
	River Bottom		The river bed is filled with gravel, boulder and sand								Reservoir		Good/Acceptable					
												Dam Construction Material		Good				

GEOLOGICAL DATA SHEET

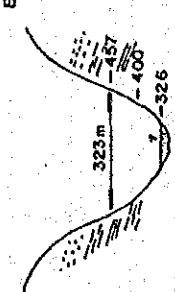
Region No.	II	I.D. No.	2-8-6-21	Scheme	LOWER PASIL	Province	KALINGA-APAYAO	River Basin	TANUDAN	Stream	PASIL
Coordinates	17°23'59" N. LAT	121°12'38" E. LONG	Type of Development	DAMB RESERVOIR	Dam/Weir Type	Reservoir Area	River Cross Section at Dam/Weir	River-bed El.	326m	Width	60m
Topo. Map No. 1:50,000	No. 3272-III	Geo. Map No. 1:250,000	Length of Water Way	M	km ²			Dam Crest El.	457 m	Height	131 m

Geologic formation and Age of the Site	Awidan Mesa Formation (Late Pleistocene) Paclic welded tuff Lubuogan Formation (Miocene) Baibolan member, Sandstone siltstone Asiga member, alternation of claystone and siltstone Basement Complex/Licuon Group (Eocene) Andesitic lava and Pyroclastics	Geologic Structure	Bedding N45°E / Dip 60-70°SE Two assumed faults (trend N25°E) occur upper stream and down stream sites	Geologic Structure	Bedding N45°E Dip 60-70°SE	Province	KALINGA-APAYAO	River Basin	TANUDAN	Stream	PASIL
Rock Type and Age of Bed-rock	Sandstone Alternation of claystone and siltstone (Miocene)	Rock Type & Age	Sandstone (Miocene)	Rock Type & Age	Sandstone (Miocene)	Dam/Weir Type		River Cross Section at Dam/Weir	River-bed El.	Width	60m
Rock Quality	Both Abutments Probably rather hard and partially slightly weathered and fractured due to effect of Kalinga fault zone	Rock Quality	Moderately hard (at right bank site)	Rock Quality	Moderately hard (at right bank site)	Reservoir Area		Dam Crest El.	457 m	Height	131 m
Permeability	Overall Probably watertight except fractured zone	Overburden	Residual and talus deposits	Overburden	Residual and talus deposits						
Overburden	Both Abutments Residual soil and talus deposits River Bottom The river bed filled with gravel, boulder and sand	Geologic Structure		Geologic Structure							

CONSTRUCTION MATERIALS

PROFILE OF DAM AXIS

GENERAL ASSESSMENT



G E O L O G I C A L D A T A S H E E T

Region No.	II	I.D. No.	2-8-6-22	Scheme	P A S I L	KALINGA-APAYAO	River Basin	TANUDAN	Stream	P A S I L
Coord. nates	17°20'28" N. Lat	121°03'25" E. Long		Type of Development	RUN of RIVER	Province	River Cross Section at Weir	River Bed	845 m	Width
Popo. Map No.	3272-III	Geo. Map No.	1:250,000	Length of Water Way	10030 m	Reservoir Area		Crest El.	865 m	Max. Height
		SCALE								40 m
										6 m

Geologic formation and Age of the Site	Licuan Formation (Eocene) Andesite Tinag Formation (Oligocene) Dacite. Lubugangan Formation (Miocene) Sandstone Intrusive Rock (Tertiary) Quartz diorite Quaternary volcanics (Pleistocene) Dacitic to Andesitic Pyroclastics & Lava		Geologic Structure	Sedstone unconformably overlies Licuan Formation		CONSTRUCTION MATERIALS	Location	4.5km east of main weir	
	Geologic Structure	Quaternary volcanic unconformably overlies Licuan Formation		Rock & Coarse Aggr. Gates	Rock Type & Age			Dacite (Oligocene)	
Rock Type and Age of Bedrock	Andesite (Eocene)		Rock Type & Age	Sandstone (Miocene)		Earth Material	Location		
Rock Quality	Probably hard to very hard with wide spaced joints		Rock Quality	Hard to rather hard slightly weathered		Sand Material	Location		
Abutments	Both		Overburden	Residual soil and Tolu deposits		Topographic Condition	Location		
	Probably hard to very hard with wide spaced joints		Geologic Structure	Assumed fault across the waterway at the middle point of waterway			Soil Type	Location	
Overall	Probably watertight except open joints and cracks		Rock Quality	Dacitic to Andesitic pyroclastics & lava (Pleistocene), Andesite (Eocene), Sandstone (Miocene)		Geologic Sketch	Quality & Volume		
	Probably watertight except open joints and cracks		Overburden	Waterway through mainly hard to very hard fresh compacted to semi compacted Quaternary volcanics			Topographic Condition	Quality & Volume	
Permeability	Probably watertight except open joints and cracks		Lithology & Age	Andesite (Eocene)		Dam Site	Location		
	Probably watertight except open joints and cracks		Permeability and Groundwater	Probably watertight except open joints and cracks			Waterway/Power Tunnel	Location	
Both Abutments	Slightly weathered rock and thin residual soil		Slope Stability	Stable		Power House	Location		
	River bed filled with sand, cobble and huge boulder		Sedimentation	Less			Reservoir	Location	
River Bottom		River bed filled with sand, cobble and huge boulder				Dam Construction Material	Location		
							Location		

