DIRECTORATE GENERAL SMALL DAMS
IRRIGATION DEPARTMENT
GOVERNMENT OF KHYBER PAKHTUNKHWA

PC-1 PROFORMA

NAME OF WORK : CONSTRUCTION OF SHAH KALEEM DAM
DISTRICT NOWSHERA
ADP NO – 1207 (2014-15)

Code 140522

(E/Cost. 595.200 Million)
575,20

CONSULTING ASSOCIATES PESHAWAR
Near Deans Complex Apartments, Behind Gul CNG, Board Bazaar, Jamrud Road, Peshawar
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JULY 2014

GOVERNMENT OF KHYBER PAKHTUNKHWA
IRRIGATION DEPARTMENT

No. PMC/PDWP/021014/ADP
Dated Peshawar, the 27-10-2014

To.

The Director General,
Small Dams, Peshawar

SUBJECT: ADMINISTRATIVE APPROVAL

In exercise of the powers delegated vide Part-I serial No. 6 Second Schedule of the Delegation of Powers under the Financial Rules and Powers of Re-appropriation Rules, 2001, the Khyber Pakhtunkhwa, Provincial Government is pleased to accord Administrative Approval for the implementation of the ADP (2014-15) scheme No. 1207 "140522- Construction of Shah Kaleem dam district Nowshera approved at reduced cost of Rs. 575.20 million as per detail given below:-

Particulars	Amounts (Rs. Million)
Capital expenditure	575.20
Revenue expenditure	Nil
Foreign Exchange/Donor Assistance	Nil

The scheme was approved by the PDWP in its meeting held on 02-10-2014 under the Chairmanship of Additional Chief Secretary, Khyber Pakhtunkhwa. The minutes of the meeting were circulated vide Planning & Development Department letter No. P&D/Water/1-5/1577-84 dated: 22-10-2014.

The expenditure involved is chargeable to 04-Economic Affairs, 042 Agricultural, Food, Irrigation, Forestry and 042250-others.

The approval does not constitute any approval or sanction to the design, rates and estimates for the work/sub work included in the PC-I, which will be the responsibility of office and authority sanctioning the estimate technically. All the codal formalities/standing instructions regarding financial regularity etc should be observed in letter and spirit.

DiV

AA 22/10

Secretary Irrigation

Endst. No Even as above
Copy forwarded to the following for information:

1. The Additional Chief Secretary, Khyber Pakhtunkhwa, Peshawar.
2. The Secretary to Govt. of Khyber Pakhtunkhwa, Finance Department, Peshawar.
3. The Accountant General, Khyber Pakhtunkhwa, Peshawar
4. The Additional Secretary, Irrigation Department, Peshawar with the request to take-up case with Finance Department for early releases of allocated funds for CFY.
5. The Chief Draftsman (local).

537
28/10/14 Copy to
2-on Shah Kaleem Dam

(Engr. Nadir Khan)
Senior Planning Officer

TABLE OF CONTENTS

Shah Kaleem Dam District Nowshera
PC-I Performa

Certificate

CERTIFICATE

Certified that all the technical detail of the scheme **"Construction of Shah Kaleem Dam District Nowshera"** have been scrutinized. The estimated quantities and rates have been checked and found correct.

Estimate is based on MRS 2013 Government of Khyber Pakhtunkhwa.

Deputy Director
Planning and Construction,
Small Dams Division, Peshawar

Director
Small Dams Irrigation Department,
Peshawar

Salient Features

SHAH KALEEM DAM PROJECT

SALIENT FEATURES

Main Dam	
Type	Earth Core gravel fill Dam (ECRD)
Crest Elevation	364.0 m (1194.28 ft) AMSL
Max. Storage Level	359.0 m (1177.52 ft) AMSL
Free Board	5 m
Crest width	10 m (32.8 ft)
Slope upstream face	2.25 H: 1.0 V
Slope downstream face	2.0H : 1.0 V
Upstream River Bed EL.	343.0 m (1125.0 ft) AMSL
Max Height of Dam	21 m (70 ft)
Length of Dam	223.8 m (734.28 ft)
Reservoir	
Catchment Area	9.96 sq miles
Reservoir Area at Gross Storage Level	29 acres
Estimated Average Annual Run-off	1862 AF
Gross Storage of Reservoir	647 AF
Dead storage capacity	98 AF
Live storage capacity	549 AF
Average Annual Evaporation	52 inches
Average Annual Rainfall	23.80 inches

Ogee Crest Spillway	
Spillway crest El.	359.0 m (1177.8 ft.) AMSL
Width of spillway	45.7 m (150 ft.)
Max. Inflow against 1000 yr Return Period	16687 Cusecs
Surcharge over Spillway	2.83 m (9.27 ft.)
Outflow from Spillway against 1000 yr Return Periods	16,427 Cusecs
Intake Structure	
Conduit Length	56.05 m (184.7 ft.)
Max. Discharge (Withdrawal)	3 cusecs
Invert level at intake	350 m (1148.35 ft.) AMSL
Irrigation System	
Irrigated command Area	900 acres
Designed discharge	3.00 cusec
Length of Main Canal	3.016 km (1.874 miles).
Project Cost & Per Unit Cost	
Project Cost	575.20 ~~595.~~200 Million
Cost Per Acre (Unit Cost)	~~0.661~~ Million 0.639

Executive Summary

EXECUTIVE SUMMARY

1.0 Project Location

The proposed dam site is located on Shah Kaleem Khwar locally known as Pitao Khwar. The proposed dam site is located in village Shaidu district Nowshehra. The village Shaidu is located on Rawalpindi-Peshawar GT road. The site is accessible through a Shingle road in the ravine of the Nullah.

2.0 Salient Features of the Dam

Main Dam	
Type	Earth Core Rock fill Dam (ECRD)
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3.0 Hydrology

The catchment area of the Pitao Khwar upto the proposed dam site is 9.96 sq. miles. The point of maximum elevation in the catchment area is 2750 ft (838.2 m) and at proposed dam site Nullah bed is at elevation 1125.3 ft (343 m). The Length of the main channel is 3.016 Km. The Nullah bed slope is 181 ft/mile.

Rainfall data of Cherat has been adopted for the proposed dam site as it is nearest gauge station. Daily rainfall data for Cherat has been collected from Meteorological Department Lahore for period of 1970-2009. Mean monthly rainfall for project area varies from 0.51

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inches to 4.08 inches while mean annual rainfall for corresponding period is 23.77 inches. The mean annual flow at dam site is estimated as 1,862 Acre–ft.

Inflow hydrographs against 1,000 years (peak 16,687cusecs) are routed through spillway and resulting inflow - outflow hydrographs against these return periods are calculated. Surcharge head of 9.27 ft resulted against these peak inflows. Outflow against this inflow is 16,427 (peak) cusecs from spillway.An ogee type spillway with crest elevation and length 359m and 150 ft (46m) is recommended against 1000 yr flood. Reservoir capacity at gross storage and dead storage is 647 and 98 acre-ft at elevation of 359 m and 350 m respectively. Life of reservoir is more than 30 yrs.

Embankment Dam Design Studies

In order to carryout a safe and economical design of the project, several options for the location and type of Structure were studied before the finally selected layout is optimized for technically feasible and financially viable project.

The main dam embankments will block the existing gap in the reservoir periphery of Pitao Khwar. The spillway is located at Left abutment of main dam. The selected type of the dam is Earth Core Rockfill Dam with total length of 223.8m (734.28 ft) and height 21 m (70 ft). The crest width of dam will be kept as 10 m (32.8 ft).

The conservation level of the reservoir has been kept at El. 359 m (1177.8 ft) and the height of dam crest has been fixed at El. 364 m (1193.92 ft) with 5 meter (16.4 ft) free board.

4.0 Geology

4.1 Project Geology

The proposed Shah Kaleem dam is on a U shaped valley on Shah Kaleem Khwar locally known as Pitao Khwar which has a seasonal flow. The Shah Kaleem Dam is located about 9 Km South of village Shaidu in Nowshehra District. Shah Kaleem Khwar is the main stream of the area which is a tributary of River Kabul. Surface and sub surface investigations are carried out which are described as under including the laboratory testing on selected core samples.

4.2 Surface Geology

Surface geological mapping of the dam site area has been carried out in detail and has been plotted and presented in (Fig 3.1). The exposed lithology on both the abutments as well in the stream channel has been shown in the map. Nullah bed is covered with overburden where as rock is well exposed on the abutments. General trend of rocks is in North West direction and plunging in north east. The rocks are slightly too moderately weathered.

4.3 Sub Surface Geology

The subsurface geology of dam site was carried out through drilling. Five boreholes were drilled, one each on left and right abutments, one at spillway and two at Nullah bed, total of 91 meters (298 feet).

4.4 Dam

In the light of so far completed investigation it is envisaged constructing a 78.74 feet high ECRD type dam. The dam axis is cited across the Pitao Khwar at a U shaped gorge.

4.5 Left Abutment

From field data and geo technical investigation it is clear that the left abutment is mainly composed of Phyllite having sparse vegetation and overburden up to 3 feet. The Phyllite is a low metamorphic rock. It is closely jointed, slightly to moderately weathered, fractured and Yellowish gray in color.

4.6 Nullah Channel Area

In the streambed unconsolidated materials are present. It consists of sand, clay, silt, gravels and cobbles. These are very loose to loose, rounded to sub rounded. The rock encountered in the stream is similar to the rocks present on abutments.

4.7 Right Abutment

From geological map of dam site and geological section it is clear that Phyllite is prevailing along the right abutment. It is yellowish gray in color, slightly to moderately weathered, closely jointed and fractured, foliated and of moderate strength.

5.0 Spillway Area

5.1 General

For Shah Kaleem dam an ogee type overflow spillway is proposed due to simplicity and economy of design and construction. A gated spillway would have increased the overall project cost, and at the same time created construction and operational complications resulting in a significant increase in construction time.

A chute spillway with ogee crest is proposed for Shah Kaleem Dam with vertical upstream face and double chute. The Spillway Crest is placed at the Max. Conservation Level i.e. 359 m (1177.8 ft) a.m.s.l. The spillway is having a width of 45.72 m (150 ft). with a designed discharge of 16,427 cusecs designed on the basis of 1000 years return period flood with a surcharge of 9.27 ft and surcharge level of 361.83 m (1187.09 ft) a.m.s.l. The stilling basin is placed at an elevation of 340 m (1115.48 ft) a.m.s.l with a length of 23.16 m (76 ft).

Concrete lined irrigation channel is proposed to off-take from outlet conduit stilling basin at an elevation 349 m (1145.0 ft) a.m.s.l with a channel width of 1.10 ft and depth of 0.95 ft in a length of 3016 m (9,895 ft). The cultuarable command area is 900 acres for which 3 cusecs discharge is allocated according to crop water requirements. The outlet conduit structure is multistage tower intake with invert level of 350 m (1148.29 ft).

5.2 Surface Geology

The proposed location of the spillway is falling on the area along the Nullah, which consist of phyllite.

5.3 Subsurface Geology

The subsurface geology is the same as that of the overall Geology of the site as earlier described.

6.0 Reservoir Geology

The reservoir is spread over some broad valleys upstream the dam axis. Both left and right abutments are on sound rocks.

7.0 Construction Material

The typical cross-section of main embankment comprised Rip-rap, Up-stream Rockfill, Up-stream Gravel Fill, Up-stream Filter, Central Core, Down-stream Filter, Drainage Blanket, Coarse Filter, Down-stream Gravel Fill, Down-stream Rockfill, and Toe Drain. Design features of various embankment components are as below:-

Construction of Shah Kaleem Dam involves an ample amount of construction materials comprising naturally available materials such as clay for central core, shoulder materials, sand and gravels for filters, rocks for riprap, embankment fill and water. Besides, industrial materials like cement will be used in spillway.

The identified potential borrow sources for construction materials are: Azim Ghari Jehangira (Clay source); Azim Ghari Jehangira (Sand source); Khairabad (Sand source); Shah Kaleem Khwar (River Bed) for gravels; Dam Site Excavation Areas (Rockfill); and Nizam Pur Area (Rockfill / Riprap).The evaluation of laboratory test results showed that quality of borrow materials identified as potential sources are suitable for construction of embankment dam. However, the sources of Rockfill cannot be used for construction of riprap. Therefore, ripraps may be constructed either from dam site excavation or an alternate source may be identified and tested for construction.

8.0 Soil and Agriculture

Total CCA of 900 acres, the proposed cropping pattern and intensities include Maize 25% of CCA followed by Kharif Fodders 8%, Sugarcane 10% and K Vegetables 5%. During Rabi Wheat occupies 40% of CCA, R. Vegetables 8%, Orchards 2%. The total Kharif intensity comes to 45 % and total Rabi intensity comes to 55%, which aggregate to 100 percent as annual cropping intensity. The Kharif Rabi ratio comes to 1:1.22. The ultimate cropping intensity of 100% will be achieved in 2 years after the commencement of the project. The estimated incremental production of cereals, fruits, vegetables and pulses totalling to 1766 tones which is almost 12 times the existing production from these un-irrigated areas. The total requirements of Nitrogen, Phosphorous and Potassium (N-P-K) have been computed and estimated as 33.4 tones. The total annual potential evapotranspiration (ETo) is estimated as 1307 inches/year. The effective rain fall are estimated as 510.8 inches. Total water allowance required at canal head is 1.34 cfs / 1000 acres of CCA.

9.0 Environment

Located on Pitao Khwar in district Nowshehra, Shah Kaleem Dam Project besides providing flood control, will irrigate lands in Nowshehra district. The stream bed elevation is 1125.00 ft. above mean sea level. It will have gross storage of 646 acre ft. Based on 60 % reduction of gross storage, the life of the dam is estimated more than 30 years. The 150 ft. wide ogee type spillway will be located on the left hand side of the dam designed for a surcharge of 8.9 ft.

9.1 Environmental Baseline

9.1.1 Physiography

Physiographically the proposed Shah Kaleem Dam site area is situated where the mountains are medium high and become high at east. Flood plains of Nowshehra are present in the north-east river Kabul runs parallel to these plains. The irrigated area is composed of Quaternary deposits. Climatically the area lies in the region characterized by cold in the winter and very hot in the summer.

9.1.2 Geology

The Shah Kaleem dam is located in mountainous region belonging to Attock - Cherat Ranges. The rocks exposed in the area range from Paleozoic to Cenozoic ages. The solid rocks of mountains are mainly composed of Slates, Phyllite, Argillite and Limestone.

9.1.3 Land Use

The land areas of the project lie on right and left side of Pitao Khwar. At present arable farming is practiced in Nowshehra District due to scarcity of water; rain fed agriculture, irrigation by using wells and flood-water cultivation resulting in low yields. Some tracts of land are used for grazing, though perpetual grazing has resulted in very poor condition of grazing lands and even complete elimination of palatable plant species. An existing system of uplift irrigation is also practiced in the project area.

9.1.4 Water Resources

Besides wells, number of streams flow throughout the district providing clean water for drinking and irrigation. The hydrological conditions are good with respect to runoff generation. The average annual rainfall at the catchment is about 23.80 inches. Mean annual runoff is 1862 acre-ft. Water quality is fit for irrigated agriculture. It can be rendered fit even for drinking purposes after necessary treatment.

9.1.5 Flora and Fauna

Part of Nowshehra district towards Cherat is mountainous which is under forest providing best shelter for wild animals. Deer, Hare, wolf, monkey, fox, jackal, mule, rabbit etc as well as wild and domestic fowl like brown and black patridge, chakor, crow, kite, shikra, pigeon, dove, sparrow, etc are found in the Cherat mountain range. In Nowshehra plains many migrated birds rest in the delta of river Kabul and river Indus. However no endangered species are found in the project area.

9.1.6 Socio – Economic Environment

There are four villages considered under the influence of Shah Kaleem Dam Project. The population of these villages is about 9500. Facilities in terms of potable water are limited whereas access to electricity is 90%. Health facilities are poor. At present 1BHU and a private hospital exist in the project area. Regional economy is largely dependent on agriculture with small number of industrial units.

9.1.7 Construction Phase Impacts

Project impacts during construction phase are negative but short lived and site specific. Environmentally, they are significant in terms of land use effect, which would result in

acquisition of 4.6 acres of cultivated land, demolition/relocation of, 1 no. of well, 1 no. of Tube well, and relocation of electric poles. These entire infrastructures would be submerged by the creation of dam reservoir. The project construction will offer benefits in terms of employment opportunities to local population.

9.1.8 Operation Phase Impacts

Significant environmental impacts during operation stage of the project are positive. During project operation benefits will accrue in terms of agricultural expansion, employment opportunities for locals and overall improvement in economy of the project area.

9.1.9 Mitigation Measures

Shah Kaleem Dam is environment friendly, as it will cause minimal environment impacts during construction and operation stages of the project. Mitigation measures have been identified wherever required. In particular, compensation amounting to 4.21 would be provided for land, houses, wells and trees to be overtaken for project implementation.

10.0 Economic and Financial Analysis

Exchange rate as prevailing in March 2013 has been taken as Rs. 98.66.00 per US Dollar. The value of SCF worked out as 0.92. The discount rate of 10% has been used in this study. The project life is assumed to be 30 years. Construction period of the project is considered as two year. Full agricultural development directly resulting from the project for arable crops is expected to be achieved in 2 years however for achieving maximum proposed yields of orchard the period of development has been taken as 10 years. Fresh orchard area will be planted during 2 years period after project completion with almost linear trend and it will start production in 5 years after planting. Projected agricultural benefits and incremental agricultural benefits for the entire Project come to Rs. 14.584 million and Rs. 11.768 million respectively.

The project costs amounts to Rs. 595.200 million. EIRR, (b) B.C ratio and NPV @ 10% are calculated from the cash flow which yields value of 11.5%,1.15:1 and Rs. 16.6 million respectively. The financial cost of the project includes interest during construction and escalation. The interest during construction has been charged at the rate of 9.96% on the cost. Interest During Construction (IDC) for the whole Project at these rates worked out to Rs. 11.212 million. The FIRR is estimated as 7.2%. The benefit Cost Ratio and Present Value of Net Inflows comes to 0.73:1 and Rs.32.6 million. Cost per Acre ft. of water Rs. 233 thousand. Cost per Acre of CCA Rs. 0.661 Million. Annual Benefits per Acre of CCA are Rs. 24 thousand.

DDR Performa

Planning Commission of Pakistan

CHECKLIST FOR DISASTER RISK REDUCTION

Infrastructure Sectors

(Circulated vide No. 5(7) Misc./PP&H/PD/10, on 23 November 2010 as part of PC1 & PC2)

1. Which types of hazards have been considered as unavoidable for the project and thus a condition for its planning and design?

   Indicate the relative order of importance of the hazards related to the project.

☐ Earthquake	☑ Drought	☑ Torrential Rains	☐ Fire
☑ Flooding	☐ Glacier Lake Outburst	☐ Windstorm	☐ Technological
☐ Landslides	☐ Locust	☐ Tsunami	☑ Intense Erosion
☐ Avalanche	☐ Cyclone	☐	☐

Others _____

2. Has the brief history of the identified hazard(s) in the area included in the PC-I.

   ☑ Yes ☐ No ☐ Partial ☐ N/A

3. Is the project prepared keeping in view the Building Codes of Pakistan 2007?

   ☐ Yes ☐ No ☐ Partial ☑ N/A

4. Is the project prepared keeping in view the prevailing Building bye-laws?

   ☐ Yes ☐ No ☐ Partial ☑ N/A

5. Does the project incorporate the prevailing territorial planning regulations (e.g. hazard zoning, institutional jurisdictions)?

   ☑ Yes ☐ No ☐ Partial ☐ N/A

6. Have the components and activities of the project been designed to resist the impact of hazards, prioritized in Q. No. 1 above, and to contribute to the reduction of its vulnerability, and that of its surroundings and beneficiaries?

   ☑ Yes ☐ No ☐ Partial ☐ N/A

7. What facilities are available in the area for rescue and emergency relief in case of a disaster?

Sr.	Facility	Controlling Organization	Distance from the Project (approx)
1	Fire Fighting Services		
2	1122 Rescue Service	✓	
3	Edhi Service		
4	Other		

8. Are there adequate arrangements within the project site for firefighting?

☐ Fire alarms ☐ Fire hoses ☐ Fire extinguishers
☐ Automatic sprinkler system ☑ NA

9. Are there funds for mitigation and periodical maintenance of its components, incorporated and meant to reduce the vulnerability of the project and its surrounding population?

☐ Yes ☑ No ☐ Partial ☐ N/A

10. Does the budget and cash flow of the project include items allowing the coverage of structural activities for risk management?

☐ Yes ☑ No ☐ Partial ☐ N/A

11. Does the budget of the project include provision to respond to emergencies (e.g. alert, contingencies, mitigation, and rehabilitation)?

☐ Yes ☑ No ☐ Partial ☐ N/A

12. Does the project include a campaign of awareness raising, training and understanding to risk management for planners, workers and beneficiaries?

☐ Yes ☑ No ☐ Partial ☐ N/A

13. Does the budget and cash flow of the project include items allowing the coverage of non-structural activities for risk management?

☐ Yes ☑ No ☐ Partial ☐ N/A

14. Do service, transfer, concession and reclamation contracts incorporate provisions for risk management?

☐ Yes ☑ No ☐ Partial ☐ N/A

15. Does the project incorporate an adequate contingency plan for possible disasters?

☐ Yes ☑ No ☐ Partial ☐ N/A

16. Does the project incorporate any instruments for its financial protection during execution and after the completion of the project (insurance, indemnity, guarantee, contingency credit arrangements, etc.)?

☐ Yes ☐ No ☐ Partial ☑ N/A

17. Are there any financial or moral incentives to promote risk management?

☐ Yes ☐ No ☐ Partial ☐ N/A

18. Is there provision in the budget for the periodic training of workers and staff to use fire extinguishers, first aid kits, and light search and rescue equipments available within the project site?

☐ Yes ☐ No ☐ Partial ☑ N/A

19. Is the evacuation plan prepared, evacuation routes and safe assembly areas indentified?

☐ Yes ☐ No ☐ Partial ☑ N/A

20. Is the communication system for emergencies established, including a warning system wherever appropriate?

☐ Yes ☐ No ☐ Partial ☑ N/A

PC-1 Performa

GOVERNMENT OF PAKISTAN
PLANNING COMMISSION
PC-I FORM
(INFRASTRUCTURE SECTORS)

1.	Name of Project	**Construction of Shah Kaleem Dam District Nowshehra ADP No 1207 (2014-15)**
2	Location	The proposed dam site is located on Shah Kaleem Khwar locally known as Pitao Khwar. The proposed dam site is located in village Shaidu district Nowshehra. The village Shaidu is located on Rawalpindi-Peshawar GT road. The site is accessible through a Shingle road in the ravine of the Nullah.
	i. Attach map of the area clearly indicating the project location	Map attached
3	Authorities Responsibilities for:	
	i. Sponsoring	Government of Khyber Pakhtunkhwa.
	ii. Execution	Directorate General Small Dams, Irrigation Department Government of Khyber Pakhtunkhwa
	iii. Operation & Maintenance	Irrigation Department, Khyber Pakhtunkhwa
4	a) Plan Provision	
	I. If the project is included in the current Five year Plan, Specify actual allocation.	Yes included in the ADP (2014-15)
	II. If not included in the current five year Plan, what warrants its inclusion and how it is now proposed to be accommodated,	N.A
	III. If the project is proposed to be financed out of block Provision, for a programme, indicate.	N.A

Total Block Provision:	Amount already Committed:	Amount Proposed for this Project:	Balance available:
Rs. 765 M	-	595.200	169.80
b)	Provision in the current years PSDP/ADP		

5	**The project objectives** • The objectives of the sector/ sub sector as indicated in the medium term/ Five year plan be re-produced.. Indicate objective of the Project and developed a linkage between proposed Projects.	Shah Kaleem Dam is a small dam designed to conserve storm run-off of Pitao Khwar for irrigation supplies to 900 acres of land. With the construction of Shah Kaleem irrigation will be done on a larger barani area of 900 acres. The dam will meet the irrigation needs of the command area, with the construction of Shah Kaleem Dam, socioeconomic conditions of the people in the project area would be improved by maximum utilization of agriculture and drinking water facility. i. Storing up to 543 acre-feet of water for regular irrigation supplies to 900 acres of area. ii. Development of agriculture in the area with assured supply of irrigation water and improved crop husbandry practices, therefore, increase in per capita income of the farmers in the command area. iii. General uplift of the people in the area by creation of employment and business opportunities due to construction of the project and later on due to marketable surplus produce in the area.
	• In case of revised project indicate objectives of the project i.e. different from original PC-1.	N.A.
6	**Description and Justification of the Project** Describe the Project; indicate existing physical facilities in the area justify the establishment of project.	Khyber Pakhtunkhwa is blessed with natural streams where small dams can be constructed. Almost entire run-off from many of these streams remains unutilized and flows down into main rivers due to non-availability of storage facilities. In the areas where small dams have been constructed in past, the stored water is being utilized to irrigate more lands boosting agriculture and drinking water in the surrounding population besides minimizing flood damages. The storage of water also helps to recharge the groundwater, which eventually can

		be reused by pumping. The small dams have significantly helped in enhancing the local economies bedsides providing a source of drinking water to the local population. The Directorate General Small Dams, Department of Irrigation Khyber Pakhtunkhwa, Peshawar has launched a planned programme for the construction of small dams to conserve the flows of such streams together with other water sources for regulated supplies for irrigation and drinking water purposes. Therefore keeping in view the vital role of water in agriculture sector and the availability of cultivable land, the Directorate General Small Dams has initiated preparation of feasibility studies for the construction of small dams and reservoirs in various parts of the province where suitable sites are available. Under the above concept, it is worth considering that wherever technically and economically feasible, the floodwater may be conserved by constructing dams for development of agriculture land. Preference should be given to those dams of medium height, which can provide enough storage for retaining at least the maximum runoff of single rainfall.
	• Provide Technical Parameters i.e. input and output of the project also discuss technological aspects of the project.	**Input parameters:** • Labour • Services • Financial Resources **ii) Output parameters:** • Increase in Agriculture Intensity • Increase in Agricultural yield • Employment generation • Socio-economic uplift

	Project Detail 1. Civil Work	**Civil Works** ▪ Earth Core Rock fill Dam ▪ Ogee type Spillway ▪ Intake structure and outlet works ▪ Irrigation Canals
	2. Equipment of Machinery.	**ii) Equipment & Machinery** The following equipment and machinery will be required for construction of the dam and appurtenant works: - Dozer D8 = 2 - Motor Grader = 1 - Scrapers = 2 - Front End Loader = 2 - Dump Trucks = 3 - Tractor with Trolley = 1 - Dumper with Tripping Bucket (1/2 ton capacity) = 1 - Air Compressor 100 cft (main Capacity) = 1 - Vibrator 1-1/2" dia = 1 - Grouting Machine = 1 - Pneumatic drilling machine = 1 - Pneumatic pavement breaker = 2 - Centrifugal Pumps ½ cfs = 2 - Crusher Plant (with screening arrangements) = 1 - vehicles = 2 - Mobile water tanker (1100 gln) = 1 - Vibratory roller = 1 The above machinery would be arranged by the Contractor from local sources.
	3. Physical and other facilities for project.	**iii) Physical and Other Facilities Required For Project:** **a) Preliminary Works** In order to achieve rapid mobilization (within specified period) for the 24 months construction schedule, it will be essential that certain preliminary works are completed prior to the award of the Contract. The preliminary works include the following: - Construction / Improvement of Access roads for construction activities. - Contractor's Camp, Engineer's Office Building and Laboratory etc.

		b) Haul Road For construction activities within the Project area, the Contractor would make his own arrangements for temporary access. **c) Water and other utilities, Education facilities, Public Health requirements** To be provided as part of the infrastructure/preliminary facilities, necessary for the Project.
	4. Technical Parameters.	**TECHNICAL PARAMETERS** **HYDROLOGY** Catchment Area: 9.96 Sq miles Average Annual Rainfall: 23.8 inch Average Annual Evaporation: 52 Inch Maximum inflow against 1000Yr return period: 16687 Cusec Average Annual Run-off: 1862 AF **RESERVOIR** Gross Storage of Reservoir: 647AF Dead storage capacity: 98 AF Live storage capacity: 549 AF Gross Storage Elevation: 1177.8ft. Dead storage Elevation: 1148 ft. Reservoir Area at Gross Storage Level: 29 Acre. **DAM** Type: Earth Core Rock fill Dam Crest Elevation: 364.0 m (1194.28 ft) AMSL Max. Storage Level: 359.0 m (1177.52 ft) AMSL Crest width: 10 m (32.8 ft) Slope upstream face: 2.25 H: 1 V Slope downstream face: 2.0H : 1.0 V Max Height of Dam: 21 m (70 ft) Length of Dam: 223.8 m (734.28 ft)

		SPILLWAY Spillway crest Elevation 359.0 m (1177.8 ft.) AMSL Width of spillway 45.7 m (150 ft.) Max. Inflow against 1000 yr Return Period 16687 Cusecs Surcharge over Spillway 2.83 m (9.27 ft.) **INTAKE STRUCTURE** Conduit Length 56.05 m (184.7 ft.) Max. Discharge (Withdrawal) 3 cusecs Invert level at intake 350 m (1148.35 ft.) AMSL **IRRIGATION SYSTEM** Irrigated command Area 900 acres Designed discharge 3 cusec Length of Main Canal 3.016 km (1.874 miles). **AGRICULTURE** Total CCA of 900 acres, the proposed cropping pattern and intensities include Maize 25% of CCA followed by Kharif Fodders 8%, Sugarcane 10% and K Vegetables 5%. During Rabi Wheat occupies 40% of CCA, R. Vegetables 8%, Orchards 2%. The total Kharif intensity comes to 45 % and total Rabi intensity comes to 55%, which aggregate to 100 percent as annual cropping intensity. The Kharif Rabi ratio comes to 1:1.22. The ultimate cropping intensity of 100% will be achieved in 2 years after the commencement of the project. The estimated incremental production of cereals, fruits, vegetables and pulses totalling to 1766 tones which is almost 12 times the existing production from these un-irrigated areas. The total requirements of Nitrogen, Phosphorous and Potassium (N-P-K) have been computed and estimated as 33.4 tones. The total annual potential

		evapotranspiration (ETo) is estimated as 1307 inches/year. The effective rain fall are estimated as 510.8 inches. Total water allowance required at canal head is 1.34 cfs / 1000 acres of CCA. The project will consist of the following components: • An earth core rock fill dam 78.74 feet high above the stream bed and 734.28 feet long at the top. • A spillway for passing a maximum flood discharge of 16687 cusec. • An outlet structure for withdrawing stored supplies for irrigation purposes. • A network of irrigation channel over the area to be irrigated. The project explained to achieved the following objectives: • Conservation of available flood flows in the nullah up to a storage capacity of 647 acre-feet (Gross) and 549 acre-feet (live). • Irrigation of about 900 acre of barren land available downstream of the dam. • Making water available for the purpose of drinking by human beings and livestock. • Mitigation of flood hazard and control of soil erosion in the reaches downstream of the dam. • Improvement in ecological environmental of the area with greenery and vegetation growth thereby imparting moderating effect on the severity of weather. • Facilities for fish breading. • Creation of excursion resort for the local people. • The development following the construction of the dam would create an attraction for the people in other areas and end their hostile attitude towards development activities, thus opening a new area for uplift of the people.
	• Indicate governance issues of the sector relevant to the project	After completion of the project, the ensured supply of water will be available to rain fed land. The socio-

	and strategy to resolve them.	economic condition in the project area is such that it can be described as one of the backward parts of the Nowshehra district. The need for developing the available resources to improve the economic conditions of the people is obvious so as to meet the national objectives of removal of existing regional disparities. The most important resources available are the land and the manpower of project area. The land is much fertile but full use thereof cannot be made unless assured and dependable water for irrigation is provided. The construction of small dam near Shah Kaleem to trap the water of Khwar (Nullah) and the subsequent irrigation channels to ensure perennial supplies is the fundamental necessity to provide the basic infrastructure for development of agriculture resources of the area. This would facilitate exploitation of other available resources of the area. Most of population in the project area is engaged in agricultural and livestock rearing. Other means of employment available in the area are transportation; shop keeping. It is estimated that due to non-availability of irrigation water, cropping level is low; with the result that farm population is under employed. So the people have to shift to other areas to work as casual hired labour. With the development of the project the manpower available would be utilized on the farm thereby resulting in increasing agricultural production to meet the food and fiber requirement of population of the project area.
	Power	
	• Give detailed description of major equipment and structure.	Not applicable
	• For hydro-electric projects:- give information regarding geological investigations flow duration curve, water storage, estimated monthly kilowatt hours generation under minimum and average flow condition and the flow conditions assumed	Not applicable

	in the project and operational regime i.e. based load or pick load plant. Rainfall record, stream flow calculation, hydrograph and other available water data along with siltation problem be provided.	
7	• Capital Cost Estimates	
	• Indicate date of estimation of project cost.	July 2014
	• Basis of determining the capital cost be provided. It includes market survey, schedule rates, estimation on the basis of the previous work done etc.	MRS-2013 The quantities of the scheme are based on detailed design level.
	• Provide years wise estimation of physical activities as per following	
	Year wise/component wise physical activities	

S. No.	Items	Year-One	Year-Two
A	Preliminaries	100%	0%
B	Works	40%	60%
C	General	70%	30%

	• Capital Cost be worked out on the basis of each item of work as stated above and provide as per following:-	

	Year wise/component wise Financial Phasing (million Rs.)			
S. No.	Items	Year-One	Year-Two	Total
A	Preliminaries	Rs. 35.00(M)	Rs. 0 (M)	Rs. 35.00 (M)
B	Works	Rs. 197.63 (M)	Rs. 296.44 (M)	Rs. 494.08 (M)
C	General	Rs. 46.28 (M)	Rs. 19.84 (M)	Rs. 66.12 (M)
D	Total	Rs. 278.91 (M)	Rs. 316.28 (M)	Rs. 595.200 (M)
	• In case of revised projects, provide:-			
	o Item wise, year wise actual expenditure and physical progress.	Not Applicable		
	o Justification for revision of PC-1 and variation in scope of project if applicable.	Not Applicable		
	o Item wise comparison of revised cost with the approved cost and give reasons for variation.	Not Applicable		
	o Exchange rates used to work out FEC in the original & revised PC-Is.	Not Applicable		

8	**Demand and supply Analysis**	
	• Existing Capacity of services and its supply/ demand.	The existing area solely depends on rainfall.
	• Projected demand for ten years	900 acres of land will be irrigated after completion of the project and development of the area throughout the year. The area is under barani cultivation. The rainfall is the sole base of cultivations but un reliable. However the land is benefited in both the Rabbi and Kharif season by winter cyclonic precipitations.
	• Capacity of the projects being implemented in public/private sector.	Public Sector
	• Supply/demand gap.	95%
	• Designed capacity and out put of the proposed project.	3 cusecs supply to irrigate 900 acres of barren land as there is no other source of irrigation.
9	**Financial Plan.**	
	Sources of Financing.	
	• (a) Equity: indicate the amount of equity be financed from each source.	
	• Sponsors won resources	Not Applicable
	• Federal Government.	-
	• Provincial Government.	
	• DFI's /Banks	N.A.
	• General public	N.A.
	• Foreign equity (indicate partner agency	N.A.
	• NGO's /beneficiaries	N.A.
	• Others	N.A.

	(b). debt: indicate the local and foreign debt, interest rate, and grace period and repayment period for each loan separately. The loan repayment schedule is also annexed.	N.A.
	(c). Grants	N.A.
	(d). weighted cost of capital.	N.A.
10	**Benefits of the project and analysis.**	
	• Financial: income to the project along with assumptions	Drinking Water= Rs. 4.574 M Fisheries = Rs. 1.365 M Total = Rs. 5.939 M
	• Economics: benefit to the economy along with assumptions.	25.181 Millions
	• Social: benefits with indicators.	Storing up to 543 acre feet of water for regular irrigation supplies to 900 acres of area. Due to construction of this dam. Development of agriculture in the area with assured supply of irrigation water and improved crop husbandry practices, therefore, increase in per capita income of the farmers in the command area. Forestation in the area shall improve the social condition of the area. In this way, reliability on wood shall be reduced and the negative impact on environment shall be minimized. Flood mitigation and migration of population shall be another aspect, which shall improve due to construction of the dam. Infrastructure of the area shall improve and this will result moderating effect in the social life of the people of the area. Mitigation of flood hazards and erosion control of the soil in the areas downstream of the dam. The initiation of watershed, wild life, range management programs could significantly improve the biological resources of the area,

		additional benefits will be supporting of fowl and shore birds. Improvement of ecological environment of the area with greenery and vegetation growth. Creation of an excursion resort for the people.
	• Environmental: environmental impact Assessment negative/positive.	The proposed sub project will cause no significant environmental impact as the reservoir any habitation and thus no resettlement is required. Although flows downstream of the dam will reduce to almost negligible after construction of the dam, no riparian rights for these flows have been witnessed. Therefore, construction of the dam will have no adverse impact. Instead, it will not only bring economic prosperity to the area by raising the living standard of the people but will also create recreational spot for the population.
	Financial/Economic Analysis (with assumptions)	
	• Quantifiable output of the project	Attached
	• Profit and loss statement and cash flow statement.	Attached
	• Net present value (NPV)	16.6 Million Rupees.
	• Unit Cost Analysis	(Rs. 0.661 Million per Acre)
	• Break even point (BEP)	
	• Payback period	
	• Internal financial rate of return (FIRR)	7.2%
	• Return on equity (ROE)	
	• Provide taxes & duties separately in the capital and operating cost.	
	• EIRR	-

	• Internal economic rate of Return (EIRR)	11.5%
	• Employment generation (Directed and indirect)	Yes, both direct and indirect employment will be generated.
	• Impact of delays on project cost and viability.	Delay on project will reduce the benefits and enhance the cost and therefore the project may touch un-viability margin.
11	**Implementation Schedule**	
	• Indicate starting and completion date of the project.	24 Months after approval of this PC-1.
	• Item-wise/year wise implementation schedule in line chart correlated with the phasing of physical activities.	Attached
12	**Management Structure and Manpower Requirements.**	
	• Administrative arrangements for implementation of projects. • Supporting staff.	Directorate General Small Dams, Irrigation Deptt: Khyber Pakhtunkhwa for assistance of limited departmental staff employment of the following project staff would be essential for execution of the project. 1. Sub-Engineer 2. Surveyor 3. Helper including driver
	• The manpower requirements by skills during execution and operation of the project are provided.	

EXECUTION STAFF

Departmental Staff		Consultants staff		Contractor's staff	
Designation	No.	Designation	No.	Designation	
1. Project Director	1/8	1. Project Manager	1	1. Project Manager	1
2. Deputy Director	1/4	2. Resident Engineer	1	2. Site Engineer	4
3. Assistant Director	1/2	3.Ziladar	1	3. Quantity Survey	1
or	1	4.Geologist	1	4. Laboratory Tech	1
4. Sub-engineer	1/2	5. Laboratory	2	5. Geologist	1
5. Zilladar	1	Technician	2	6. Surveyor	2
6. Patwari	4	6. Quantity Surveyor	1	7. Site In charge	1
7. Supporting Staff.		7. Inspector	2	8. Foreman	15
		8. Cad Operator	1	9. Skilled Labour	85
		9. Computer Operator	1	10. Unskilled Labour	70
		10. Peon	1		
		11. Chowidkar	1		
		12. Driver	1		
		13. Work Supervisor	1		
		14. Site Inspector During defect Liability period			

OPERATION STAFF	
Designation	No.
1. Sub engineer	1
2. Guage Reader	1
3. Patwari	1
4. Beldars	2
5. Chowkidar	2

13	**Additional Projects/decisions required**	
	Indicate additional projects/ decisions required to optimize the investment being undertaken on the project.	Not Applicable

Result Based Monitoring Indicator (RBMs)

Activity: Construction of

Shah Kaleem Dam Project

Inputs	Outputs	Outcomes		Impacts
		Baseline Indicators	Targets after Completion of Project	
Human Resources:- **Department Staff** 1.Deputy Director 2.Asstt. Director 3.Sub-Engineer 4.Zilladar 5.Patwari 6.Supporting Staff 7. Lab Tech 8. Driver **- Consultant Staff** 1.Resident Engineer 2.Inspector 3.Lab Technician 4.Quantity Surveyor 5.Project Staff (WC) **- Contractor's Staff** 1.Project Manager 2.Site Engineer 3.Quantity Surveyor 4.Laboratory Tech 5.Geologist 6.Surveyor 7.Foreman 8.Skilled Labor	**Construction of:** Dam Embankment. - Spillway -Intake/Outlet Structure -Irrigation System - Rest House - Access Road	-Conserving 543 Acre ft. of water for assured irrigation supply to 900 Acre of barren land. -Development of Fish farming in the reservoir. -Providing 24 cusec of water round the year for Irrigation supply to the barren land.	- Development of agriculture in the area with improved cropping pattern and crop yields producing Rs. 11.786 million revenue. Developing fish farming benefit 0.973 millions. Drinking water benefit 3.659M	-Increase in per capita income of the farmers in the command area. - Environmental Improvement through conservation of water and forestation. -Aesthetic improvement of the area. -Conversion of Barren land in to cultivated land. -Employment generation for the locals of the area.

9.Unskilled Labor -Equipment/ Machinery/Tools/ Material: Dozer D8 = 2 Motor Grader= 1 Scrapers = 2 Front End Loader =2 Dump Trucks= 3 Tractor with Trolley=1 Dumper with Tripping Bucket =1 (1/2 ton capacity) AirCompressor100Cft =1(main Capacity) Vibrator 1-1/2" dia=1 Grouting Machine =1 Pneumatic drilling machine= 1 Pneumatic pavement breaker=2 Centrifugal Pumps ½ cfs =2 Crusher Plant (with screening=1 arrangements) vehicles = 2 Mobile water tanker (1100 gln) =1 Vibratory roller =1 The above machinery would be arranged by the Contractor from local				

sources.-Survey GPS Levels etc. Office Space: Time Duration:24 Months Cost: 595.200 Million				

15. Certified that the project proposal has been prepared on the basis of guidelines provided by the Planning Commission for the preparation of the PC-I for infrastructure sectors.

Prepared by:

Deputy Director
Planning & Construction Small Dams Division
Peshawar.

Consulting Associates Peshawar (CA).

Checked by :

Director
Small Dams, Irrigation Department,
Peshawar

25/8/14

Recommended by:

Director General
Small Dams, Irrigation Department,
Peshawar.

27/8/14

Approved for submission by:

Secretary to the Government. of Khyber Pakhtunkhwa
Irrigation Department
Peshawar.

Hydrology

- **Estimation of Design Flood**

Design flood was estimated for Shah Kaleem dam using Hydrological model HMS. HMS is rainfall-runoff model in which catchment area, characteristics in terms of loss rate, time of concentration and time distribution of rainfall is assigned as input and flood hydrograph at different junctions as output. Different parameters used for Hydrological model HMS for used for Pitao Khwar Basin are derived as under:

- **Time of Concentration**

Various methods are used for estimating time of concentration. Some are from stream hydraulics and others by using lengths of streams and slopes. The Consultants have used the following methods which are based on lengths and slopes.

US SCS and USBR recommended Kirpich's equation from California Culverts Practice, California Highways and Public Works, September 1942. The equation is:

$$T_c = \left[\frac{11.9\,L^4}{H}\right]^{0.485}$$

Where,

L = length of longest watercourse in miles

H = elevation difference in feet

Length of Main Water Channel	**Miles**	**3.016 Km (1.874 miles)**
Inlet Elevation	ft	2750
Outlet Elevation	ft	1125.3
Difference El.	ft	1624.7
Slope	ft/miles	181
Time of Concent. Tc .	hr	1.90
Lag Time, T_{lag}	hr	1.33

- **Derivation of Unit Hydrographs**

Synthetic unit hydrograph for Shah Kaleem catchment has been developed using SCS triangular hydrograph parameters and curvilinear dimensionless unit hydrograph. Computer model HEC-HMS of US Army Corps of Engineer (ver. 4.0.1, 2006) has been used for the derivation of unit hydrograph.

- **Estimation of Excess Rainfall**

Excess rainfall, also called the effective rainfall, is the difference between the rainfall and the basin retention loss and produces the surface runoff to the streams of the basin. The basin retention loss is the sum of losses due to interception, infiltration and depression storage (detention loss).

For estimation of direct runoff from rainfall, Design of Small Dams gives curves of rainfall-runoff relationships developed by Soil Conservation Service from analyses of rainfall and respective runoff records of numerous watersheds. The SCS curves are obtained using the equation:

$$Q = (P-0.2S)^2 / (P + 0.8S)$$

Where,

Q = direct runoff in inches

P = storm rainfall in inches, and

S = maximum potential difference between P and Q, in inches, at the beginning of storm.

After study of basin, the soil group, land use and hydrologic conditions of the catchment were evaluated. These hydrologic soil-cover complex data, were then used to determine the SCS curve numbers of the catchment. It is worked out to be 89.

With the help of HEC-HMS, rainfall excesses were computed from the provision that hourly retention rates (indicated by the use of runoff curves).

- **Temporal Distribution of Rainfall**

Storm pattern was selected on the basis of extreme storms. Data was collected from SWHP, WAPDA for gauging station Mardan. Several severe storms were selected and average among them was considered for further flood estimation.

- **Results of Hydrological Model (HMS)**

HMS model results are shown in **Figure - 4.11.** Results in terms of flood peaks are tabulated below.

- **Elevation Area Capacity Relationship**

From topographic survey of reservoir area (**Figure - 4.13**), reservoir capacity and area is computed at different elevations. Area capacity is given below and shown in **Figure - 4.14.**

ELEVATION		HEIGHT	AREA, ACRES		CAPACITY,AF	
m	ft	ft	Total	Average	Incr.	Total
343	1125	0	0.13			0
345	1132	7	1.47	0.8	5.3	5.3
346	1135	10	2.97	2.2	7.3	12.5
348	1142	16	6.72	4.8	31.8	44.4
350	1148	23	9.51	8.1	53.3	97.6
351	1152	26	10.77	10.1	33.3	130.9
352	1155	30	13.65	12.2	40.1	171.0
355	1165	39	18.89	16.3	160.2	331.1
357	1171	46	24.10	21.5	141.0	472.2
359	1178	52	29.00	26.5	174.2	647.4
360	1181	56	32.00	30.5	100.1	746.5
362	1188	62	40.00	36.0	236.2	982.7
365	1198	72	55.00	47.5	467.5	1450.2

- **Dead Storage**

For sediment accumulation, dead storage of 98 acre-ft at 1148ft amsl is proposed.

- **Water Demand**

For Rabi and Kharif seasons water demand was estimated by agriculturist and Tabulated below for 900 acres irrigated area against cropping intensity of 100%. This is based on detailed agriculture studies and includes irrigation need and drinking water for water supply for 2972 person @15 gallons per capita per day Monthly Irrigation demand is tabulated below.

Monthly Demand Pattern 900 Acres+2972 Persons

MONTHS	IRRIGATION WATER DEMAND (ACRE-FT)	IRRIGATION + DRINKING WATER DEMAND (ACRE-FT)
APR	18	45
MAY	37	65
JUN	85	112
JUL	88	117
AUG	94	120
SEP	81	110
OCT	35	61.9
NOV	31	55.1
DEC	38	81
JAN	31	49
FEB	21	42
MAR	17	42
RABI	172	331
KHARIF	403	569
ANNUAL	575	900

- **Reservoir Operation**

Reservoir operation studies were carried out for gross storage of 647 acre ft against 1177.8 ft (359 m) elevation amsl.

- **Results of Reservoir Operation Model**

Reservoir operation model (ROM) was used to simulate effect of different demand pattern and results in terms of yearly inflow, demand, releases, shortages and lake evaporation and spillage from reservoir are tabulated in **Table -4.5** and given in **Annexure –A.** From

Sediment yield of Regional Major Rivers / Nullahs

Sr. No.	River Name	Drainage Area Sq. Miles	Period	Sediment Yield Acre-ft / Sq. Miles	
				Water Yield	Sediment Yield
1	Kabul at Warsak	26,000	1961-70	676	0.52
2	Kabul at Nowshera	34,200	1961-05	632	0.88
3	Indus at Mandori	102,000	1963-96	868	1.47
4	Kalpani at Rasalpur	1,100	1960-68	694	2.89
AVERAGE YIELD (ACRE-FT /SQ.MILES)					**1.44**
Catchment Area				**Sq. Miles**	**9.96**
Sediment Inflow Rate per year				**Acre-Ft/Sq. Miles**	**14.34**

Source: Sediment Appraisal of Pakistani Rivers (1960-2000), SWHP, WAPDA

- **Reservoir Life**

Sediment deposition in reservoir is estimated by using Brune envelope curve. From capacity inflow ratio and trap efficiency in reservoir, sediment deposition is estimated for different years. Details of calculations are tabulated in **Table- 4.6 and Figure-4.15.** Internal distribution of sediment at different levels will be evaluated after finalization of reservoir operation study. From table it is evident that life of reservoir is more than 30 yrs.

CONCLUSIONS

1)	Catchment Area (sq. miles)	9.96
2)	Average Annual Rainfall (Inches)	23.80
4)	Average Annual Evaporation (Inches)	52
4)	Estimated Average Annual Runoff (Acre-ft)	1862
5)	El. of River Bed at Dam Site (Ft amsl)	1125.3
6)	Max. El. at Catchment Inlet of Nullah (Ft amsl).	2750
7)	Gross Storage of Reservoir (Acre-ft)	647
8)	Live Storage of Reservoir (Acre-ft)	549
9)	Dead Storage of Reservoir (Acre-ft)	98
10)	El. At Gross Storage Level (Ft amsl)	1177.8 (359m)
11)	El. At Dead Storage Level (Ft amsl)	1148.3 (350m)
12)	Crest of Spillway (Ft amsl)	1177.8 (359m)
13)	Width of Spillway in (Ft)	150
14)	Max. Inflow against 1000 yr Return Period (Cusecs)	16687
15)	Surcharge over Spillway (Ft)	9.27
16)	Outflow from Spillway against 1000 yr Return Period (Cusecs)	16427
17)	Reservoir Area at Gross Storage Level (Acres)	29
18)	Irrigated Area (Acres)	900

TABLE- 4.1

MONTHLY RAINFALL DATA

INCHES

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
1970	0.9	2.2	2.8	0.7	0.0	0.5	1.4	3.3	2.3	0.0	0.0	0.1	14.2
1971	0.1	1.9	1.5	4.5	0.6	0.2	0.7	2.9	1.6	0.2	0.0	0.2	14.3
1972	1.5	2.6	2.0	2.3	1.5	0.4	0.7	0.4	0.5	0.1	0.5	2.0	14.4
1973	0.2	2.7	3.6	0.7	2.4	0.0	0.6	1.6	2.5	0.1	0.0	0.4	14.7
1974	0.2	2.0	0.1	1.2	0.3	0.0	0.8	0.9	0.6	0.0	0.0	1.3	7.5
1975	0.0	1.9	3.7	1.7	2.5	0.1	2.8	4.1	0.1	0.0	0.0	0.2	17.1
1976	0.5	3.3	3.2	2.7	0.1	0.7	1.6	11.0	0.8	0.5	0.0	0.0	24.6
1978	0.6	0.6	8.8	1.0	0.0	0.4	3.5	2.9	0.3	0.1	1.2	0.0	19.6
1979	0.0	0.0	0.0	0.0	1.4	0.5	0.6	3.7	0.0	0.0	0.7	0.0	7.0
1980	1.1	2.8	2.7	0.3	0.6	1.3	2.0	1.9	0.2	0.3	0.3	0.1	13.6
1981	1.3	1.1	5.9	1.1	1.4	0.0	1.0	3.3	0.0	0.4	0.0	0.0	15.5
1982	1.2	0.5	3.8	0.8	0.2	0.1	0.1	3.7	0.0	0.0	2.0	0.6	12.8
1983	1.5	1.5	3.2	7.1	1.5	0.6	2.4	8.6	0.7	0.4	0.4	0.1	28.0
1984	0.2	1.2	1.6	2.6	0.1	0.2	4.0	9.3	0.9	0.0	0.4	0.2	20.5
1985	1.1	0.2	1.0	1.2	0.8	0.0	1.0	3.8	0.2	0.1	0.4	3.7	13.4
1986	0.7	2.8	2.9	0.9	0.6	0.6	0.9	1.6	1.0	0.0	2.5	1.4	16.0
1987	0.0	2.8	6.4	0.3	1.3	0.8	0.2	0.0	0.2	1.3	0.0	0.1	13.5
1988	1.6	0.4	6.4	0.5	0.2	0.2	0.6	2.6	0.2	0.3	0.0	1.2	14.2
1989	1.5	0.4	1.8	0.8	0.4	0.0	2.0	0.7	0.6	0.4	0.1	1.2	9.9
1990	2.0	2.7	2.1	1.0	0.7	0.1	0.4	2.9	1.6	2.1	0.3	1.8	17.7
1991	0.4	2.1	5.6	2.3	2.8	1.4	0.5	0.8	0.2	0.1	0.1	0.2	16.5
1992	3.3	2.4	4.5	2.9	2.3	0.1	0.2	4.1	1.1	0.7	0.0	1.3	22.8
1993	1.4	0.6	7.0	1.4	0.5	2.3	2.3	0.0	2.2	0.4	0.4	0.0	18.5
1994	0.7	3.1	2.4	3.1	1.0	0.6	6.4	1.5	2.2	2.2	0.0	2.2	25.3
1995	0.0	2.2	5.4	4.5	1.1	0.0	3.9	3.6	2.6	0.5	0.5	0.1	24.4
1996	1.1	3.4	2.5	1.5	0.6	0.5	0.7	4.3	2.0	8.0	1.7	0.0	26.3
1997	0.6	1.1	1.6	5.3	1.1	1.5	1.4	0.5	0.5	2.5	0.3	0.9	17.4
1998	1.8	5.7	2.6	2.7	1.4	1.6	3.3	2.4	0.8	0.2	0.0	0.0	22.6
1999	5.9	1.1	2.9	0.0	0.3	1.9	1.0	1.9	0.2	0.0	0.9	0.0	16.0
2000	2.2	1.6	1.2	0.2	0.5	0.5	0.4	0.6	1.8	0.4	0.0	0.9	10.2
2001	0.0	8.2	0.3	1.7	0.7	1.4	2.0	1.5	0.7	0.0	0.9	0.0	17.5
2002	0.1	3.0	2.9	0.9	0.2	2.1	0.0	0.0	0.8	0.1	0.2	1.5	11.8
2003	1.3	6.4	1.4	5.1	0.9	0.4	6.1	4.5	4.4	2.8	1.7	0.7	35.6
2004	4.3	3.7	0.0	2.4	0.0	0.0	0.6	2.2	1.4	1.7	0.6	0.9	17.8
2005	5.0	5.2	5.9	1.1	1.9	0.0	0.8	1.0	2.6	0.2	0.8	0.0	24.6
2006	2.7	1.0	2.4	0.6	0.7	0.6	3.6	1.6	0.6	1.3	0.9	3.6	19.6
MAX	5.9	8.2	8.8	7.1	2.8	2.3	6.4	11.0	4.4	8.0	2.5	3.7	35.6
AVG	1.3	2.3	3.1	1.9	0.9	0.6	1.7	2.8	1.1	0.8	0.5	0.8	17.6

Table - 4.2
MONTHLY INFLOW (ACRE-FT)

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL	JULY TO SEPT	Acre-ft % of Total
1970	0	85	0	0	0	0	3	688	299	0	0	0	1075	990	92
1971	0	0	27	1265	0	0	0	0	0	0	0	0	1292	0	0
1972	0	251	0	204	0	0	0	0	0	0	0	0	455	0	0
1973	0	0	326	0	191	0	0	0	165	0	0	0	682	165	24
1974	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1975	0	0	19	0	9	0	344	301	0	0	0	0	673	645	96
1976	0	34	440	137	0	0	0	2599	0	0	0	0	3209	2599	81
1978	0	0	1724	0	0	0	6	13	0	0	0	0	1742	18	1
1979	0	0	0	0	1	0	0	9	0	0	0	0	9	9	93
1980	0	234	0	0	0	0	0	146	0	0	0	0	379	146	38
1981	0	0	777	21	0	0	0	115	0	0	0	0	913	115	13
1982	0	0	71	0	0	0	0	318	0	0	179	0	568	318	56
1983	0	0	0	946	0	0	246	2419	0	0	0	0	3611	2665	74
1984	0	0	0	0	0	0	327	2407	0	0	0	0	2734	2734	100
1985	0	0	0	0	0	0	0	1056	0	0	0	327	1383	1056	76
1986	0	143	0	0	0	0	16	131	0	0	286	0	576	147	25
1987	0	293	328	0	0	0	0	0	0	0	0	0	622	0	0
1988	0	0	508	0	0	0	0	220	0	0	0	0	727	220	30
1989	77	0	0	0	0	0	4	0	0	0	0	0	81	4	4
1990	1	34	0	0	0	0	0	713	0	13	0	0	762	713	94
1991	0	0	1005	0	216	0	0	0	0	0	0	0	1221	0	0
1992	480	4	217	214	0	0	0	886	0	0	0	1	1802	886	49
1993	0	0	1448	0	0	51	0	0	221	0	0	0	1720	221	13
1994	0	301	0	326	0	0	636	0	216	4	0	0	1483	852	57
1995	0	0	826	246	0	0	700	342	252	0	0	0	2365	1294	55
1996	0	6	0	0	0	0	0	792	48	2446	182	0	3473	840	24
1997	0	0	0	413	0	0	0	0	0	229	0	0	643	0	0
1998	0	447	77	161	0	0	7	252	0	0	0	0	944	259	27
1999	314	0	96	0	0	264	0	0	0	0	0	0	674	0	0
2000	42	0	0	0	0	0	0	0	0	0	0	0	42	0	0
2001	0	3155	0	0	0	0	0	0	0	0	0	0	3155	0	0
2002	0	70	70	0	0	0	0	0	0	0	0	0	139	0	0
2003	1	935	0	846	0	0	1340	905	1100	981	112	0	6200	3345	54
2004	223	941	0	200	0	0	0	1	0	0	0	0	1365	1	0
2005	1019	387	634	0	0	0	0	0	205	0	0	0	2245	205	9
2006	52	0	0	0	0	0	301	0	0	0	0	714	1067	301	28
AVG	61	203	239	138	12	9	109	397	70	101	21	29	1390	576	34

TABLE-4.3
1 DAY MAXIMUM RAINFALL DATA

INCHES

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
1970	0.6	1.1	0.6	0.7	0.0	0.3	1.4	2.1	2.0	0.0	0.0	0.1	2.1
1971	0.1	1.0	0.9	3.3	0.2	0.2	0.7	0.9	1.2	0.2	0.0	0.2	3.3
1972	0.7	1.8	0.8	1.7	0.4	0.4	0.3	0.2	0.4	0.0	0.4	0.6	1.8
1973	0.1	1.0	1.8	0.3	1.4	0.0	0.4	0.8	1.6	0.1	0.0	0.2	1.8
1974	0.2	0.7	0.1	0.8	0.1	0.0	0.5	0.5	0.4	0.0	0.0	0.3	0.8
1975	0.0	0.7	1.1	0.8	0.9	0.1	2.1	1.9	0.1	0.0	0.0	0.2	2.1
1976	0.4	0.9	1.6	1.4	0.1	0.5	0.4	4.0	0.4	0.3	0.0	0.0	4.0
1978	0.5	0.5	2.7	0.3	0.0	0.3	0.7	0.9	0.3	0.1	0.7	0.0	2.7
1979	0.0	0.0	0.0	0.0	1.3	0.4	0.4	1.0	0.0	0.0	0.6	0.0	1.3
1980	0.6	1.8	1.0	0.3	0.4	0.8	1.8	1.5	0.2	0.2	0.2	0.1	1.8
1981	0.4	0.5	2.2	0.8	0.8	0.0	0.5	1.3	0.0	0.2	0.0	0.0	2.2
1982	0.5	0.3	1.0	0.3	0.1	0.1	0.1	1.3	0.0	0.0	1.6	0.5	1.6
1983	0.5	0.7	1.1	2.0	0.8	0.5	1.3	3.3	0.6	0.4	0.4	0.1	3.3
1984	0.2	0.4	0.5	1.1	0.1	0.2	2.1	3.4	0.4	0.0	0.4	0.1	3.4
1985	0.9	0.2	0.7	0.6	0.3	0.0	0.6	2.4	0.1	0.0	0.3	1.2	2.4
1986	0.6	1.5	1.2	0.3	0.3	0.6	0.8	1.4	0.6	0.0	1.9	0.6	1.9
1987	0.0	1.6	2.1	0.2	0.7	0.4	0.1	0.0	0.2	1.2	0.0	0.1	2.1
1988	1.1	0.4	1.2	0.3	0.2	0.1	0.5	1.7	0.2	0.3	0.0	0.9	1.7
1989	1.2	0.3	0.4	0.4	0.3	0.0	1.4	0.6	0.4	0.4	0.1	0.6	1.4
1990	1.2	0.8	0.8	0.4	0.4	0.1	0.3	2.2	1.2	1.3	0.2	0.9	2.2
1991	0.2	0.7	2.4	1.1	1.7	1.3	0.4	0.7	0.1	0.1	0.1	0.1	2.4
1992	1.7	1.4	1.1	1.1	0.8	0.1	0.2	2.2	0.4	0.6	0.0	1.3	2.2
1993	0.5	0.5	2.6	0.6	0.3	1.0	0.8	0.0	1.6	0.4	0.2	0.0	2.6
1994	0.6	2.0	0.7	1.7	0.5	0.2	1.7	0.8	1.7	1.4	0.0	0.8	2.0
1995	0.0	0.7	1.8	1.4	0.5	0.0	2.2	1.3	1.8	0.3	0.5	0.1	2.2
1996	0.7	1.1	0.7	1.1	0.2	0.4	0.7	2.4	1.0	5.6	1.6	0.0	5.6
1997	0.5	0.5	0.7	1.5	0.4	1.2	0.6	0.4	0.4	1.1	0.2	0.8	1.5
1998	1.2	1.5	1.2	1.5	0.5	0.9	1.1	1.9	0.5	0.2	0.0	0.0	1.9
1999	1.2	0.4	0.9	0.0	0.1	1.9	0.8	0.4	0.2	0.0	0.8	0.0	1.9
2000	1.3	1.1	0.8	0.1	0.4	0.3	0.2	0.5	0.5	0.2	0.0	0.6	1.3
2001	0.0	7.0	0.2	1.1	0.7	0.8	0.8	0.5	0.7	0.0	0.4	0.0	7.0
2002	0.0	1.1	1.1	0.2	0.2	1.2	0.0	0.0	0.8	0.1	0.1	1.1	1.2
2003	1.3	2.2	0.4	2.2	0.6	0.4	2.8	1.8	2.6	2.7	1.3	0.6	2.8
2004	1.7	2.7	0.0	1.0	0.0	0.0	0.2	1.3	1.1	1.0	0.6	0.6	2.7

TABLE - 4.4

GEV-1 FREQUENCY ANALYSIS

No. year	36
Average	2.4
Std. Dev.	1.2

YEAR	RAINFALL (INCHES)	DESENDING ORDER	RANK	GUMBEL		GARINGATON	
				TYEAR	VARIATE V	TYEAR	VARIATE V
1970	2.1	7.0	1	37.00	3.6	65	4.2
1971	3.3	5.6	2	18.50	2.9	23	3.1
1972	1.8	4.0	3	12.33	2.5	14	2.6
1973	1.8	3.4	4	9.25	2.2	10	2.3
1974	0.8	3.3	5	7.40	1.9	8	2.0
1975	2.1	3.3	6	6.17	1.7	6	1.8
1976	4.0	2.8	7	5.29	1.6	6	1.6
1978	2.7	2.8	8	4.63	1.4	5	1.4
1979	1.3	2.7	9	4.11	1.3	4	1.3
1980	1.8	2.7	10	3.70	1.2	4	1.2
1981	2.2	2.6	11	3.36	1.0	3	1.1
1982	1.6	2.4	12	3.08	0.9	3	1.0
1983	3.3	2.4	13	2.85	0.8	3	0.9
1984	3.4	2.2	14	2.64	0.7	3	0.8
1985	2.4	2.2	15	2.47	0.7	2	0.7
1986	1.9	2.2	16	2.31	0.6	2	0.6
1987	2.1	2.2	17	2.18	0.5	2	0.5
1988	1.7	2.2	18	2.06	0.4	2	0.4
1989	1.4	2.1	19	1.95	0.3	2	0.3
1990	2.2	2.1	20	1.85	0.3	2	0.2
1991	2.4	2.1	21	1.76	0.2	2	0.2
1992	2.2	2.0	22	1.68	0.1	2	0.1
1993	2.6	1.9	23	1.61	0.0	2	0.0
1994	2.0	1.9	24	1.54	0.0	2	-0.1
1995	2.2	1.9	25	1.48	-0.1	1	-0.1
1996	5.6	1.8	26	1.42	-0.2	1	-0.2
1997	1.5	1.8	27	1.37	-0.3	1	-0.3
1998	1.9	1.8	28	1.32	-0.3	1	-0.4
1999	1.9	1.7	29	1.28	-0.4	1	-0.4
2000	1.3	1.6	30	1.23	-0.5	1	-0.5
2001	7.0	1.5	31	1.19	-0.6	1	-0.6
2002	1.2	1.4	32	1.16	-0.7	1	-0.7
2003	2.8	1.3	33	1.12	-0.8	1	-0.8
2004	2.7	1.3	34	1.09	-0.9	1	-1.0
2005	2.8	1.2	35	1.06	-1.1	1	-1.1
2006	2.2	0.8	36	1.03	-1.3	1	-1.4

GUMBEL - SUMMARY OF RESULTS

Return Period	Reduce Variate	STDEV	Reduce Variate	Freq. Fact	Cal. Val.	95% CONFIDENCE LIMIT			
T YEAR	YN FROM TABLE	SN FROM TABLE	YT	K	XT	FC	SE	UPPER	LOWER
2	0.54	1.13	0.37	-0.15	2.21	1.96	0	3	2
10	0.54	1.13	2.25	1.51	4.19	1.96	0	5	3
20	0.54	1.13	2.97	2.15	4.95	1.96	1	6	4
50	0.54	1.13	3.90	2.97	5.93	1.96	1	7	4
100	0.54	1.13	4.60	3.59	6.66	1.96	1	8	5
500	0.54	1.13	6.21	5.01	8.36	1.96	1	11	6
1000	0.54	1.13	6.91	5.63	9.08	1.96	1	12	7

TABLE -4.5
SHAH KALEEM DAM PROJECT
RESERVOIR OPERATION MODEL - YEARLY SUMMARY

Culturable Command Area (Acres)	600	Gross Storage Level (Ft- amsl)	1117.8	Gross Storage (Acre-ft)	646
		Dead Storage Level (Ft amsl)	1148	Dead Storage (Acre-ft)	198

Year	Dam Inflow	Rainfall at Dam		Irrigation				Lake Evap		Spill	End of Period Values	
	A-Ft	In	A-Ft	Demand (A-Ft)	Releases (A-Ft)	Shortage (A-Ft)	% Shortage	In	A-Ft	A-Ft	Vol	El
COL.1	COL.2	COL.3	COL.4	COL.5	COL.6	COL.7	COL.8	COL.9	COL.10	COL.11	COL.12	COL.13
1	1017	12	23	643	643	0	0	35	69	0	474	1171
2	1516	17	26	643	597	46	7	35	53	0	265	1161
3	530	15	17	643	419	224	35	35	40	0	178	1155
4	356	11	13	643	590	53	8	35	45	0	195	1156
5	19	11	8	643	0	643	100	35	26	0	84	1147
6	1128	19	29	643	407	235	37	35	50	0	358	1166
7	4460	28	54	643	643	0	0	35	68	0	460	1171
8	18	10	14	643	496	147	23	35	48	0	209	1157
9	243	14	13	643	72	571	89	35	28	0	116	1150
10	923	15	17	643	337	305	48	35	32	0	149	1153
11	207	13	17	643	643	0	0	35	53	0	252	1160
12	497	14	18	643	352	291	45	35	38	0	224	1158
13	3611	25	50	643	643	0	0	35	69	0	458	1171
14	2734	18	31	643	607	35	6	35	54	0	357	1166
15	1527	18	34	643	534	108	17	35	54	0	415	1169
16	1055	19	37	643	643	0	0	35	59	0	393	1168
17	508	13	18	643	524	118	18	35	49	0	241	1159
18	297	9	13	643	643	0	0	35	53	0	268	1161
19	39	13	10	643	90	553	86	35	28	0	94	1148
20	1732	19	34	643	325	318	49	35	46	0	341	1165
21	917	19	38	643	638	5	1	35	61	0	364	1166
22	2550	22	44	643	643	0	0	35	68	0	454	1170
23	573	16	28	643	643	0	0	35	61	0	376	1167
24	2008	27	56	643	643	0	0	35	72	0	512	1173
25	1545	24	51	643	643	0	0	35	72	0	500	1172
26	3468	23	45	643	612	31	5	35	59	0	460	1171
27	1167	24	46	643	643	0	0	35	61	0	388	1167
28	830	22	45	643	643	0	0	35	68	0	462	1171
29	305	11	18	643	643	0	0	35	61	0	328	1165
30	3155	14	18	643	132	510	79	35	32	0	176	1155
31	139	15	19	643	532	111	17	35	47	0	206	1157
32	936	15	19	643	132	510	79	35	32	0	176	1155
33	6429	34	78	643	643	0	0	35	76	0	576	1175
34	2240	26	49	643	601	41	6	35	59	0	361	1166
35	257	15	22	643	643	0	0	35	54	0	286	1162
Average	1398	18		643	504	139	22	35	53	0	319	1163

No. of years when Shortage is less than 15%	21
No. of years when Shortage is more than 15%	14
No. of years when any Spillage Occur	0

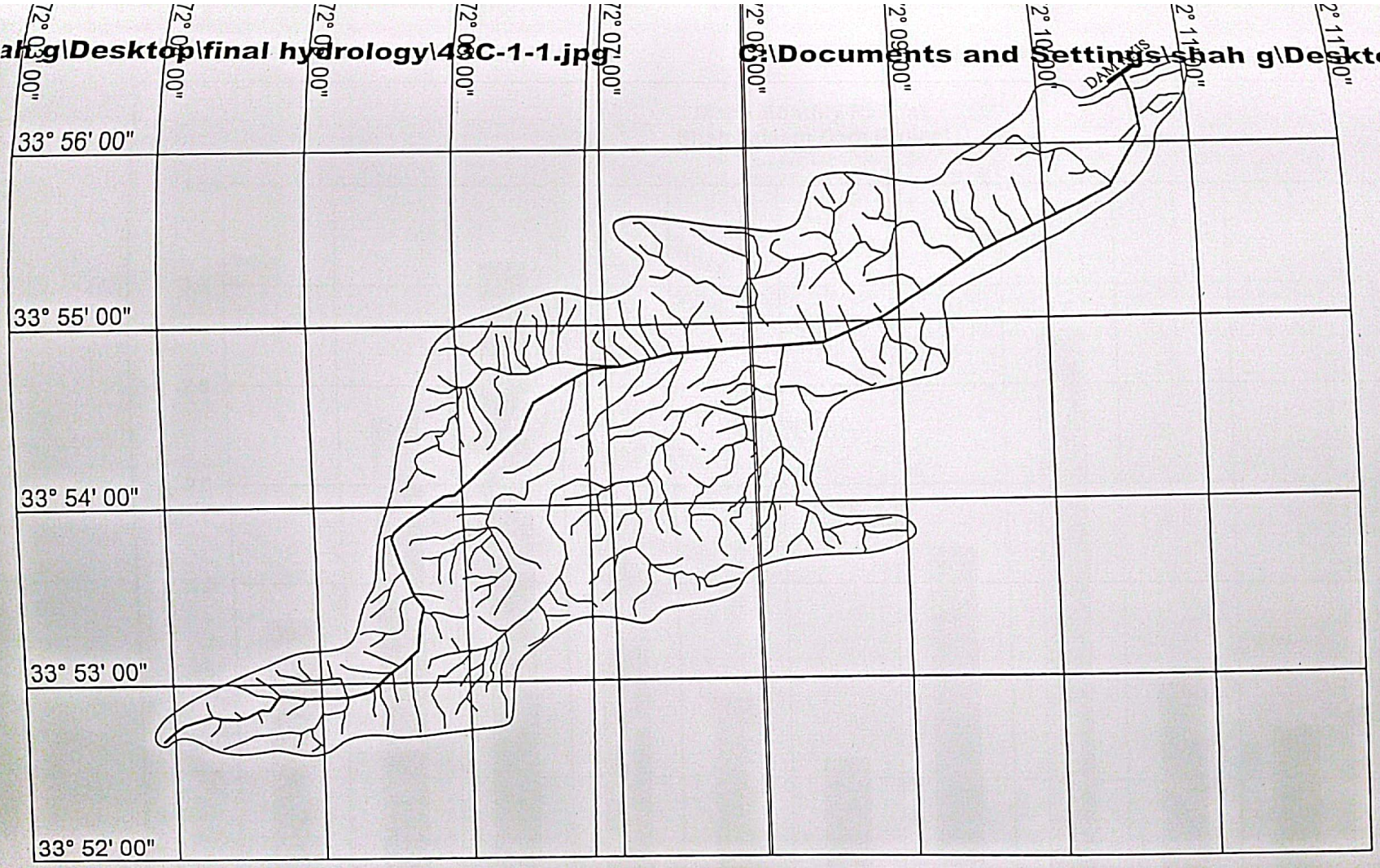
TABLE -4.6
ESTIMATION OF RESERVOIR LIFE - SHAH KALEEM DAM

Average Annual water Inflow	1390	Acre-ft
Sediment Inflow	13.96	Acre-ft
		Gross Capacity. 646

Year of Operation	Capacity	% Loss	Cap./ Inflow	Trap. Efficiency	Annual Sed. Deposition	Acc. Sed	Rev. Capacity
0	646	0%	0.46	97			646
1	646	0%	0.46	97	14	14	632
2	632	2%	0.46	97	14	27	619
3	619	4%	0.45	97	13	41	605
4	605	6%	0.44	97	13	54	592
5	592	8%	0.43	97	13	67	579
6	579	10%	0.42	97	13	81	565
7	565	13%	0.41	96	13	94	552
8	552	15%	0.40	96	13	108	538
9	538	17%	0.39	96	13	121	525
10	525	19%	0.38	96	13	135	511
11	511	21%	0.37	96	13	148	498
12	498	23%	0.36	96	13	162	484
13	484	25%	0.35	96	13	175	471
14	471	27%	0.34	96	13	188	458
15	458	29%	0.33	96	13	202	444
16	444	31%	0.32	95	13	215	431
17	431	33%	0.31	95	13	228	418
18	418	35%	0.30	95	13	242	404
19	404	37%	0.29	95	13	255	391
20	391	39%	0.28	95	13	268	378
21	378	41%	0.27	95	13	281	365
22	365	44%	0.26	95	13	294	352
23	352	46%	0.25	94	13	308	338
24	338	48%	0.24	94	13	321	325
25	325	50%	0.23	94	13	334	312
26	312	52%	0.22	94	13	347	299
27	299	54%	0.22	93	13	360	286
28	286	56%	0.21	93	13	373	273
29	273	58%	0.20	93	13	386	260
30	260	60%	0.19	92	13	399	247

RESERVOIR LIFE (USBR, DESIGN OF SMALL DAM)

River Bed Level	1125.3	ft
Dead storage level	1148.3	ft
Gross storage level	1177.8	ft
height at dead	23	ft
Height at Gr. Str.	52.5	ft
Relative height at dead storage	0.43	
For type II Dam from Design of small dam sediment deposited	0.35	
After 50yrs of operation Siltation	140	acre-ft



0 1.0 2.0 KM

LEGEND

Catchment Boundary	
Main Stream	
Tributaries	

CHARACTERISTICS

Catchment Area	9.96 Square Miles
Main Stream Length	8.96 Miles
Inlet Level	343 m (1125.3 ft) a.m.s.l
Outlet Level	905.3 m (2970.0 ft) a.m.s.l
Slope	206 ft/mile

S.NO.	DATE	DESCRIPTION	CHECK

SMALL DAMS ORGANIZATION, IRRIGATION DEPARTMENT GOVT OF KWFP

SMALL DAM PROJECT

SHAH KALIM DAM CATCHMENT AREA

CONSULTING ASSOCIATES.

DRAWN
DESIGNED
CHECKED
APPROVED

DATE JAN 2010
FIGURE NO. 4.1
REV. No.

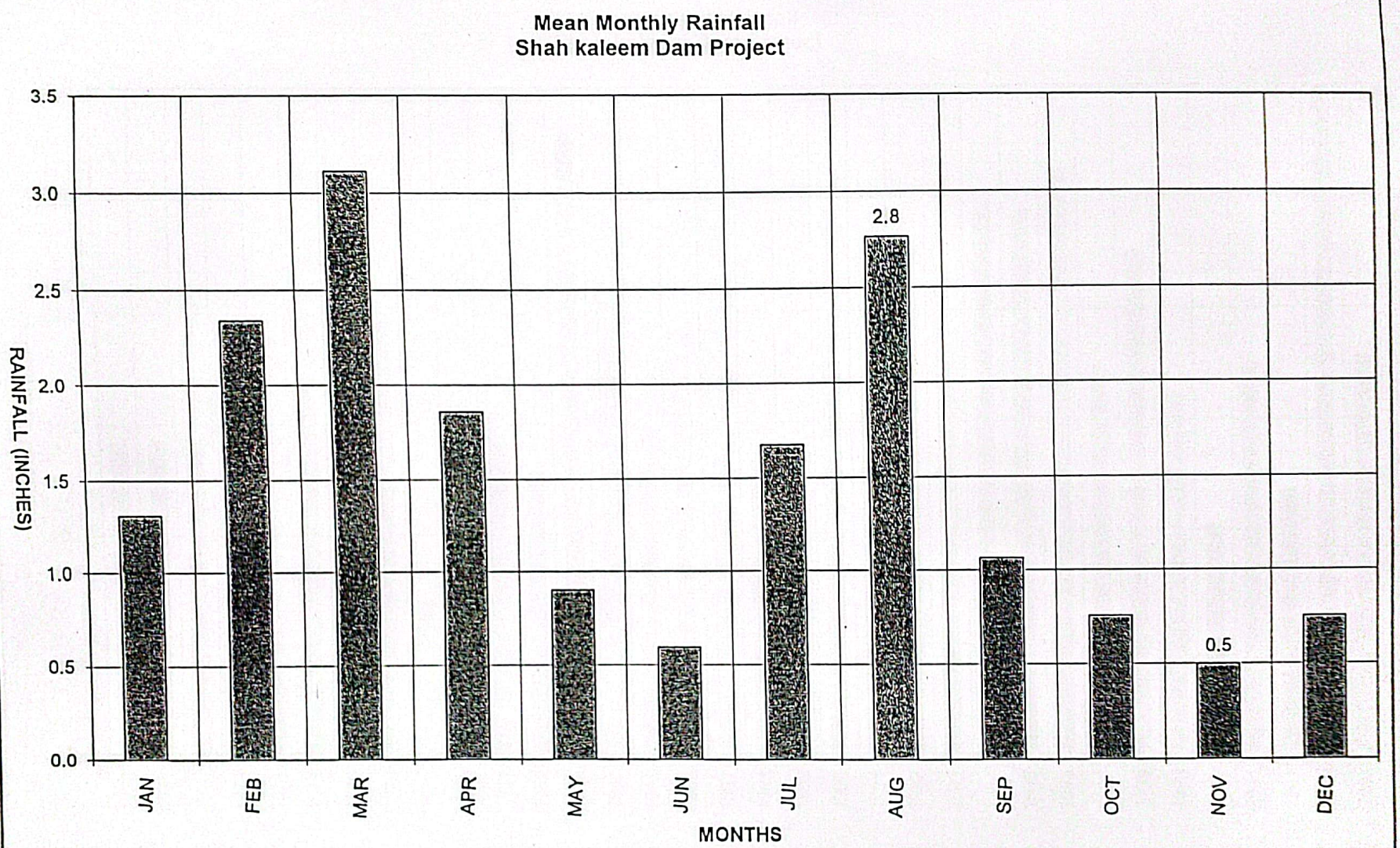


Figure -4.2 Mean Monthly Rainfall

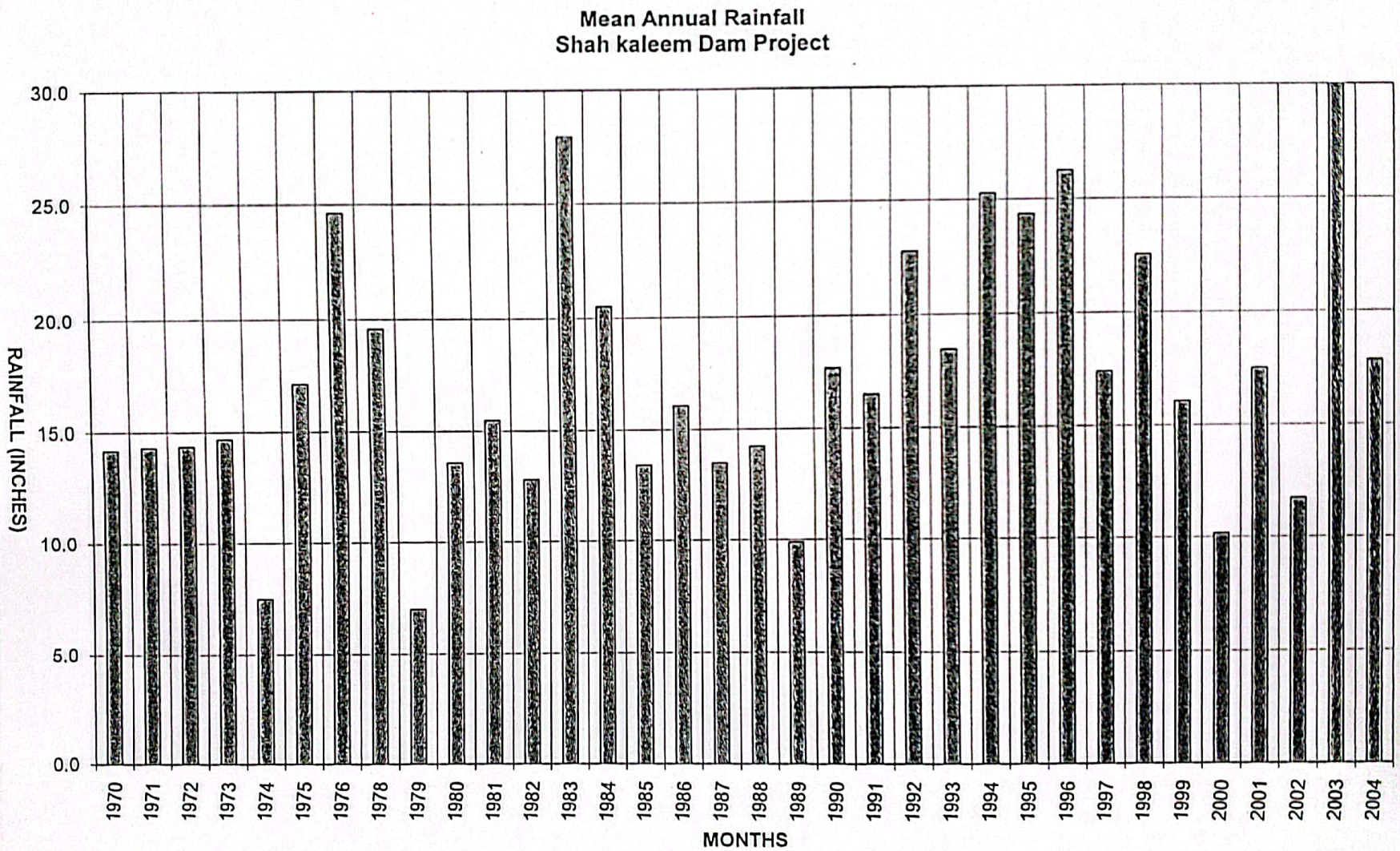


Figure -4.3 Mean Annual Rainfall

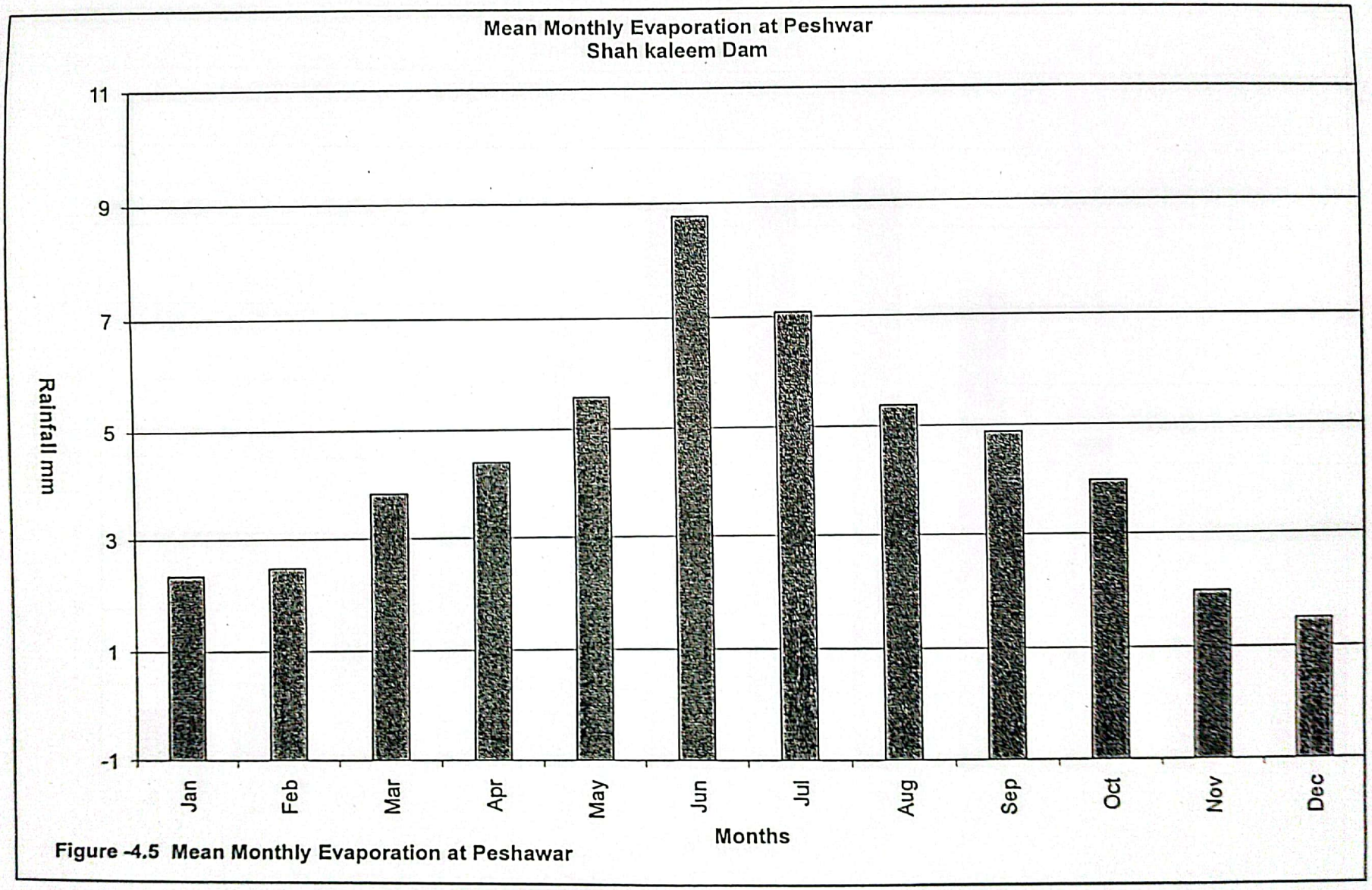


Figure -4.5 Mean Monthly Evaporation at Peshawar

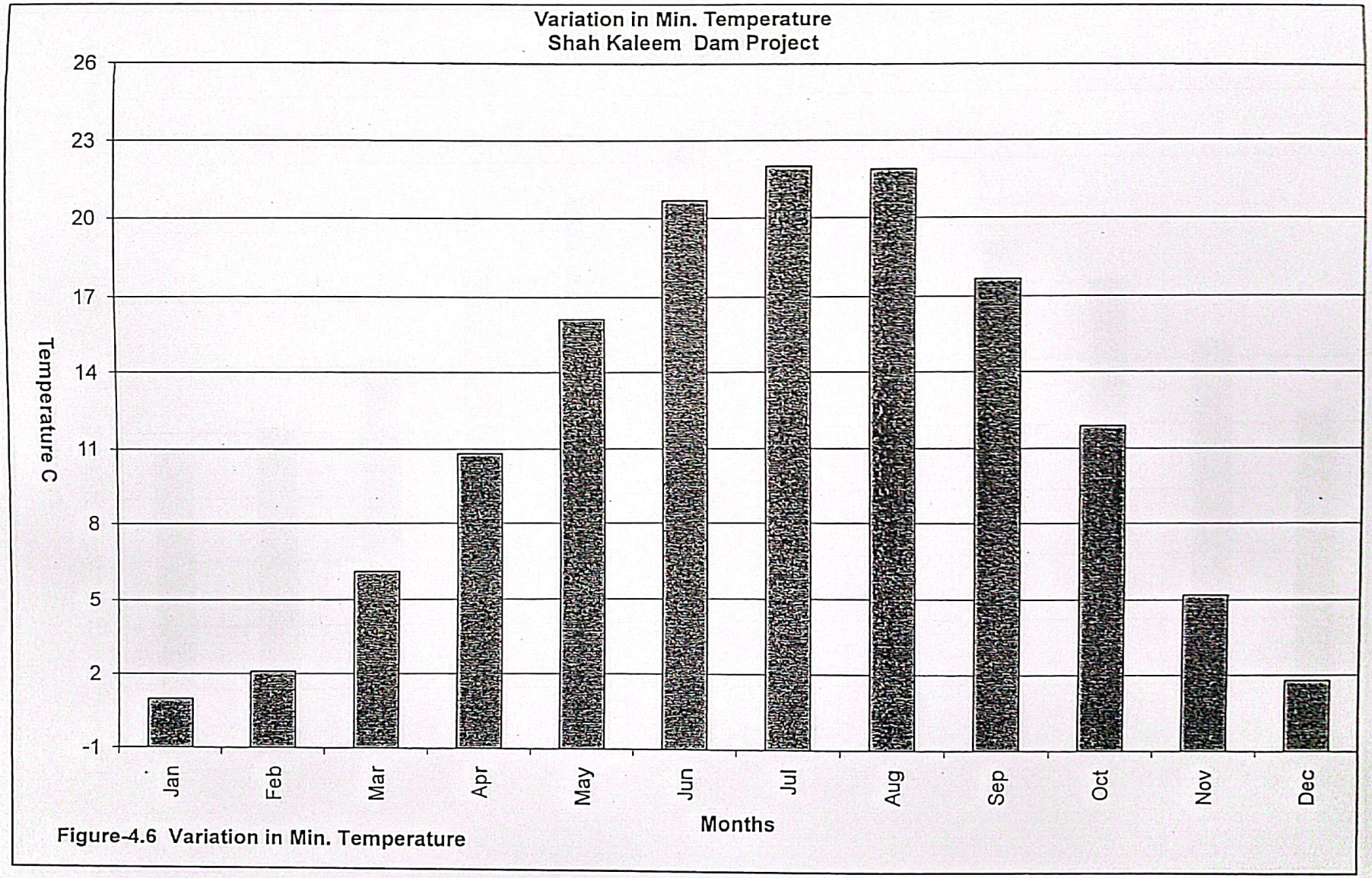


Figure-4.6 Variation in Min. Temperature

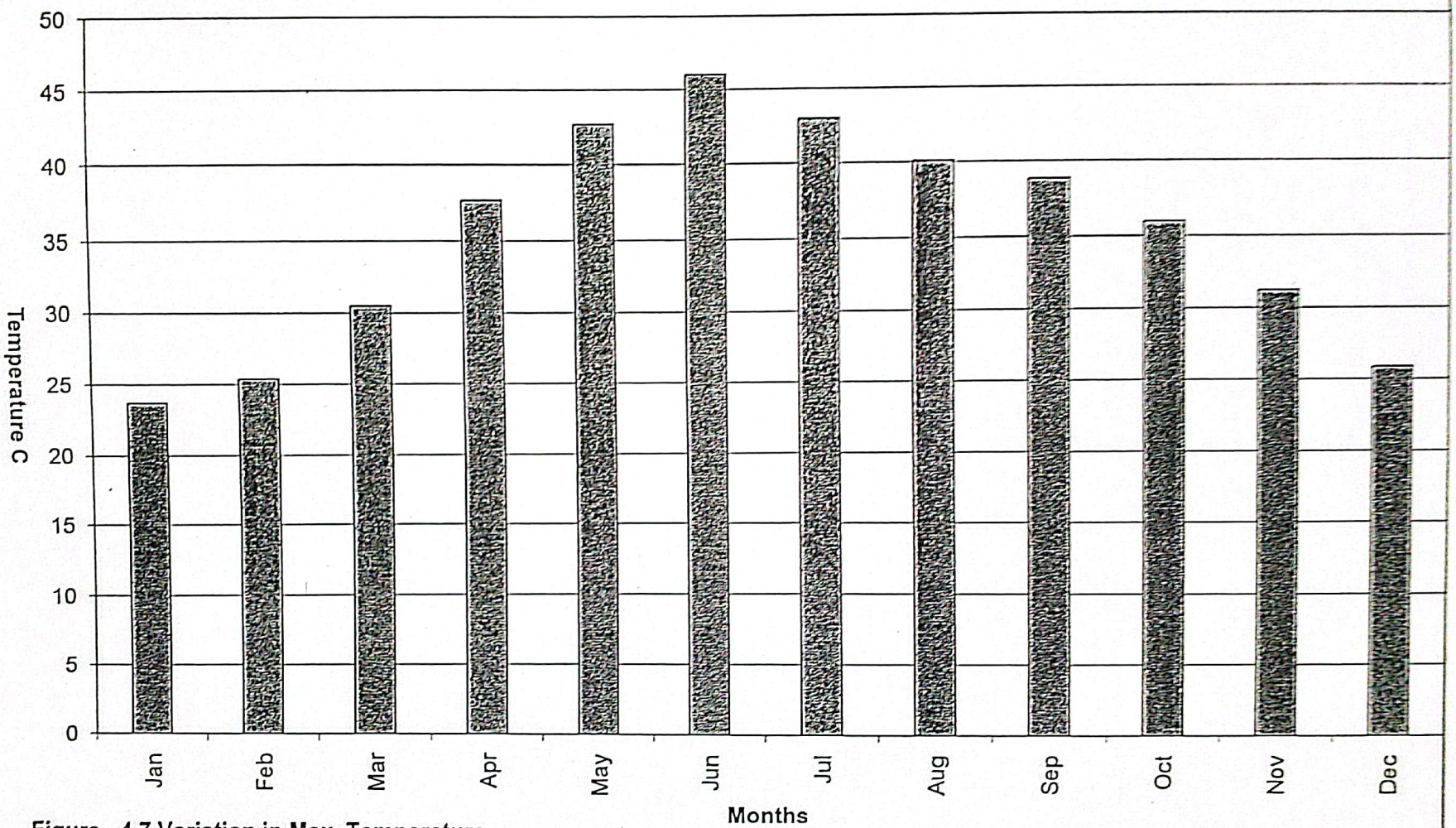


Figure - 4.7 Variation in Max. Temperature

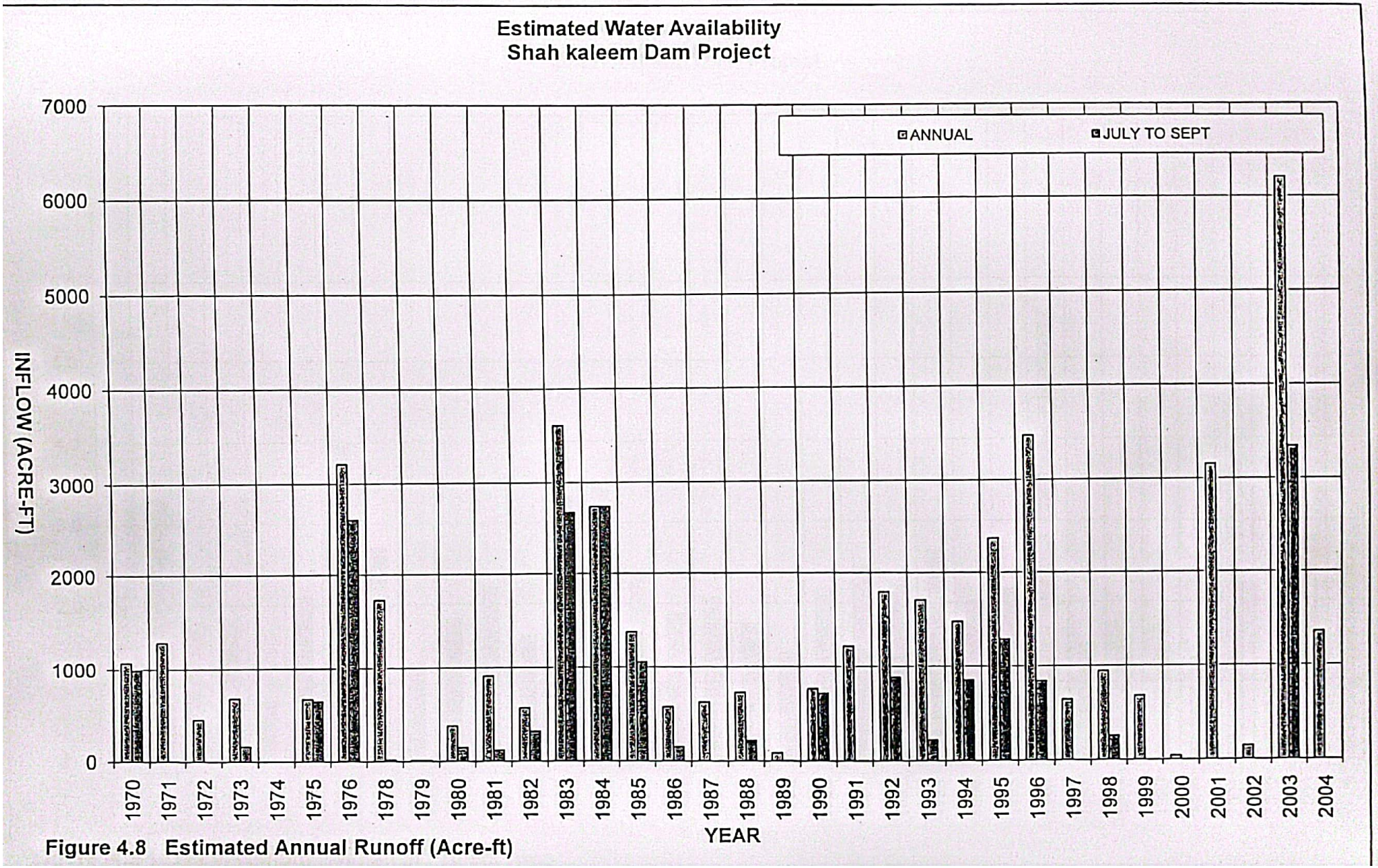


Figure 4.8 Estimated Annual Runoff (Acre-ft)

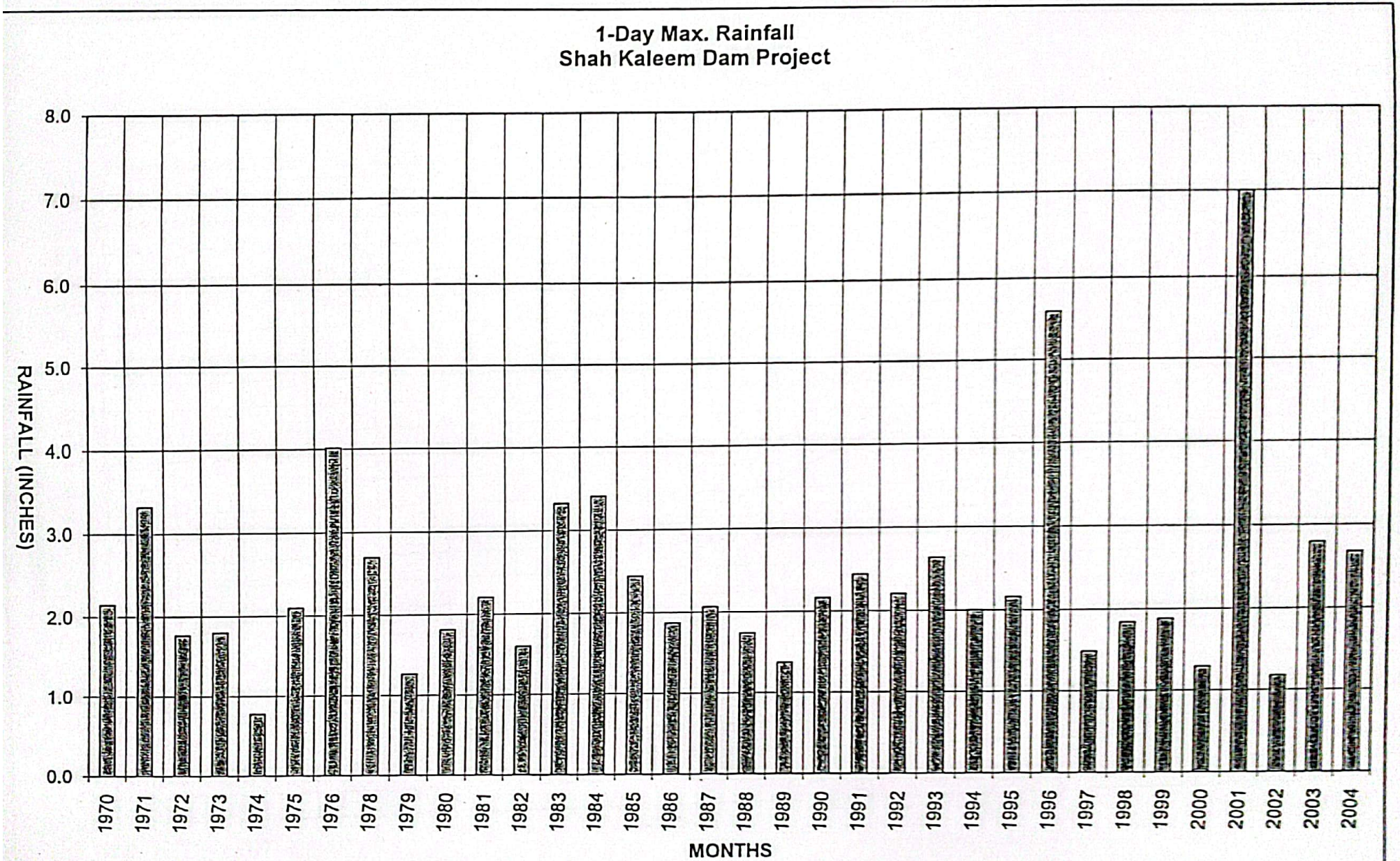


Figure -4.9 1-Day Maximum Rainfall at Project Area

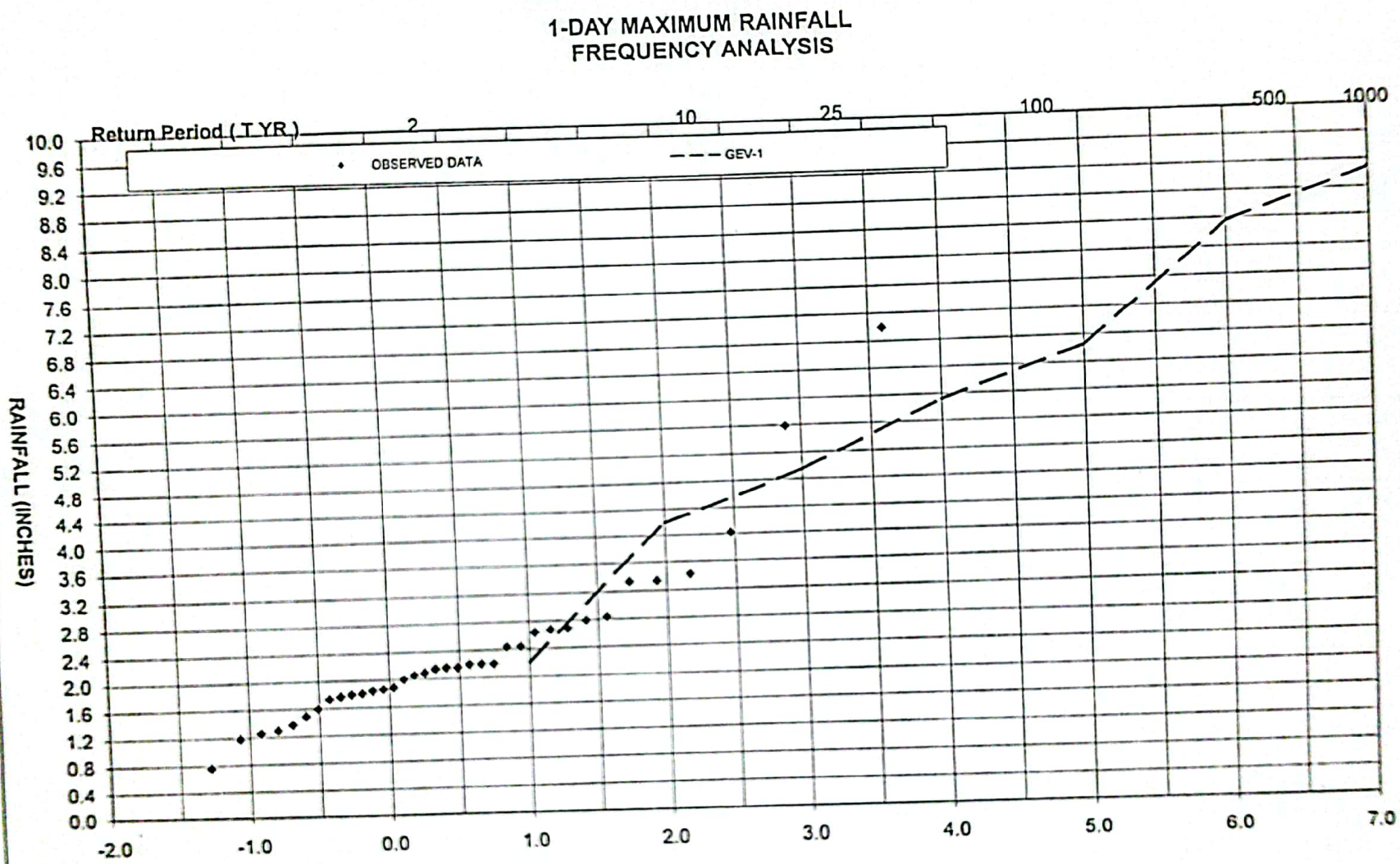


Figure- 4.10 Frequency Analysis

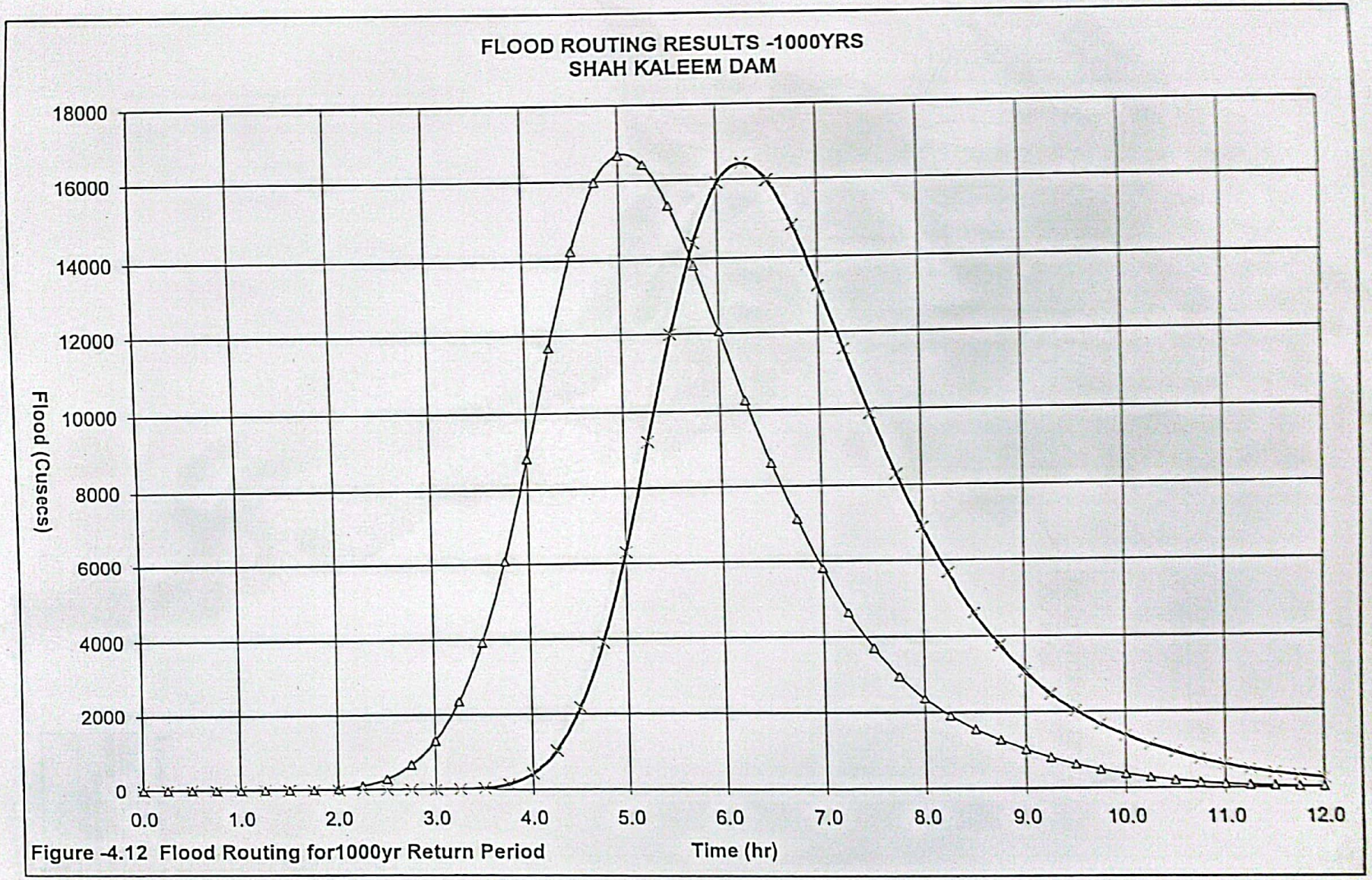


Figure -4.12 Flood Routing for1000yr Return Period


Dam Axis
CONSERVATION LEVEL
359' amsl.
DEAD STORAGE LEVEL
350' amsl.
Track
Well
E.P
C.Land
Nullah
House
School
0
100
200 METERS
SMALL DAMS ORGANIZATION, IRRIGATION DEPARTMENT GOVT OF NWFP
SMALL DAM PROJECT
SHAH KALIM DAM
RESERVOIR AREA
CONSULTING ASSOCIATES.
4.13

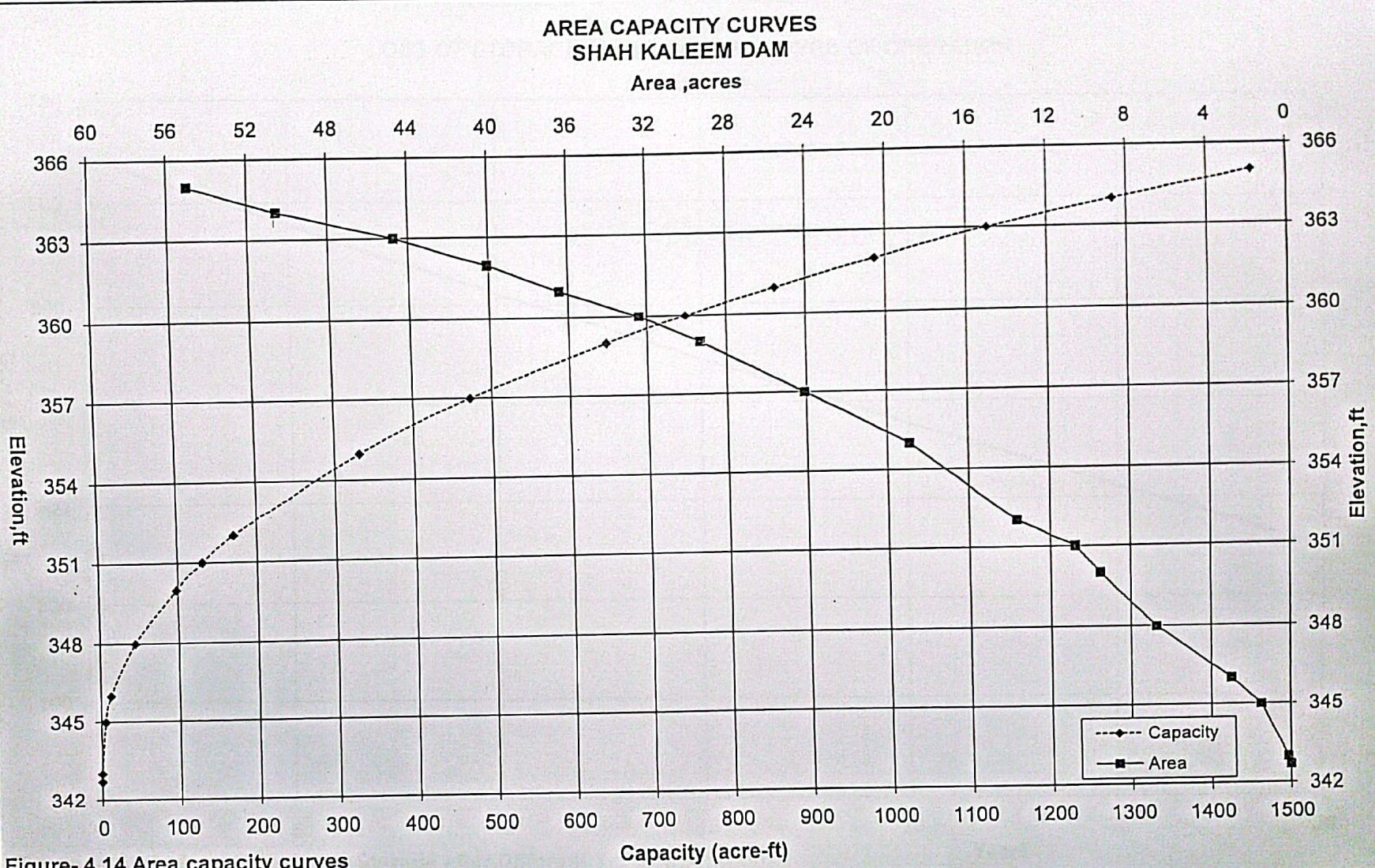


Figure- 4.14 Area capacity curves

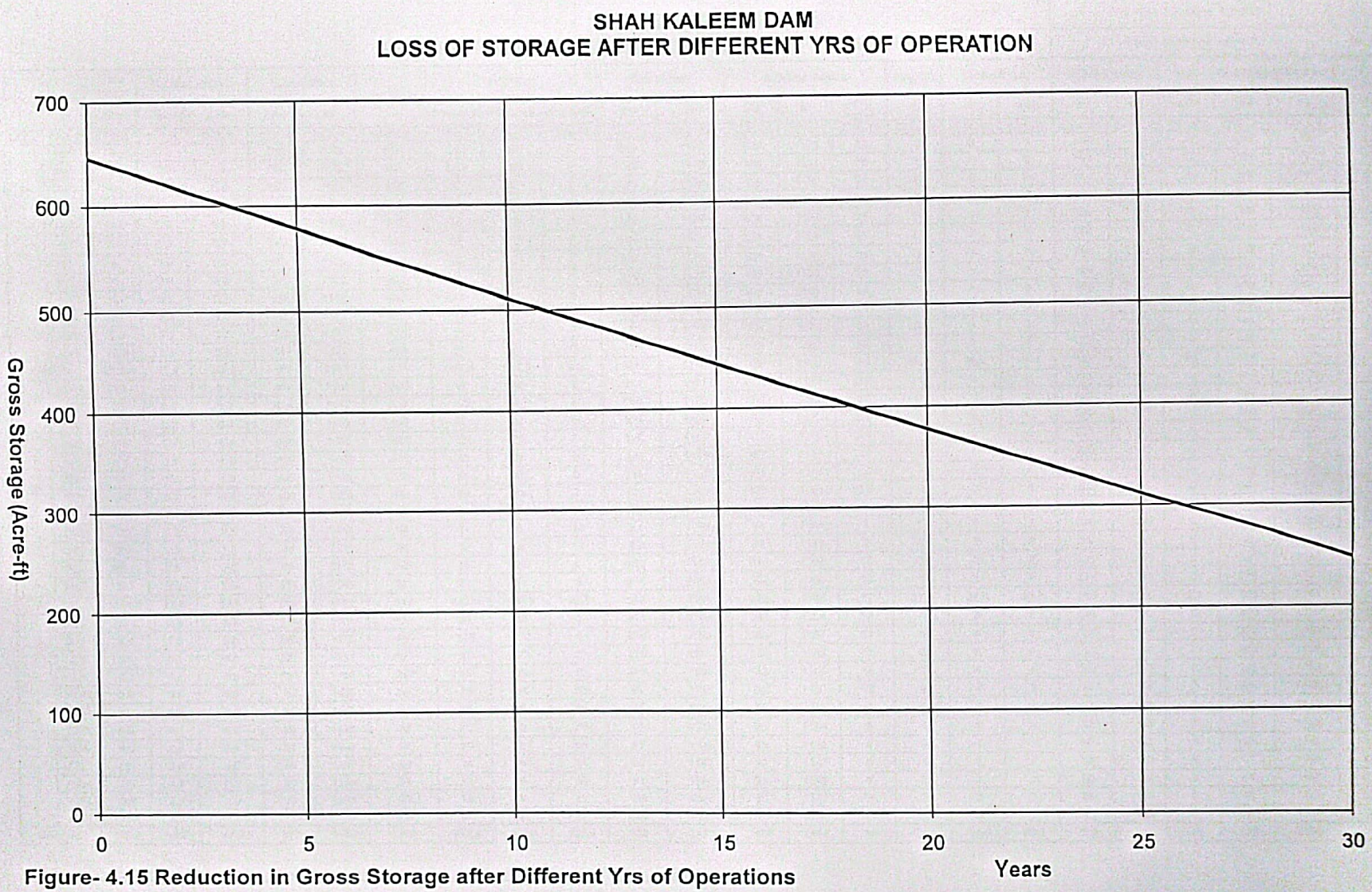


Figure- 4.15 Reduction in Gross Storage after Different Yrs of Operations

RESERVOIR OPERATION MODEL - MONTHLY BASIS

Gross Storage Acre-ft	646
Dead Storage Acre-ft	97.6

Lake fact 0.7

Year	Month	Dam Inflow	Rainfall at Dam		Start Values		End St+In	Irrigation			End Values		Average Values			Avg. ET	Lake Evap		Final Values		Spill	End of period values		% Irrigation Shortage
		A-Ft	In	A-Ft	Vol	El		Demand	Releases	Shortage	Vol	El	Vol	El	Area Acres	In	In	A-Ft	Vol	El	A-Ft	Vol	El	
COL.1	COL.2	COL.3	COL.4	COL.5	COL.6	COL.7	COL.8	COL.9	COL.10	COL.11	COL.12	COL.13	COL.14	COL.15	COL.16	COL.17	COL.18	COL.19	COL.21	COL.22	COL.23	COL.24	COL.25	COL.26
1	APR	0	0.7	1.7	646	1178	646	36	36	0	611	1177	628	1177	28	4	3	7	605	1176	0	605	1176	0
	MAY	0	0.0	0.0	605	1176	605	110	110	0	495	1172	550	1174	26	5	4	8	488	1172	0	488	1172	0
	JUN	0	0.5	0.9	488	1172	488	97	97	0	391	1168	439	1170	23	9	6	11	381	1167	0	381	1167	0
	JUL	3	1.4	2.3	381	1167	383	75	75	0	308	1163	344	1165	19	7	5	8	303	1163	0	303	1163	0
	AUG	688	3.3	6.3	303	1163	646	78	78	0	569	1175	436	1170	23	5	4	7	568	1175	0	568	1175	0
	SEP	299	2.3	5.1	568	1175	646	66	66	0	580	1175	574	1175	27	5	3	7	578	1175	0	578	1175	0
	OCT	0	0.0	0.0	578	1175	578	70	70	0	507	1173	543	1174	28	4	3	6	502	1172	0	502	1172	0
	NOV	0	0.0	0.0	502	1172	502	13	13	0	489	1172	495	1172	25	2	1	3	486	1172	0	486	1172	0
	DEC	0	0.1	0.3	486	1172	486	14	14	0	471	1171	479	1172	24	1	1	2	470	1171	0	470	1171	0
	JAN	0.0	0.1	0.1	470	1171	470	12	12	0	458	1171	464	1171	24	2	2	3	455	1171	0	455	1171	0
	FEB	0.0	1.9	3.7	455	1171	455	15	15	0	440	1170	448	1170	23	2	2	3	441	1170	0	441	1170	0
	MAR	26.9	1.5	2.8	441	1170	468	57	57	0	411	1168	426	1169	22	4	3	5	409	1168	0	409	1168	0
ANNUAL		1016.8	11.8	23.2	493	1172	531	642.6	642.6	0.0	476	1172	486	1172	24	52.0	34.6	69.1	474	1171	0.0	474	1171	
2	APR	1264.9	4.5	9.4	409	1168	646	36	36	0	611	1177	510	1173	25	4	3	6	614	1177	0	614	1177	0
	MAY	0.0	0.6	1.2	614	1177	614	110	110	0	504	1173	559	1175	27	5	4	8	497	1172	0	497	1172	0
	JUN	0.0	0.2	0.5	497	1172	497	97	97	0	400	1168	449	1170	23	9	6	11	390	1167	0	390	1167	0
	JUL	0.0	0.7	1.1	390	1167	390	75	75	0	315	1164	352	1166	20	7	5	8	308	1163	0	308	1163	0
	AUG	0.2	2.9	4.0	308	1163	308	78	78	0	231	1159	269	1161	17	5	4	5	229	1159	0	229	1159	0
	SEP	0.1	1.6	1.0	229	1159	230	66	66	0	163	1154	196	1156	14	5	3	4	161	1154	0	161	1154	0
	OCT	0.0	0.2	0.2	161	1154	161	70	63	7	98	1148	129	1151	11	4	3	2	95	1148	0	95	1148	10
	NOV	0.0	0.0	0.0	95	1148	95	13	0	13	95	1148	95	1148	9	2	1	1	94	1148	0	94	1148	100
	DEC	0.0	0.2	0.2	94	1148	94	14	0	14	94	1148	94	1148	9	1	1	1	94	1148	0	94	1148	100
	JAN	0.0	1.5	1.2	94	1148	94	12	0	12	94	1148	94	1148	9	2	2	1	94	1148	0	94	1148	100
	FEB	251.0	2.6	3.2	94	1148	345	15	15	0	330	1165	212	1157	18	2	2	2	331	1165	0	331	1165	0
	MAR	0.0	2.0	3.0	331	1165	331	57	57	0	274	1161	303	1163	18	4	3	4	274	1161	0	274	1161	0
ANNUAL		1516.2	16.9	25.9	276	1161	317	642.6	596.8	45.9	267	1161	272	1161	17	52.0	34.6	53.3	265	1161	0.0	265	1161	
3	APR	203.6	2.3	3.7	274	1161	477	36	36	0	441	1170	357	1166	20	4	3	5	440	1170	0	440	1170	0
	MAY	0.0	1.5	2.6	440	1170	440	110	110	0	330	1165	385	1167	21	5	4	6	327	1164	0	327	1164	0
	JUN	0.0	0.4	0.6	327	1164	327	97	97	0	230	1159	278	1162	17	9	6	8	222	1158	0	222	1158	0
	JUL	0.0	0.7	0.8	222	1158	222	75	75	0	147	1153	185	1156	14	7	5	6	142	1153	0	142	1153	0
	AUG	0.0	0.4	0.3	142	1153	142	78	45	33	98	1148	120	1151	10	5	4	3	95	1148	0	95	1148	42
	SEP	0.0	0.5	0.4	95	1148	95	66	0	66	95	1148	95	1148	9	5	3	3	93	1148	0	93	1148	100
	OCT	0.0	0.1	0.0	93	1148	93	70	0	70	93	1148	93	1148	9	4	3	2	91	1148	0	91	1148	100
	NOV	0.0	0.5	0.4	91	1148	91	13	0	13	91	1148	91	1148	9	2	1	1	90	1147	0	90	1147	100
	DEC	0.0	2.0	1.5	90	1147	90	14	0	14	90	1147	90	1147	9	1	1	1	91	1148	0	91	1148	100
	JAN	0.0	0.2	0.1	91	1148	91	12	0	12	91	1148	91	1148	9	2	2	1	90	1147	0	90	1147	100
	FEB	0.0	2.7	2.0	90	1147	90	15	0	15	90	1147	90	1147	9	2	2	1	91	1147	0	91	1147	100
	MAR	326.1	3.6	4.7	91	1147	417	57	57	0	360	1160	225	1158	15	4	3	3	362	1166	0	362	1166	0
ANNUAL		529.6	14.8	17.0	170	1155	214	642.6	418.8	223.9	180	1155	175	1155	14	52.0	34.6	40.1	156	1154	0.0	178	1155	

RESERVOIR OPERATION MODEL - MONTHLY BASIS

Gross Storage Acre-ft	646
Dead Storage Acre-ft	97.6

Lake fact	0.7

Year	Month	Dam Inflow	Rainfall at Dam		Start Values		End St+In	Irrigation			End Values		Average Values			Avg. ET	Lake Evap		Final Values		Spill	End of period values		% Irrigation Shortage
		A-Ft	In	A-Ft	Vol	El		Demand	Releases	Shortage	Vol	El	Vol	El	Area Acres	In	In	A-Ft	Vol	El	A-Ft	Vol	El	
4	APR	0.0	0.7	1.1	362	1166	362	36	36	0	326	1164	344	1165	19	4	3	5	322	1164	0	322	1164	0
	MAY	190.6	2.4	4.1	322	1164	513	110	110	0	403	1168	362	1166	20	5	4	6	401	1168	0	401	1168	0
	JUN	0.0	0.0	0.0	401	1168	401	97	97	0	304	1163	353	1166	20	9	6	10	295	1163	0	295	1163	0
	JUL	0.0	0.6	0.8	295	1163	295	75	75	0	219	1158	257	1160	16	7	5	6	214	1158	0	214	1158	0
	AUG	0.0	1.6	1.9	214	1158	214	78	78	0	136	1152	175	1155	14	5	4	4	134	1152	0	134	1152	0
	SEP	165.3	2.5	2.9	134	1152	299	66	66	0	233	1159	183	1156	14	5	3	4	232	1159	0	232	1159	0
	OCT	0.0	0.1	0.1	232	1159	232	70	70	0	162	1154	197	1156	14	4	3	3	158	1154	0	158	1154	0
	NOV	0.0	0.0	0.0	158	1154	158	13	13	0	145	1153	152	1153	12	2	1	1	144	1153	0	144	1153	0
	DEC	0.0	0.4	0.3	144	1153	144	14	14	0	130	1152	137	1152	11	1	1	1	129	1151	0	129	1151	0
	JAN	0.0	0.2	0.2	129	1151	129	12	12	0	117	1150	123	1151	10	2	2	1	116	1150	0	116	1150	0
	FEB	0.0	2.0	1.7	116	1150	116	15	15	0	101	1149	109	1149	10	2	2	1	101	1149	0	101	1149	0
	MAR	0.0	0.1	0.1	101	1149	101	57	4	53	98	1148	100	1149	10	4	3	2	96	1148	0	96	1148	93
ANNUAL		355.9	10.6	13.1	217	1158	247	642.6	590.0	52.7	198	1157	208	1157	15	52.0	34.6	44.9	195	1156	0.0	195	1156	
5	APR	0.0	1.2	1.0	96	1148	96	36	0	36	96	1148	96	1148	9	4	3	2	94	1148	0	94	1148	100
	MAY	0.0	0.3	0.2	94	1148	94	110	0	110	94	1148	94	1148	9	5	4	3	92	1148	0	92	1148	100
	JUN	0.0	0.0	0.0	92	1148	92	97	0	97	92	1148	92	1148	9	9	6	4	87	1147	0	87	1147	100
	JUL	0.0	0.8	0.6	87	1147	87	75	0	75	87	1147	87	1147	9	7	5	4	84	1147	0	84	1147	100
	AUG	0.0	0.9	0.6	84	1147	84	78	0	78	84	1147	84	1147	9	5	4	3	82	1146	0	82	1146	100
	SEP	0.0	0.6	0.5	82	1146	82	66	0	66	82	1146	82	1146	9	5	3	2	80	1146	0	80	1146	100
	OCT	0.0	0.0	0.0	80	1146	80	70	0	70	80	1146	80	1146	9	4	3	2	79	1146	0	79	1146	100
	NOV	0.0	0.0	0.0	79	1146	79	13	0	13	79	1146	79	1146	9	2	1	1	78	1146	0	78	1146	100
	DEC	0.0	1.3	0.9	78	1146	78	14	0	14	78	1146	78	1146	8	1	1	1	78	1146	0	78	1146	100
	JAN	0	0.0	0.0	78	1146	78	12	0	12	78	1146	78	1146	8	2	2	1	77	1146	0	77	1146	100
	FEB	0	1.9	1.4	77	1146	77	15	0	15	77	1146	77	1146	8	2	2	1	77	1146	0	77	1146	100
	MAR	19	3.7	2.7	77	1146	96	57	0	57	96	1148	86	1147	9	4	3	2	97	1148	0	97	1148	100
ANNUAL		18.7	10.8	7.9	84	1147	85	642.6	0.0	642.6	85	1147	84	1147	9	52.0	34.6	25.8	84	1147	0.0	84	1147	
6	APR	0	1.7	1.3	97	1148	97	36	0	36	97	1148	97	1148	9	4	3	2	96	1148	0	96	1148	100
	MAY	9	2.5	2.0	96	1148	105	110	7	103	98	1148	97	1148	9	5	4	3	97	1148	0	97	1148	94
	JUN	0	0.1	0.1	97	1148	97	97	0	97	97	1148	97	1148	9	9	6	5	92	1148	0	92	1148	100
	JUL	344	2.8	3.6	92	1148	436	75	75	0	361	1166	227	1158	15	7	5	6	359	1166	0	359	1166	0
	AUG	301	4.1	8.2	359	1166	646	78	78	0	569	1175	464	1171	24	5	4	7	570	1175	0	570	1175	0
	SEP	0	0.1	0.2	570	1175	570	66	66	0	503	1172	537	1174	26	5	3	7	497	1172	0	497	1172	0
	OCT	0	0.0	0.0	497	1172	497	70	70	0	426	1169	461	1171	24	4	3	5	421	1169	0	421	1169	0
	NOV	0	0.0	0.0	421	1169	421	13	13	0	408	1168	415	1169	22	2	1	2	406	1168	0	406	1168	0
	DEC	0	0.2	0.4	406	1168	406	14	14	0	391	1168	398	1168	21	1	1	2	390	1167	0	390	1167	0
	JAN	0	0.5	0.9	390	1167	390	12	12	0	378	1167	384	1167	21	2	2	3	376	1167	0	376	1167	0
	FEB	34	3.3	5.7	376	1167	410	15	15	0	395	1168	386	1167	21	2	2	3	398	1168	0	398	1168	0
	MAR	440	3.2	6.6	398	1168	646	57	57	0	590	1176	494	1172	25	4	3	5	591	1176	0	591	1176	0
ANNUAL		1127.7	18.5	29.0	316	1164	393	642.6	407.2	235.4	359	1166	338	1165	19	52.0	34.6	50.1	358	1166	0.0	358	1166	

RESERVOIR OPERATION MODEL - MONTHLY BASIS

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Year	Month	Dam Inflow	Rainfall at Dam		Start Values		End St+In	Irrigation			End Values		Average Values			Avg. ET	Lake Evap		Final Values		Spill	End of period values		% Irrigation Shortage
		A-Ft	In	A-Ft	Vol	El		Demand	Releases	Shortage	Vol	El	Vol	El	Area Acres	In	In	A-Ft	Vol	El	A-Ft	Vol	El	
7	APR	137	2.7	6.3	591	1176	646	36	36	0	611	1177	601	1176	28	4	3	7	610	1177	0	610	1177	0
	MAY	0	0.1	0.3	610	1177	610	110	110	0	500	1172	555	1174	26	5	4	8	493	1172	0	493	1172	0
	JUN	0	0.7	1.4	493	1172	493	97	97	0	396	1168	444	1170	23	9	6	11	386	1167	0	386	1167	0
	JUL	0	1.6	2.6	386	1167	386	75	75	0	311	1164	348	1166	20	7	5	8	306	1163	0	306	1163	0
	AUG	2599	11.0	21.0	306	1163	646	78	78	0	569	1175	437	1170	23	5	4	7	583	1175	0	583	1175	0
	SEP	0	0.8	1.8	583	1175	583	66	66	0	516	1173	550	1174	26	5	3	7	511	1173	0	511	1173	0
	OCT	0	0.5	1.1	511	1173	511	70	70	0	441	1170	476	1171	24	4	3	5	437	1170	0	437	1170	0
	NOV	0	0.0	0.0	437	1170	437	13	13	0	423	1169	430	1169	23	2	1	3	421	1169	0	421	1169	0
	DEC	0	0.0	0.1	421	1169	421	14	14	0	406	1168	414	1169	22	1	1	2	405	1168	0	405	1168	0
	JAN	0	0.6	1.1	405	1168	405	12	12	0	393	1168	399	1168	21	2	2	3	392	1168	0	392	1168	0
	FEB	0	0.6	1.1	392	1168	392	15	15	0	376	1167	384	1167	21	2	2	3	375	1167	0	375	1167	0
	MAR	1724	8.8	17.8	375	1167	646	57	57	0	590	1176	482	1172	24	4	3	5	602	1176	0	602	1176	0
ANNUAL		4459.5	27.6	54.5	459	1171	515	642.6	642.6	0.0	461	1171	460	1171	24	52.0	34.6	67.9	460	1171	0.0	460	1171	
8	APR	0	1.0	2.4	602	1176	602	36	36	0	567	1175	585	1176	27	4	3	7	562	1175	0	562	1175	0
	MAY	0	0.0	0.1	562	1175	562	110	110	0	452	1170	507	1173	25	5	4	7	445	1170	0	445	1170	0
	JUN	0	0.4	0.7	445	1170	445	97	97	0	348	1166	397	1168	21	9	6	10	339	1165	0	339	1165	0
	JUL	6	3.5	5.2	339	1165	344	75	75	0	269	1161	304	1163	18	7	5	7	267	1161	0	267	1161	0
	AUG	13	2.9	3.8	267	1161	280	78	78	0	202	1157	235	1159	16	5	4	5	201	1157	0	201	1157	0
	SEP	0	0.3	0.4	201	1157	201	66	66	0	135	1152	168	1155	13	5	3	4	132	1152	0	132	1152	0
	OCT	0	0.1	0.1	132	1152	132	70	34	36	98	1148	115	1150	10	4	3	2	95	1148	0	95	1148	52
	NOV	0	1.2	1.0	95	1148	95	13	0	13	95	1148	95	1148	9	2	1	1	95	1148	0	95	1148	100
	DEC	0	0.0	0.0	95	1148	95	14	0	14	95	1148	95	1148	9	1	1	1	95	1148	0	95	1148	100
	JAN	0	0.0	0.0	95	1148	95	12	0	12	95	1148	95	1148	9	2	2	1	93	1148	0	93	1148	100
	FEB	0	0.0	0.0	93	1148	93	15	0	15	93	1148	93	1148	9	2	2	1	92	1148	0	92	1148	100
	MAR	0	0.0	0.0	92	1148	92	57	0	57	92	1148	92	1148	9	4	3	2	90	1147	0	90	1147	100
ANNUAL		18.1	9.6	13.6	252	1160	253	642.6	495.6	147.1	212	1157	232	1159	16	52.0	34.6	48.4	209	1157	0.0	209	1157	
9	APR	0	0.0	0.0	90	1147	90	36	0	36	90	1147	90	1147	9	4	3	2	88	1147	0	88	1147	100
	MAY	1	1.4	1.1	88	1147	89	110	0	110	89	1147	88	1147	9	5	4	3	87	1147	0	87	1147	100
	JUN	0	0.5	0.3	87	1147	87	97	0	97	87	1147	87	1147	9	9	6	4	83	1147	0	83	1147	100
	JUL	0	0.6	0.4	83	1147	83	75	0	75	83	1147	83	1147	9	7	5	3	80	1146	0	80	1146	100
	AUG	9	3.7	2.7	80	1146	89	78	0	78	89	1147	84	1147	9	5	4	3	89	1147	0	89	1147	100
	SEP	0	0.0	0.0	89	1147	89	66	0	66	89	1147	89	1147	9	5	3	2	86	1147	0	86	1147	100
	OCT	0	0.0	0.0	86	1147	86	70	0	70	86	1147	86	1147	9	4	3	2	84	1147	0	84	1147	100
	NOV	0	0.7	0.5	84	1147	84	13	0	13	84	1147	84	1147	9	2	1	1	84	1147	0	84	1147	100
	DEC	0	0.0	0.0	84	1147	84	14	0	14	84	1147	84	1147	9	1	1	1	83	1147	0	83	1147	100
	JAN	0	1.1	0.8	83	1147	83	12	0	12	83	1147	83	1147	9	2	2	1	83	1147	0	83	1147	100
	FEB	234	2.8	3.3	83	1147	316	15	15	0	301	1163	192	1156	14	2	2	2	303	1163	0	303	1163	0
	MAR	0	2.7	3.9	303	1163	303	57	57	0	246	1160	274	1161	17	4	3	4	246	1160	0	246	1160	0
ANNUAL		242.8	13.6	13.1	103	1149	124	642.6	71.7	570.9	118	1150	110	1150	10	52.0	34.6	28.1	116	1150	0.0	116	1150	

RESERVOIR OPERATION MODEL - MONTHLY BASIS

Lake Fact	0.7	Gross Storage Acre ft	446
		Dead Storage Acre ft	67.6

Year	Month	Dam Inflow	Rainfall at Dam		Start Values		End Stage	Irrigation			End Values		Average Values			Avg. ET	Lake Evap		Final Values		Spill	End of period values		% Irrigation Shortage
		A.F.	In	A.F.	Vol	El		Demand	Releases	Shortage	Vol	El	Vol	El	Area Acres	In	In	A.F.	Vol	El	A.F.	Vol	El	
10	APR	0	0.3	0.4	248	1160	248	38	38	0	211	1157	229	1158	18	4	3	4	207	1157	0	207	1157	0
	MAY	0	0.6	0.8	207	1157	207	110	110	0	98	1148	152	1153	12	5	4	4	95	1148	0	95	1148	0
	JUN	0	1.5	1.0	95	1148	95	87	0	87	95	1148	95	1148	8	6	5	3	91	1148	0	91	1148	100
	JUL	0	2.0	1.5	91	1148	91	78	0	78	91	1148	91	1148	8	7	5	4	88	1147	0	88	1147	100
	AUG	145	1.8	1.7	88	1147	235	78	78	0	157	1154	123	1151	10	5	4	3	153	1154	0	153	1154	0
	SEP	0	0.2	0.2	153	1154	153	66	58	8	95	1148	124	1151	11	5	3	3	93	1148	0	93	1148	12
	OCT	0	0.3	0.2	85	1148	85	70	0	70	85	1148	85	1148	8	4	3	2	83	1148	0	83	1148	100
	NOV	0	0.3	0.2	83	1148	83	75	0	75	83	1148	83	1148	8	2	1	1	82	1148	0	82	1148	100
	DEC	0	0.1	0.1	82	1148	82	74	0	74	82	1148	82	1148	8	1	1	1	82	1148	0	82	1148	100
	JAN	0	1.3	1.0	82	1148	82	72	0	72	82	1148	82	1148	8	2	2	1	81	1148	0	81	1148	100
	FEB	0	1.1	0.8	81	1148	81	75	0	75	81	1148	81	1148	8	2	2	1	81	1148	0	81	1148	100
	MAR	677	5.8	8.4	81	1148	766	37	37	0	390	1178	240	1165	16	4	3	4	385	1178	0	385	1178	0
ANNUAL		822.7	18.4	17.3	130	1151	178	842.8	337.4	505.3	150	1153	135	1152	11	52.0	36.8	32.0	146	1153	0.0	146	1153	
11	APR	21	1.1	2.5	385	1178	408	38	38	0	380	1175	383	1176	27	4	3	7	378	1175	0	378	1175	0
	MAY	0	1.4	2.8	378	1175	378	110	110	0	468	1171	421	1173	25	5	4	8	462	1171	0	462	1171	0
	JUN	0	0.0	0.1	462	1171	462	87	87	0	365	1168	413	1169	22	6	8	11	354	1168	0	354	1168	0
	JUL	0	1.0	1.5	354	1168	354	75	75	0	278	1162	317	1164	18	7	5	7	273	1161	0	273	1161	0
	AUG	115	3.3	4.8	273	1161	389	78	78	0	311	1164	292	1162	18	5	4	5	311	1163	0	311	1163	0
	SEP	0	0.0	0.0	311	1163	311	68	68	0	244	1158	277	1161	17	5	3	3	240	1158	0	240	1158	0
	OCT	0	0.4	0.4	240	1158	240	70	70	0	169	1153	204	1157	15	4	3	3	166	1153	0	166	1153	0
	NOV	0	0.0	0.0	166	1153	166	13	13	0	153	1153	160	1154	13	2	1	1	152	1153	0	152	1153	0
	DEC	0	0.0	0.0	152	1153	152	14	14	0	137	1152	145	1153	12	1	1	1	137	1152	0	137	1152	0
	JAN	0	1.2	1.1	137	1152	137	12	12	0	125	1151	131	1152	11	2	2	1	125	1151	0	125	1151	0
	FEB	0	0.5	0.4	125	1151	125	15	15	0	110	1150	117	1150	10	2	2	1	108	1150	0	108	1150	0
	MAR	71	3.8	3.2	108	1149	180	37	37	0	123	1151	118	1150	10	4	3	2	124	1151	0	124	1151	0
ANNUAL		207.2	12.6	17.0	282	1162	309	842.8	842.8	0.0	233	1160	273	1161	17	52.0	36.8	32.7	232	1160	0.0	232	1160	
12	APR	0	0.8	0.8	124	1151	124	38	29	8	95	1148	111	1150	10	4	3	2	93	1148	0	93	1148	22
	MAY	0	0.2	0.1	93	1148	93	110	0	110	93	1148	93	1148	8	5	4	3	90	1148	0	90	1148	100
	JUN	0	0.1	0.0	90	1148	90	87	0	87	90	1148	90	1148	8	6	5	3	87	1147	0	87	1147	100
	JUL	0	0.1	0.1	87	1147	87	75	0	75	87	1147	87	1147	8	7	5	4	83	1147	0	83	1147	100
	AUG	318	3.7	4.8	83	1147	406	78	78	0	328	1164	205	1157	15	5	4	4	326	1164	0	326	1164	0
	SEP	0	0.0	0.0	326	1164	326	68	68	0	259	1160	293	1162	18	5	3	3	255	1160	0	255	1160	0
	OCT	0	0.0	0.0	255	1160	255	70	70	0	184	1155	219	1158	15	4	3	3	181	1155	0	181	1155	0
	NOV	170	2.0	2.8	181	1155	350	13	13	0	347	1165	264	1161	17	2	1	2	345	1165	0	345	1165	0
	DEC	0	0.8	0.8	345	1165	345	14	14	0	333	1165	341	1165	18	1	1	2	333	1165	0	333	1165	0
	JAN	0	1.8	2.4	333	1165	333	12	12	0	321	1164	327	1165	18	2	2	2	321	1164	0	321	1164	0
	FEB	0	1.3	2.3	321	1164	321	15	15	0	308	1163	314	1164	18	2	2	2	306	1163	0	306	1163	0
	MAR	0	3.2	4.6	306	1163	309	37	37	0	248	1160	279	1161	17	4	3	4	242	1160	0	242	1160	0
ANNUAL		487.2	13.6	18.4	213	1157	294	842.8	331.8	511.1	223	1158	219	1158	15	52.0	36.8	37.8	224	1158	0.0	224	1158	

RESERVOIR OPERATION MODEL - MONTHLY BASIS

Gross Storage Acre-ft	646
Dead Storage Acre-ft	97.6
Lake fact	0.7

Year	Month	Dam Inflow	Rainfall at Dam		Start Values		End St+In	Irrigation			End Values		Average Values			Avg. ET	Lake Evap		Final Values		Spill	End of period values		% Irrigation Shortage
		A-Ft	In	A-Ft	Vol	El		Demand	Releases	Shortage	Vol	El	Vol	El	Area Acres	In	In	A-Ft	Vol	El	A-Ft	Vol	El	
13	APR	946	7.1	13.3	250	1160	646	36	36	0	611	1177	430	1169	23	4	3	6	618	1177	0	618	1177	0
	MAY	0	1.5	3.4	618	1177	618	110	110	0	508	1173	563	1175	27	5	4	8	504	1173	0	504	1173	0
	JUN	0	0.6	1.1	504	1173	504	97	97	0	407	1168	455	1171	23	9	6	11	397	1168	0	397	1168	0
	JUL	246	2.4	5.0	397	1168	643	75	75	0	568	1175	482	1172	24	7	5	10	563	1175	0	563	1175	0
	AUG	2419	8.6	19.1	563	1175	646	78	78	0	569	1175	566	1175	27	5	4	8	560	1175	0	560	1175	0
	SEP	0	0.7	1.6	560	1175	560	66	66	0	513	1173	547	1174	26	5	3	7	508	1173	0	508	1173	0
	OCT	0	0.4	0.8	508	1173	508	70	70	0	438	1170	473	1171	24	4	3	5	433	1169	0	433	1169	0
	NOV	0	0.4	0.7	433	1169	433	13	13	0	420	1169	426	1169	22	2	1	2	418	1169	0	418	1169	0
	DEC	0	0.1	0.1	418	1169	418	14	14	0	404	1168	411	1168	22	1	1	2	402	1168	0	402	1168	0
	JAN	0	0.2	0.3	402	1168	402	12	12	0	391	1168	396	1168	21	2	2	3	388	1167	0	388	1167	0
	FEB	0	1.2	2.0	388	1167	388	15	15	0	373	1167	381	1167	21	2	2	3	372	1167	0	372	1167	0
	MAR	0	1.6	2.5	372	1167	372	57	57	0	316	1164	344	1165	19	4	3	4	314	1164	0	314	1164	0
ANNUAL		3610.9	24.6	49.9	453	1170	513	642.6	642.6	0.0	460	1171	456	1171	24	52.0	34.6	68.8	458	1171	0.0	458	1171	
14	APR	0	0.1	0.2	314	1164	314	36	36	0	278	1162	296	1163	18	5	4	5	273	1161	0	273	1161	0
	MAY	0	0.1	0.2	273	1161	273	110	110	0	163	1154	218	1158	15	5	4	5	159	1154	0	159	1154	0
	JUN	0	0.2	0.2	159	1154	159	97	61	35	98	1148	128	1151	11	9	6	5	93	1148	0	93	1148	37
	JUL	327	4.0	5.0	93	1148	420	75	75	0	345	1165	219	1158	15	7	5	6	344	1165	0	344	1165	0
	AUG	2407	9.3	18.3	344	1165	646	78	78	0	569	1175	456	1171	24	5	4	7	560	1175	0	560	1175	0
	SEP	0	0.9	1.9	560	1175	560	66	66	0	514	1173	547	1174	26	5	3	7	508	1173	0	508	1173	0
	OCT	0	0.0	0.0	508	1173	508	70	70	0	438	1170	473	1171	24	4	3	5	433	1169	0	433	1169	0
	NOV	0	0.4	0.7	433	1169	433	13	13	0	420	1169	426	1169	22	2	1	2	418	1169	0	418	1169	0
	DEC	0	0.2	0.3	418	1169	418	14	14	0	403	1168	411	1168	22	1	1	2	402	1168	0	402	1168	0
	JAN	0	1.1	2.0	402	1168	402	12	12	0	390	1168	396	1168	21	2	2	3	390	1167	0	390	1167	0
	FEB	0	0.2	0.4	390	1167	390	15	15	0	374	1167	382	1167	21	2	2	3	372	1167	0	372	1167	0
	MAR	0	1.0	1.5	372	1167	372	57	57	0	316	1164	344	1165	19	4	3	4	313	1164	0	313	1164	0
ANNUAL		2734.0	17.5	30.7	357	1166	410	642.6	607.2	35.4	359	1166	358	1166	20	53.0	35.2	54.4	357	1166	0.0	357	1166	
15	APR	0	1.2	1.7	313	1164	313	36	36	0	277	1161	295	1163	18	4	3	4	275	1161	0	275	1161	0
	MAY	0	0.8	1.0	275	1161	275	110	110	0	165	1154	220	1158	16	5	4	5	161	1154	0	161	1154	0
	JUN	0	0.0	0.0	161	1154	161	97	63	33	98	1148	129	1151	11	9	6	5	92	1148	0	92	1148	34
	JUL	0	1.0	0.8	92	1148	92	75	0	75	92	1148	92	1148	9	7	5	4	90	1147	0	90	1147	100
	AUG	1056	3.8	5.9	90	1147	646	78	78	0	569	1175	329	1165	19	5	4	6	569	1175	0	569	1175	0
	SEP	0	0.2	0.4	569	1175	569	66	66	0	503	1172	536	1174	26	5	3	7	496	1172	0	496	1172	0
	OCT	0	0.1	0.2	496	1172	496	70	70	0	426	1169	461	1171	24	4	3	5	421	1169	0	421	1169	0
	NOV	0	0.4	0.6	421	1169	421	13	13	0	408	1168	414	1169	22	2	1	2	406	1168	0	406	1168	0
	DEC	327	3.7	7.9	406	1168	646	14	14	0	632	1177	519	1173	25	1	1	2	638	1178	0	638	1178	0
	JAN	0	0.7	1.6	638	1178	638	12	12	0	626	1177	632	1177	29	2	2	4	624	1177	0	624	1177	0
	FEB	143	2.8	6.6	624	1177	646	15	15	0	631	1177	628	1177	28	2	2	4	634	1177	0	634	1177	0
	MAR	0	2.9	6.7	634	1177	634	57	57	0	578	1175	606	1176	28	4	3	6	578	1175	0	578	1175	0
ANNUAL		1526.6	17.5	33.7	393	1168	461	642.6	534.3	108.3	417	1169	405	1168	22	52.0	34.6	53.6	415	1169	0.0	415	1169	

RESERVOIR OPERATION MODEL - MONTHLY BASIS

																								Gross Storage Acre-ft			546
																		Lake Surf	0.7	Dead Storage Acre-ft							97.5
Year	Month	Dam Inflow	Rainfall at Dam		Start Values		End St+In	Irrigation			End Values		Average Values			Avg. ET	Lake Evap			Final Values			Spill	End of period values		% Irrigation Shortage
		A-Ft	In	A-Ft	Vol	El		Demand	Releases	Shortage	Vol	El	Vol	El	Area Acres	In	In	A-Ft		Vol	El	A-Ft		Vol	El	
16	APR	0	0.9	2.1	578	1175	578	36	36	0	543	1174	560	1175	27	4	3	6		528	1174	0		528	1174	0
	MAY	0	0.6	1.2	538	1174	538	110	110	0	428	1169	483	1172	24	5	4	7		422	1169	0		422	1169	0
	JUN	0	0.6	1.1	422	1169	422	97	97	0	325	1164	374	1167	20	9	6	10		316	1164	0		316	1164	0
	JUL	16	0.9	1.3	316	1164	332	75	75	0	257	1160	287	1162	17	7	5	7		252	1160	0		252	1160	0
	AUG	131	1.6	2.3	252	1160	382	78	78	0	305	1163	279	1162	17	5	4	5		302	1163	0		302	1163	0
	SEP	0	1.0	1.4	302	1163	302	66	66	0	236	1159	269	1161	17	5	3	5		232	1159	0		232	1159	0
	OCT	0	0.0	0.0	232	1159	232	70	70	0	162	1154	197	1157	15	4	3	3		159	1154	0		159	1154	0
	NOV	286	2.5	3.7	159	1154	445	13	13	0	432	1169	295	1163	18	2	1	2		434	1170	0		434	1170	0
	DEC	0	1.4	2.6	434	1170	434	14	14	0	419	1169	426	1169	22	1	1	2		420	1169	0		420	1169	0
	JAN	0	0.0	0.0	420	1169	420	12	12	0	408	1168	414	1169	22	2	2	3		406	1168	0		406	1168	0
	FEB	293	2.8	5.9	406	1168	646	15	15	0	631	1177	518	1173	25	2	2	3		634	1177	0		634	1177	0
	MAR	329	6.4	15.0	634	1177	646	57	57	0	590	1176	612	1177	28	4	3	6		589	1176	0		589	1176	0
ANNUAL		1054.5	18.8	36.6	391	1168	448	642.6	642.6	0.0	395	1168	393	1168	21	52.0	34.6	59.5		393	1168	0.0		393	1168	
17	APR	0	0.3	0.8	589	1176	589	36	36	0	553	1175	571	1175	27	4	3	7		557	1175	0		557	1175	0
	MAY	0	1.3	2.7	557	1175	557	110	110	0	447	1170	502	1172	25	5	4	7		443	1170	0		443	1170	0
	JUN	0	0.8	1.4	443	1170	443	97	97	0	346	1165	394	1168	21	9	6	10		337	1165	0		337	1165	0
	JUL	0	0.2	0.3	337	1165	337	75	75	0	262	1160	299	1163	18	7	5	7		255	1160	0		255	1160	0
	AUG	0	0.0	0.0	255	1160	255	78	78	0	177	1155	216	1158	15	5	4	5		173	1155	0		173	1155	0
	SEP	0	0.2	0.2	173	1155	173	66	66	0	107	1149	140	1152	11	5	3	3		104	1149	0		104	1149	0
	OCT	0	1.3	1.1	104	1149	104	70	6	64	98	1148	101	1149	10	4	3	2		97	1148	0		97	1148	91
	NOV	0	0.0	0.0	97	1148	97	13	0	13	97	1148	97	1148	9	2	1	1		95	1148	0		95	1148	100
	DEC	0	0.1	0.1	95	1148	95	14	0	14	95	1148	95	1148	9	1	1	1		95	1148	0		95	1148	100
	JAN	0	1.6	1.2	95	1148	95	12	0	12	95	1148	95	1148	9	2	2	1		95	1148	0		95	1148	100
	FEB	0	0.4	0.3	95	1148	95	15	0	15	95	1148	95	1148	9	2	2	1		94	1148	0		94	1148	100
	MAR	506	6.4	9.9	94	1148	601	57	57	0	545	1174	319	1164	19	4	3	4		551	1174	0		551	1174	0
ANNUAL		507.8	12.7	17.9	245	1159	288	642.6	524.3	118.3	244	1159	245	1159	18	52.0	34.6	49.4		241	1159	0.0		241	1159	
18	APR	0	0.5	1.2	551	1174	551	36	36	0	515	1173	533	1174	26	4	3	6		510	1173	0		510	1173	0
	MAY	0	0.2	0.3	510	1173	510	110	110	0	400	1168	455	1171	23	5	4	7		393	1168	0		393	1168	0
	JUN	0	0.2	0.3	393	1168	393	97	97	0	297	1163	345	1165	19	9	6	9		297	1162	0		297	1162	0
	JUL	0	0.6	0.9	297	1162	297	75	75	0	212	1157	250	1160	16	7	5	6		207	1157	0		207	1157	0
	AUG	220	2.6	3.7	207	1157	426	78	78	0	349	1166	278	1161	17	5	4	5		347	1166	0		347	1166	0
	SEP	0	0.2	0.3	347	1166	347	66	66	0	281	1162	314	1164	18	5	3	5		276	1161	0		276	1161	0
	OCT	0	0.3	0.4	276	1161	276	70	70	0	206	1157	241	1159	16	4	3	4		203	1157	0		203	1157	0
	NOV	0	0.0	0.0	203	1157	203	13	13	0	190	1156	196	1156	14	2	1	2		188	1156	0		188	1156	0
	DEC	0	1.2	1.4	188	1156	188	14	14	0	174	1155	181	1156	14	1	1	1		174	1155	0		174	1155	0
	JAN	77	1.5	1.8	174	1155	251	12	12	0	240	1159	207	1157	15	2	2	2		240	1159	0		240	1159	0
	FEB	0	0.4	0.6	240	1159	240	15	15	0	225	1158	232	1159	16	2	2	2		223	1158	0		223	1158	0
	MAR	0	1.8	2.2	223	1158	223	57	57	0	167	1155	195	1156	14	4	3	3		166	1154	0		166	1154	0
ANNUAL		297.1	9.5	13.0	300	1163	325	642.6	642.6	0.0	271	1161	286	1162	17	52.0	34.6	52.6		258	1161	0.0		258	1161	

RESERVOIR OPERATION MODEL - MONTHLY BASIS

Gross Storage Acre-ft	646
Dead Storage Acre-ft	97.6

Lake fact: 0.7

Year	Month	Dam Inflow	Rainfall at Dam		Start Values		End St+In	Irrigation			End Values		Average Values			Avg. ET	Lake Evap		Final Values		Spill	End of period values		% Irrigation Shortage
		A-Ft	In	A-Ft	Vol	El		Demand	Releases	Shortage	Vol	El	Vol	El	Area Acres	In	In	A-Ft	Vol	El	A-Ft	Vol	El	
19	APR	0	0.8	0.8	166	1154	166	36	36	0	130	1152	148	1153	12	4	3	3	128	1151	0	128	1151	0
	MAY	0	0.4	0.3	128	1151	128	110	30	80	98	1148	113	1150	10	5	4	3	95	1148	0	95	1148	73
	JUN	0	0.0	0.0	95	1148	95	97	0	97	95	1148	95	1148	9	9	6	5	90	1147	0	90	1147	100
	JUL	4	2.0	1.5	90	1147	94	75	0	75	94	1148	92	1148	9	7	5	4	92	1148	0	92	1148	100
	AUG	0	0.7	0.5	92	1148	92	78	0	78	92	1148	92	1148	9	5	4	3	90	1147	0	90	1147	100
	SEP	0	0.6	0.5	90	1147	90	66	0	66	90	1147	90	1147	9	5	3	2	88	1147	0	88	1147	100
	OCT	0	0.4	0.3	88	1147	88	70	0	70	88	1147	88	1147	9	4	3	2	86	1147	0	86	1147	100
	NOV	0	0.1	0.1	86	1147	86	13	0	13	86	1147	86	1147	9	2	1	1	85	1147	0	85	1147	100
	DEC	0	1.2	0.9	85	1147	85	14	0	14	85	1147	85	1147	9	1	1	1	85	1147	0	85	1147	100
	JAN	1	2.0	1.5	85	1147	87	12	0	12	87	1147	86	1147	9	2	2	1	87	1147	0	87	1147	100
	FEB	34	2.7	2.1	87	1147	121	15	15	0	106	1149	96	1148	9	2	2	1	107	1149	0	107	1149	0
	MAR	0	2.1	1.7	107	1149	107	57	9	48	98	1148	102	1149	10	4	3	2	97	1148	0	97	1148	84
ANNUAL		38.9	13.0	10.2	100	1149	103	642.6	90.0	552.6	96	1148	98	1148	10	52.0	34.6	27.5	94	1148	0.0	94	1148	
20	APR	0	1.0	0.8	97	1148	97	36	0	36	97	1148	97	1148	9	4	3	2	96	1148	0	96	1148	100
	MAY	0	0.7	0.5	96	1148	96	110	0	110	96	1148	96	1148	9	5	4	3	93	1148	0	93	1148	100
	JUN	0	0.1	0.1	93	1148	93	97	0	97	93	1148	93	1148	9	9	6	5	89	1147	0	89	1147	100
	JUL	0	0.4	0.3	89	1147	89	75	0	75	89	1147	89	1147	9	7	5	4	86	1147	0	86	1147	100
	AUG	713	2.9	4.6	86	1147	646	78	78	0	569	1175	327	1165	19	5	4	6	568	1175	0	568	1175	0
	SEP	0	1.6	3.4	568	1175	568	66	66	0	502	1172	535	1174	26	5	3	7	498	1172	0	498	1172	0
	OCT	13	2.1	4.1	498	1172	512	70	70	0	441	1170	470	1171	24	4	3	5	440	1170	0	440	1170	0
	NOV	0	0.3	0.6	440	1170	440	13	13	0	427	1169	434	1170	23	2	1	3	425	1169	0	425	1169	0
	DEC	0	1.8	3.4	425	1169	425	14	14	0	411	1168	418	1169	22	1	1	2	412	1169	0	412	1169	0
	JAN	0	0.4	0.7	412	1169	412	12	12	0	401	1168	407	1168	22	2	2	3	399	1168	0	399	1168	0
	FEB	0	2.1	3.8	399	1168	399	15	15	0	384	1167	391	1168	21	2	2	3	384	1167	0	384	1167	0
	MAR	1005	5.6	11.4	384	1167	646	57	57	0	590	1176	487	1172	25	4	3	5	596	1176	0	596	1176	0
ANNUAL		1731.6	19.0	33.7	299	1163	369	642.6	325.1	317.5	342	1165	320	1164	19	52.0	34.6	46.3	341	1165	0.0	341	1165	
21	APR	0	2.3	5.2	596	1176	596	36	36	0	560	1175	578	1175	27	4	3	7	559	1175	0	559	1175	0
	MAY	216	2.8	6.1	559	1175	646	110	110	0	536	1174	548	1174	26	5	4	8	535	1174	0	535	1174	0
	JUN	0	1.4	2.8	535	1174	535	97	97	0	438	1170	486	1172	24	9	6	12	429	1169	0	429	1169	0
	JUL	0	0.5	0.9	429	1169	429	75	75	0	354	1166	391	1168	21	7	5	8	346	1165	0	346	1165	0
	AUG	0	0.8	1.2	346	1165	346	78	78	0	269	1161	308	1163	18	5	4	5	265	1161	0	265	1161	0
	SEP	0	0.2	0.3	265	1161	265	66	66	0	198	1157	231	1159	16	5	3	4	194	1156	0	194	1156	0
	OCT	0	0.1	0.1	194	1156	194	70	70	0	124	1151	159	1154	13	4	3	3	121	1151	0	121	1151	0
	NOV	0	0.1	0.1	121	1151	121	13	13	0	108	1149	115	1150	10	2	1	1	107	1149	0	107	1149	0
	DEC	0	0.2	0.2	107	1149	107	14	9	5	98	1148	102	1149	10	1	1	1	97	1148	0	97	1148	35
	JAN	480	3.3	5.3	97	1148	577	12	12	0	565	1175	331	1165	19	2	2	2	568	1175	0	568	1175	0
	FEB	4	2.4	5.4	568	1175	572	15	15	0	557	1174	562	1175	27	2	2	4	558	1175	0	558	1175	0
	MAR	217	4.5	10.1	558	1175	646	57	57	0	590	1176	574	1175	27	4	3	6	594	1176	0	594	1176	0
ANNUAL		916.8	18.6	37.6	365	1166	419	642.6	637.5	5.1	366	1166	365	1166	20	52.0	34.6	60.8	364	1166	0.0	364	1166	

RESERVOIR OPERATION MODEL - MONTHLY BASIS

Gross Storage Acre-ft	646
Dead Storage Acre-ft	97.6

Lake fact	0.7

Year	Month	Dam Inflow	Rainfall at Dam		Start Values		End St+In	Irrigation			End Values		Average Values			Avg. ET	Lake Evap		Final Values		Spill	End of period values		% Irrigation Shortage
		A-Ft	In	A-Ft	Vol	El		Demand	Releases	Shortage	Vol	El	Vol	El	Area Acres	In	In	A-Ft	Vol	El	A-Ft	Vol	El	
22	APR	214	2.9	6.6	594	1176	646	36	36	0	611	1177	602	1176	26	4	3	7	610	1177	0	610	1177	0
	MAY	0	2.3	5.2	610	1177	610	110	110	0	501	1172	555	1174	26	5	4	8	498	1172	0	498	1172	0
	JUN	0	0.1	0.2	498	1172	498	97	97	0	401	1168	449	1170	23	9	6	11	390	1167	0	390	1167	0
	JUL	0	0.2	0.3	390	1167	390	75	75	0	315	1164	352	1166	20	7	5	8	307	1163	0	307	1163	0
	AUG	886	4.1	7.7	307	1163	646	78	78	0	569	1175	438	1170	23	5	4	7	570	1175	0	570	1175	0
	SEP	0	1.1	2.3	570	1175	570	66	66	0	503	1172	536	1174	26	5	3	7	498	1172	0	498	1172	0
	OCT	0	0.7	1.4	498	1172	498	70	70	0	428	1169	463	1171	24	4	3	5	424	1169	0	424	1169	0
	NOV	0	0.0	0.0	424	1169	424	13	13	0	411	1168	418	1169	22	2	1	2	409	1168	0	409	1168	0
	DEC	1	1.3	2.3	409	1168	410	14	14	0	396	1168	402	1168	22	1	1	2	396	1168	0	396	1168	0
	JAN	0	1.4	2.5	396	1168	396	12	12	0	385	1167	390	1168	21	2	2	3	385	1167	0	385	1167	0
	FEB	0	0.6	1.0	385	1167	385	15	15	0	369	1167	377	1167	21	2	2	3	368	1166	0	368	1166	0
	MAR	1448	7.0	14.2	368	1166	646	57	57	0	590	1176	479	1172	24	4	3	5	599	1176	0	599	1176	0
ANNUAL		2549.7	21.6	43.6	454	1170	510	642.6	642.6	0.0	456	1171	455	1171	23	52.0	34.6	67.7	454	1170	0.0	454	1170	
23	APR	0	1.4	3.1	599	1176	599	36	36	0	563	1175	581	1175	27	4	3	7	560	1175	0	560	1175	0
	MAY	0	0.5	1.0	560	1175	560	110	110	0	450	1170	505	1173	25	5	4	7	443	1170	0	443	1170	0
	JUN	51	2.3	4.2	443	1170	494	97	97	0	397	1168	420	1169	22	9	6	11	391	1168	0	391	1168	0
	JUL	0	2.3	3.8	391	1168	391	75	75	0	316	1164	353	1166	20	7	5	8	312	1164	0	312	1164	0
	AUG	0	0.0	0.0	312	1164	312	78	78	0	234	1159	273	1161	17	5	4	5	229	1158	0	229	1158	0
	SEP	221	2.2	3.3	229	1158	450	66	66	0	384	1167	306	1163	18	5	3	5	382	1167	0	382	1167	0
	OCT	0	0.4	0.7	382	1167	382	70	70	0	312	1164	347	1165	19	4	3	4	308	1163	0	308	1163	0
	NOV	0	0.4	0.6	308	1163	308	13	13	0	295	1163	302	1163	18	2	1	2	294	1162	0	294	1162	0
	DEC	0	0.0	0.0	294	1162	294	14	14	0	279	1162	288	1162	17	1	1	1	278	1161	0	278	1161	0
	JAN	0	0.7	0.9	278	1161	278	12	12	0	266	1161	272	1161	17	2	2	2	265	1161	0	265	1161	0
	FEB	301	3.1	5.5	265	1161	566	15	15	0	551	1174	408	1168	22	2	2	3	554	1174	0	554	1174	0
	MAR	0	2.4	5.0	554	1174	554	57	57	0	497	1172	526	1173	26	4	3	5	497	1172	0	497	1172	0
ANNUAL		573.3	15.5	28.2	384	1167	432	642.6	642.6	0.0	379	1167	382	1167	21	52.0	34.6	60.9	376	1167	0.0	376	1167	
24	APR	326	3.1	6.9	497	1172	646	36	36	0	611	1177	554	1174	26	4	3	6	611	1177	0	611	1177	0
	MAY	0	1.0	2.2	611	1177	611	110	110	0	501	1172	556	1174	26	5	4	8	495	1172	0	495	1172	0
	JUN	0	0.6	1.1	495	1172	495	97	97	0	399	1168	447	1170	23	9	6	11	388	1167	0	388	1167	0
	JUL	636	6.4	12.9	388	1167	646	75	75	0	571	1175	460	1172	24	7	5	10	575	1175	0	575	1175	0
	AUG	0	1.5	3.2	575	1175	575	78	78	0	497	1172	536	1174	26	5	4	8	493	1172	0	493	1172	0
	SEP	216	2.2	4.7	493	1172	646	66	66	0	580	1175	536	1174	26	5	3	7	578	1175	0	578	1175	0
	OCT	4	2.2	4.6	578	1175	581	70	70	0	511	1173	544	1174	26	4	3	6	510	1173	0	510	1173	0
	NOV	0	0.0	0.1	510	1173	510	13	13	0	497	1172	503	1172	25	2	1	3	494	1172	0	494	1172	0
	DEC	0	2.2	4.6	494	1172	494	14	14	0	480	1172	487	1172	25	1	1	2	482	1172	0	482	1172	0
	JAN	0	0.0	0.0	482	1172	482	12	12	0	471	1171	476	1171	24	2	2	3	468	1171	0	468	1171	0
	FEB	0	2.2	4.3	468	1171	468	15	15	0	452	1170	460	1171	24	2	2	3	454	1170	0	454	1170	0
	MAR	826	5.4	11.4	454	1170	646	57	57	0	590	1176	522	1173	25	4	3	5	596	1176	0	596	1176	0
ANNUAL		2007.8	26.8	56.2	504	1173	567	642.6	642.6	0.0	513	1173	508	1173	25	52.0	34.6	72.2	512	1173	0.0	512	1173	

RESERVOIR OPERATION MODEL - MONTHLY BASIS

Gross Storage Acre-ft	646
Lake fact 0.7 / Dead Storage Acre-ft	97.6

Year	Month	Dam Inflow	Rainfall at Dam		Start Values		End St+In	Irrigation			End Values		Average Values			Avg. ET	Lake Evap		Final Values		Spill	End of period values		% Irrigation Shortage
		A-Ft	In	A-Ft	Vol	El		Demand	Releases	Shortage	Vol	El	Vol	El	Area Acres	In	In	A-Ft	Vol	El	A-Ft	Vol	El	
25	APR	246	4.5	10.4	596	1176	646	36	36	0	611	1177	603	1176	28	4	3	7	614	1177	0	614	1177	0
	MAY	0	1.1	2.4	614	1177	614	110	110	0	504	1173	559	1175	27	5	4	8	499	1172	0	499	1172	0
	JUN	0	0.0	0.1	499	1172	499	97	97	0	402	1168	450	1170	23	9	6	11	391	1168	0	391	1168	0
	JUL	700	3.9	7.9	391	1168	646	75	75	0	571	1175	481	1172	24	7	5	10	570	1175	0	570	1175	0
	AUG	342	3.6	8.0	570	1175	646	78	78	0	569	1175	569	1175	27	5	4	8	569	1175	0	569	1175	0
	SEP	252	2.6	5.8	569	1175	646	66	66	0	580	1175	574	1175	27	5	3	7	578	1175	0	578	1175	0
	OCT	0	0.5	1.1	578	1175	578	70	70	0	508	1173	543	1174	26	4	3	6	503	1172	0	503	1172	0
	NOV	0	0.5	1.1	503	1172	503	13	13	0	490	1172	497	1172	25	2	1	3	489	1172	0	489	1172	0
	DEC	0	0.1	0.2	489	1172	489	14	14	0	474	1171	481	1172	24	1	1	2	472	1171	0	472	1171	0
	JAN	0	1.1	2.3	472	1171	472	12	12	0	461	1171	467	1171	24	2	2	3	460	1171	0	460	1171	0
	FEB	6	3.4	6.7	460	1171	466	15	15	0	451	1170	455	1171	23	2	2	3	454	1170	0	454	1170	0
	MAR	0	2.5	4.6	454	1170	454	57	57	0	398	1168	426	1169	22	4	3	5	398	1168	0	398	1168	0
ANNUAL		1545.3	23.8	50.5	516	1173	555	642.6	642.6	0.0	502	1172	509	1173	25	52.0	34.6	72.5	500	1172	0.0	500	1172	
26	APR	0	1.5	2.6	398	1168	398	36	36	0	362	1166	380	1167	21	4	3	5	359	1166	0	359	1166	0
	MAY	0	0.6	0.9	359	1166	359	110	110	0	249	1160	304	1163	18	5	4	5	245	1159	0	245	1159	0
	JUN	0	0.5	0.6	245	1159	245	97	97	0	148	1153	196	1156	14	9	6	7	142	1153	0	142	1153	0
	JUL	0	0.7	0.8	142	1153	142	75	44	31	98	1148	120	1151	10	7	5	4	94	1148	0	94	1148	41
	AUG	792	4.3	6.8	94	1148	646	78	78	0	569	1175	331	1165	19	5	4	6	570	1175	0	570	1175	0
	SEP	48	2.0	4.4	570	1175	618	66	66	0	552	1174	561	1175	27	5	3	7	549	1174	0	549	1174	0
	OCT	2446	8.0	17.7	549	1174	646	70	70	0	576	1175	562	1175	27	4	3	6	588	1176	0	588	1176	0
	NOV	162	1.7	3.9	588	1176	646	13	13	0	633	1177	611	1177	28	2	1	3	634	1177	0	634	1177	0
	DEC	0	0.0	0.0	634	1177	634	14	14	0	620	1177	627	1177	28	1	1	2	617	1177	0	617	1177	0
	JAN	0	0.6	1.5	617	1177	617	12	12	0	606	1176	611	1177	28	2	2	4	604	1176	0	604	1176	0
	FEB	0	1.1	2.6	604	1176	604	15	15	0	588	1176	596	1176	28	2	2	4	587	1176	0	587	1176	0
	MAR	0	1.6	3.6	587	1176	587	57	57	0	531	1174	559	1175	27	4	3	6	529	1173	0	529	1173	0
ANNUAL		3467.7	22.6	45.1	449	1170	512	642.6	611.6	31.1	461	1171	455	1171	23	52.0	34.6	58.7	460	1171	0.0	460	1171	
27	APR	413	5.3	11.9	529	1173	646	36	36	0	611	1177	570	1175	27	4	3	7	616	1177	0	616	1177	0
	MAY	0	1.1	2.5	616	1177	616	110	110	0	506	1173	561	1175	27	5	4	8	501	1172	0	501	1172	0
	JUN	0	1.5	2.9	501	1172	501	97	97	0	404	1168	452	1170	23	9	6	11	395	1168	0	395	1168	0
	JUL	0	1.4	2.2	395	1168	395	75	75	0	320	1164	358	1166	20	7	5	8	315	1164	0	315	1164	0
	AUG	0	0.5	0.7	315	1164	315	78	78	0	237	1159	276	1161	17	5	4	5	233	1159	0	233	1159	0
	SEP	0	0.5	0.6	233	1159	233	66	66	0	166	1155	200	1157	15	5	3	4	163	1154	0	163	1154	0
	OCT	229	2.5	3.3	163	1154	392	70	70	0	322	1164	242	1159	16	4	3	4	322	1164	0	322	1164	0
	NOV	0	0.3	0.5	322	1164	322	13	13	0	309	1163	315	1164	18	2	1	2	307	1163	0	307	1163	0
	DEC	0	0.9	1.4	307	1163	307	14	14	0	293	1162	300	1163	18	1	1	1	293	1162	0	293	1162	0
	JAN	0	1.8	2.6	293	1162	293	12	12	0	281	1162	287	1162	17	2	2	2	282	1162	0	282	1162	0
	FEB	447	5.7	11.1	282	1162	646	15	15	0	631	1177	456	1171	24	2	2	3	639	1178	0	639	1178	0
	MAR	77	2.6	6.2	639	1178	646	57	57	0	590	1176	615	1177	28	4	3	6	590	1176	0	590	1176	0
ANNUAL		1167.2	24.1	46.0	383	1167	443	642.6	642.6	0.0	389	1167	386	1167	21	52.0	34.6	61.2	388	1167	0.0	388	1167	

RESERVOIR OPERATION MODEL - MONTHLY BASIS

Gross Storage Acre-ft	646
Dead Storage Acre-ft	97.6
Lake fact	0.7

Year	Month	Dam Inflow	Rainfall at Dam		Start Values		End St+In	Irrigation			End Values		Average Values			Avg. ET	Lake Evap		Final Values		Spill	End of period values		% Irrigation Shortage
		A-Ft	In	A-Ft	Vol	El		Demand	Releases	Shortage	Vol	El	Vol	El	Area Acres	In	In	A-Ft	Vol	El	A-Ft	Vol	El	
28	APR	161	2.7	6.3	590	1176	646	36	36	0	611	1177	600	1176	28	4	3	7	610	1177	0	610	1177	0
	MAY	0	1.4	3.1	610	1177	610	110	110	0	500	1172	555	1174	26	5	4	8	495	1172	0	495	1172	0
	JUN	0	1.6	3.1	495	1172	495	97	97	0	399	1168	447	1170	23	9	6	11	390	1168	0	390	1168	0
	JUL	7	3.3	5.5	390	1168	397	75	75	0	322	1164	356	1166	20	7	5	8	320	1164	0	320	1164	0
	AUG	252	2.4	4.4	320	1164	572	78	78	0	494	1172	407	1168	22	5	4	6	492	1172	0	492	1172	0
	SEP	0	0.8	1.7	492	1172	492	66	66	0	426	1169	459	1171	24	5	3	6	421	1169	0	421	1169	0
	OCT	0	0.2	0.3	421	1169	421	70	70	0	351	1166	386	1167	21	4	3	5	346	1165	0	346	1165	0
	NOV	0	0.0	0.0	346	1165	346	13	13	0	333	1165	340	1165	19	2	1	2	331	1165	0	331	1165	0
	DEC	0	0.0	0.0	331	1165	331	14	14	0	317	1164	324	1164	19	1	1	2	315	1164	0	315	1164	0
	JAN	314	5.9	11.8	315	1164	629	12	12	0	618	1177	466	1171	24	2	2	3	626	1177	0	626	1177	0
	FEB	0	1.1	2.6	626	1177	626	15	15	0	611	1177	619	1177	25	2	2	4	610	1177	0	610	1177	0
	MAR	96	2.9	6.7	610	1177	646	57	57	0	590	1176	600	1176	28	4	3	6	591	1176	0	591	1176	0
ANNUAL		829.6	22.5	45.4	462	1171	518	642.6	642.6	0.0	464	1171	463	1171	24	52.0	34.6	67.6	462	1171	0.0	462	1171	
29	APR	0	0.0	0.0	591	1176	591	36	36	0	555	1174	573	1175	27	4	3	7	548	1174	0	548	1174	0
	MAY	0	0.3	0.5	548	1174	548	110	110	0	438	1170	493	1172	25	5	4	7	432	1169	0	432	1169	0
	JUN	264	1.9	3.9	432	1169	646	97	97	0	550	1174	491	1172	25	9	6	12	541	1174	0	541	1174	0
	JUL	0	1.0	2.0	541	1174	541	75	75	0	466	1171	504	1173	25	7	5	10	459	1171	0	459	1171	0
	AUG	0	1.9	3.5	459	1171	459	78	78	0	381	1167	420	1169	22	5	4	7	378	1167	0	378	1167	0
	SEP	0	0.2	0.3	378	1167	378	66	66	0	311	1164	345	1165	19	5	3	5	306	1163	0	306	1163	0
	OCT	0	0.0	0.1	306	1163	306	70	70	0	236	1159	271	1161	17	4	3	4	232	1159	0	232	1159	0
	NOV	0	0.9	1.2	232	1159	232	13	13	0	219	1158	226	1158	15	2	1	2	219	1158	0	219	1158	0
	DEC	0	0.0	0.0	219	1158	219	14	14	0	204	1157	212	1157	15	1	1	1	203	1157	0	203	1157	0
	JAN	42	2.2	2.8	203	1157	245	12	12	0	233	1159	218	1158	15	2	2	2	234	1159	0	234	1159	0
	FEB	0	1.6	2.0	234	1159	234	15	15	0	219	1158	227	1158	15	2	2	2	219	1158	0	219	1158	0
	MAR	0	1.2	1.4	219	1158	219	57	57	0	162	1154	191	1156	14	4	3	3	161	1154	0	161	1154	0
ANNUAL		305.3	11.1	17.6	363	1166	385	642.6	642.6	0.0	331	1165	347	1166	19	52.0	34.6	61.4	328	1165	0.0	328	1165	
30	APR	0	0.2	0.2	161	1154	161	36	36	0	125	1151	143	1153	12	4	3	3	122	1151	0	122	1151	0
	MAY	0	0.5	0.4	122	1151	122	110	25	85	98	1148	110	1150	10	5	4	3	95	1148	0	95	1148	78
	JUN	0	0.5	0.4	95	1148	95	97	0	97	95	1148	95	1148	9	9	6	5	91	1148	0	91	1148	100
	JUL	0	0.4	0.3	91	1148	91	75	0	75	91	1148	91	1148	9	7	5	4	88	1147	0	88	1147	100
	AUG	0	0.6	0.4	88	1147	88	78	0	78	88	1147	88	1147	9	5	4	3	85	1147	0	85	1147	100
	SEP	0	1.8	1.4	85	1147	85	66	0	66	85	1147	85	1147	9	5	3	2	84	1147	0	84	1147	100
	OCT	0	0.4	0.3	84	1147	84	70	0	70	84	1147	84	1147	9	4	3	2	83	1146	0	83	1146	100
	NOV	0	0.0	0.0	83	1146	83	13	0	13	83	1146	83	1146	9	2	1	1	82	1146	0	82	1146	100
	DEC	0	0.9	0.6	82	1146	82	14	0	14	82	1146	82	1146	9	1	1	1	81	1146	0	81	1146	100
	JAN	0	0.0	0.0	81	1146	81	12	0	12	81	1146	81	1146	9	2	2	1	80	1146	0	80	1146	100
	FEB	3155	8.2	13.5	80	1146	646	15	15	0	631	1177	356	1166	20	2	2	3	642	1178	0	642	1178	0
	MAR	0	0.3	0.8	642	1178	642	57	57	0	586	1176	614	1177	28	4	3	6	580	1175	0	580	1175	0
ANNUAL		3154.7	13.7	18.3	141	1152	188	642.6	132.1	510.5	177	1155	159	1154	13	52.0	34.6	32.4	176	1155	0.0	176	1155	

RESERVOIR OPERATION MODEL - MONTHLY BASIS

Gross Storage Acre-ft	646
Dead Storage Acre-ft	97.6

Year	Month	Dam Inflow	Rainfall at Dam		Start Values		End St+In	Irrigation			End Values		Average Values			Avg. ET	Lake Evap (Lake fact 0.7)		Final Values		Spill	End of period values		% Irrigation Shortage
		A-Ft	In	A-Ft	Vol	El		Demand	Releases	Shortage	Vol	El	Vol	El	Area Acres	In	In	A-Ft	Vol	El	A-Ft	Vol	El	
31	APR	0	1.7	3.7	580	1175	580	36	36	0	545	1174	563	1175	27	4	3	7	542	1174	0	542	1174	0
	MAY	0	0.7	1.5	542	1174	542	110	110	0	432	1169	487	1172	25	5	4	7	426	1169	0	426	1169	0
	JUN	0	1.4	2.5	426	1169	426	97	97	0	329	1165	378	1167	21	9	6	10	322	1164	0	322	1164	0
	JUL	0	2.0	2.8	322	1164	322	75	75	0	247	1160	284	1162	17	7	5	7	243	1159	0	243	1159	0
	AUG	0	1.5	1.9	243	1159	243	78	78	0	165	1154	204	1157	15	5	4	4	163	1154	0	163	1154	0
	SEP	0	0.7	0.6	163	1154	163	66	65	2	98	1148	130	1152	11	5	3	3	95	1148	0	95	1148	2
	OCT	0	0.0	0.0	95	1148	95	70	0	70	95	1148	95	1148	9	4	3	2	93	1148	0	93	1148	100
	NOV	0	0.9	0.7	93	1148	93	13	0	13	93	1148	93	1148	9	2	1	1	93	1148	0	93	1148	100
	DEC	0	0.0	0.0	93	1148	93	14	0	14	93	1148	93	1148	9	1	1	1	92	1148	0	92	1148	100
	JAN	0	0.1	0.1	92	1148	92	12	0	12	92	1148	92	1148	9	2	2	1	91	1148	0	91	1148	100
	FEB	70	3.0	2.6	91	1148	161	15	15	0	146	1153	118	1150	10	2	2	1	147	1153	0	147	1153	0
	MAR	70	2.9	3.0	147	1153	216	57	57	0	160	1154	153	1153	12	4	3	3	160	1154	0	160	1154	0
ANNUAL		139.3	14.9	19.4	241	1159	252	642.6	631.8	110.9	208	1157	224	1158	15	52.0	34.6	47.1	206	1157	0.0	206	1157	
32	APR	0	0.9	0.9	160	1154	160	36	36	0	124	1151	142	1153	12	4	3	3	122	1151	0	122	1151	0
	MAY	0	0.2	0.2	122	1151	122	110	25	85	98	1148	110	1150	10	5	4	3	95	1148	0	95	1148	77
	JUN	0	2.1	1.6	95	1148	95	97	0	97	95	1148	95	1148	9	9	6	5	92	1148	0	92	1148	100
	JUL	0	0.0	0.0	92	1148	92	75	0	75	92	1148	92	1148	9	7	5	4	88	1147	0	88	1147	100
	AUG	0	0.0	0.0	88	1147	88	78	0	78	88	1147	88	1147	9	5	4	3	86	1147	0	86	1147	100
	SEP	0	0.8	0.6	86	1147	86	66	0	66	86	1147	86	1147	9	5	3	2	84	1147	0	84	1147	100
	OCT	0	0.1	0.1	84	1147	84	70	0	70	84	1147	84	1147	9	4	3	2	82	1146	0	82	1146	100
	NOV	0	0.2	0.2	82	1146	82	13	0	13	82	1146	82	1146	9	2	1	1	81	1146	0	81	1146	100
	DEC	0	1.5	1.1	81	1146	81	14	0	14	81	1146	81	1146	9	1	1	1	81	1146	0	81	1146	100
	JAN	1	1.3	0.9	81	1146	82	12	0	12	82	1146	82	1146	9	2	2	1	82	1146	0	82	1146	100
	FEB	935	6.4	10.5	82	1146	646	15	15	0	631	1177	357	1166	20	2	2	3	639	1178	0	639	1178	0
	MAR	0	1.4	3.3	639	1178	639	57	57	0	583	1175	611	1177	28	4	3	6	580	1175	0	580	1175	0
ANNUAL		935.8	14.9	19.3	141	1152	188	642.6	132.3	510.3	177	1155	159	1154	13	52.0	34.6	32.4	176	1155	0.0	176	1155	
33	APR	846	5.1	11.7	580	1175	646	36	36	0	611	1177	595	1176	28	4	3	7	616	1177	0	616	1177	0
	MAY	0	0.9	2.0	616	1177	616	110	110	0	506	1173	561	1175	27	5	4	8	500	1172	0	500	1172	0
	JUN	0	0.4	0.8	500	1172	500	97	97	0	403	1168	451	1170	23	9	6	11	392	1168	0	392	1168	0
	JUL	1340	6.1	12.5	392	1168	646	75	75	0	571	1175	482	1172	24	7	5	10	574	1175	0	574	1175	0
	AUG	905	4.5	10.1	574	1175	646	78	78	0	569	1175	572	1175	27	5	4	8	571	1175	0	571	1175	0
	SEP	1100	4.4	9.8	571	1175	646	66	66	0	580	1175	575	1175	27	5	3	7	582	1175	0	582	1175	0
	OCT	961	2.8	6.2	582	1175	646	70	70	0	576	1175	579	1175	27	4	3	6	576	1175	0	576	1175	0
	NOV	112	1.7	3.8	576	1175	646	13	13	0	633	1177	605	1176	28	2	1	3	634	1177	0	634	1177	0
	DEC	0	0.7	1.8	634	1177	634	14	14	0	620	1177	627	1177	28	1	1	2	619	1177	0	619	1177	0
	JAN	223	4.3	10.2	619	1177	646	12	12	0	635	1177	627	1177	28	2	2	4	641	1178	0	641	1178	0
	FEB	941	3.7	8.8	641	1178	646	15	15	0	631	1177	636	1178	29	2	2	4	636	1177	0	636	1177	0
	MAR	0	0.0	0.0	636	1177	636	57	57	0	580	1175	608	1176	28	4	3	6	574	1175	0	574	1175	0
ANNUAL		6429.1	34.5	77.6	577	1175	630	642.6	642.6	0.0	576	1175	576	1175	27	52.0	34.6	75.8	576	1175	0.0	576	1175	

RESERVOIR OPERATION MODEL - MONTHLY BASIS

Gross Storage Acre-ft	646
Dead Storage Acre-ft	97.6

Lake fact	0.7

Year	Month	Dam Inflow	Rainfall at Dam		Start Values		End St+In	Irrigation			End Values		Average Values			Avg. ET	Lake Evap		Final Values		Spill	End of period values		% Irrigation Shortage
		A-Ft	In	A-Ft	Vol	El		Demand	Releases	Shortage	Vol	El	Vol	El	Area Acres	In	In	A-Ft	Vol	El	A-Ft	Vol	El	
34	APR	200	2.4	5.4	574	1175	646	36	36	0	611	1177	592	1176	27	4	3	7	609	1176	0	609	1176	0
	MAY	0	0.0	0.0	609	1176	609	110	110	0	499	1172	554	1174	26	5	4	8	491	1172	0	491	1172	0
	JUN	0	0.0	0.0	491	1172	491	97	97	0	395	1168	443	1170	23	9	8	11	383	1167	0	383	1167	0
	JUL	0	0.6	1.0	383	1167	383	75	75	0	308	1163	346	1165	19	7	5	8	302	1163	0	302	1163	0
	AUG	1	2.2	3.1	302	1163	302	78	78	0	225	1158	263	1161	17	5	4	5	223	1158	0	223	1158	0
	SEP	0	1.4	1.6	223	1158	223	66	66	0	157	1154	190	1156	14	5	3	4	154	1154	0	154	1154	0
	OCT	0	1.7	1.5	154	1154	154	70	57	14	98	1148	126	1151	11	4	3	2	97	1148	0	97	1148	19
	NOV	0	0.6	0.5	97	1148	97	13	0	13	97	1148	97	1148	9	2	1	1	96	1148	0	96	1148	100
	DEC	0	0.9	0.7	96	1148	96	14	0	14	96	1148	96	1148	9	1	1	1	96	1148	0	96	1148	100
	JAN	1019	5.0	8.5	96	1148	646	12	12	0	635	1177	366	1166	20	2	2	3	641	1178	0	641	1178	0
	FEB	387	5.2	12.4	641	1178	646	15	15	0	631	1177	636	1177	29	2	2	4	640	1178	0	640	1178	0
	MAR	634	5.9	13.9	640	1178	646	57	57	0	590	1176	615	1177	28	4	3	6	598	1176	0	598	1176	0
ANNUAL		2239.7	26.1	48.7	359	1166	412	642.6	601.5	41.1	362	1166	360	1166	20	52.0	34.6	58.8	361	1166	0.0	361	1166	
35	APR	0	1.1	2.4	598	1176	598	36	36	0	562	1175	580	1175	27	4	3	7	558	1175	0	558	1175	0
	MAY	0	1.9	4.0	558	1175	558	110	110	0	448	1170	503	1172	25	5	4	7	444	1170	0	444	1170	0
	JUN	0	0.0	0.0	444	1170	444	97	97	0	348	1166	396	1168	21	9	6	10	337	1165	0	337	1165	0
	JUL	0	0.8	1.2	337	1165	337	75	75	0	262	1161	300	1163	18	7	5	7	256	1160	0	256	1160	0
	AUG	0	1.0	1.2	256	1160	256	78	78	0	179	1155	218	1158	15	5	4	5	176	1155	0	176	1155	0
	SEP	205	2.6	3.5	176	1155	381	66	66	0	314	1164	245	1159	16	5	3	4	313	1164	0	313	1164	0
	OCT	0	0.2	0.3	313	1164	313	70	70	0	243	1159	278	1162	17	4	3	4	240	1159	0	240	1159	0
	NOV	0	0.8	1.0	240	1159	240	13	13	0	226	1158	233	1159	16	2	1	2	226	1158	0	226	1158	0
	DEC	0	0.0	0.0	226	1158	226	14	14	0	211	1157	219	1158	15	1	1	1	210	1157	0	210	1157	0
	JAN	52	2.7	3.5	210	1157	262	12	12	0	250	1160	230	1159	16	2	2	2	252	1160	0	252	1160	0
	FEB	0	1.0	1.4	252	1160	252	15	15	0	236	1159	244	1159	16	2	2	2	236	1159	0	236	1159	0
	MAR	0	2.4	2.9	236	1159	236	57	57	0	179	1155	207	1157	15	4	3	3	179	1155	0	179	1155	0
ANNUAL		256.6	14.5	21.5	320	1164	342	642.6	642.6	0.0	288	1162	304	1163	18	52.0	34.6	54.5	286	1162	0.0	286	1162	

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GEOLOGY & GEOTECHNICS

1.1 General

This chapter deals with the studies regarding the geological and geotechnical conditions of the region. For review report the following literatures and reports were studied

- Pre-feasibility report of Shah Kaleem dam site proposed by SAK Consultants
- Geological Map of Pakistan by Ahmad Hussain 1984.
- Stratigraphy of Pakistan 1980

The Shah Kaleem Dam is located about 9 Km South of village Shaidu in Nowshera District. The stream name is Pitao Khwar. Shah Kaleem Khwar is the main stream of the area which is a tributary of River Kabul. The command area is situated at the left side of the proposed dam site. The command area is composed of Quaternary deposits.

Detail surface and subsurface geological conditions of the site will be known after geological mapping, geophysical survey, drilling and from field and Laboratory investigation.

1.1.1 Topography and Geomorphology

Physiographically the proposed Shah Kaleem Dam site area is situated where the mountains are medium high and become high at east. Flood plains of Nowshera are present in the north-east. River Kabul runs parallel to these plains. The irrigated area is composed of Quaternary deposits. The elevation of reservoir is 1501 ft AMS. Climatically the area lies in the region characterized by cold in the winter and very hot in the summer.

1.2 Regional Geology

Attock-Cherat ranges form an important tectonic segment of the North Western Himalayas. The main rock units being comprised of slates, Phyllites quartzite and limestone which representing tectonic setup. It is traversed by Main Mantle Thrust (MMT) to the north and Main boundary Thrust (MBT) to the south of the area.

The Attock-Cherat range consists of the three east-west trending thrust bounded blocks. Those are folded and dip generally towards the north. The metamorphosed Paleozoic Sequence of the range is faulted against the un-metamorphosed Mesozoic and early Cenozoic strata of the Kalachitta range. The contact between the Paleozoic rocks of the Nowshera and the Precambrian rocks of the Attock-Cherat range is concealed under quaternary cover. Three major faults named the Khairabad thrust, Cherat thrust and Hisarthang thrust dominate the structure of the area.

The similarity of tertiary sequence in the Kalachitta range and southern and central blocks of Attock-cherat range demonstrate that the pre-Paleocene sequence was just apposed by the

Hisarthang and Cherat faults prior to the deposition of Paleocene Lockhart limestone and the contrast between the older rocks argue for large pre-Paleocene displacement.

1.3 Stratigraphy

The stratigraphic units of rocks exposed in the region are as under:

Manki Formation

It is the oldest Formation and crops out mainly in the northern foothills of the Attock-Cherat Range. It consists of dark gray to black, thin bedded argillite sericite bearing slate, Phyllites and subordinate lenses of limestone.

Shahkot and Utch Khattak Formation ((undivided))

It consists of light yellowish-gray to brownish –gray limestone and dark gray argillite overlain by dark gray rubbly stromatolitic limestone

Shakhai Formation

It is dominated by light gray, medium to thick bedded and massive limestone with subordinate quartzite and argillite at the base.

Manki Formation

It consists of a thick sequence of argillite, sandstone and subordinate limestone.

1.4.1 Paleozoic

Ambar Formation

It is the oldest Formation exposed in the Nowshera area. The principal lithology is light gray to brownish-gray thin to medium bedded dolomite

Misri Banda Quartzite

It consists of light gray pinkish-gray feldspathic quartzite with subordinate argillinte.

Panjpir Formation

It is composed of predominantly of argillite and Phyllites with lenses and interbeds of crinoidal limestone and quartzite.

Nowshera Formation

It is composed of pinkish-gray thin to medium bedded and massive limestone, dolomite and carbonate cemented sandstone and quartzite.

Darwaza Formation

It is the oldest Formation exposed on the southern slopes on the Attock-Cherat Range.

Hisartang Formation

It consists of upper and lower quartzite and intervening argillite.

Inzari Formation

It is light yellowish-gray to light greenish-gray, finely crystalline and thin to thick bedded.

1.4 .2 Mesozoic

Mianwali, Chak jabbi and kingriali Formation ((undivided))

It consists of light ray to yellowish-gray limestone, marl, dolomite, and micritc limestone.

Datta, shenawari and Samana Suk Formation (undivided)

It consists of limestone, calcareous sandstone, shale and marl

Samana Suk Formation

It consists of limestone and calcareous sandstone. The lime stone is yellowish-gray to dark gray, medium to thick bedded and partly argillaceous.

Chichali and Lumshiwal Formation (undivided)

It consists of dark gray to greenish-gray glauconitic sandstone and shale overlain by brownish-gray to greenish –gray quarzose sandstone glauconitic sandstone and limestone.

Kawagarh Formation

It consists of marl with subordinate interbedded limestone

1.4 .3 Cenozoic

Hangu Formation and Lockhart Limestone (undivided)

It consists of light gray, brownish-gray to black sandstone and shale brownish-gray medium bedded limestone overlain light gray to dark gray nodular limestone.

Lockhart Limestone

It is light gray to dark gray, medium to thick bedded massive, nodular and resistant. Intercalation of dark gray to black, thinly laminated shale occurs locally.

Patala Formation

It consists of interblended shale and limestone with subordinate sandstone

Murree Formation

It consists of interblended sandstone, siltstone and shale. The sandstone and siltstone are red, purple, greenish-gray and thin to medium bedded, fissile and readily weathered to clay-covered slope

Lacustrine, Deltaic and Fluvial Deposits

Lacustrine, Deltaic and Fluvial Deposits are found in parts of Peshawar and Attock basins.

Loess Deposits (Ql) of Sup-Recent to Recent age composed of reworked clay and silt with a thin gravel cover.

Flood plain Deposits (Qf) of Sub-Recent to recent age are part of the flood plain of the Indus and Kabul Rivers and comprise sand and gravel with subordinate clay and silt.

Alluvial Fan Deposits (Qaf) of Sub-Recent to recent age composed of clay silt sand and gravel. These are characterized by the presence of coarser material down slope.

Stream Channel Deposits (Qal) of recent age consist of varying amount of gravels, sand, silt and clay material.

1.5 Geology of the Project Area

Stratigraphy

Manki Formation is the oldest lithological unit and is confined mainly to the northern foothills of the Attock–Cherat Ranges. It consists of slate with subordinate lenses of limestone. The slate is dark gray to black, thin bedded and show weak cleavage parallel and oblique to the bedding planes. Hydrothermal quartz veins and dolerite sills and dykes are sparsely found. The limestone lenses are yellowish gray, thin to medium bedded and finely crystalline. The upper contact of Manki Formation is gradational with Shahkot Formation at its normal stratigraphic position while its lower contact is not exposed. No fossils have been found in this Formation. The rocks have been tentatively assigned to Pre-Cambrian age on the basis of their lithological correlation with Hazara Formation which has been determined to be of late Pre-Cambrian age on the basis of radiometric dating by Rb-Sr method by A.R Crawford and RG Davis (1975). The approximate thickness of the Formation is 950 meters

1.6 Structure

The main structure trends in the area correspond generally with geographic profile both striking almost east - west. The stratum is moderately dipping becoming steeper in localized zones. The rocks mostly dip Northward at angle ranging from 45 to 65.

Two major thrust faults Khairabad and Cherat Thrusts dominate the structural setup of the area. These faults are partly responsible for the present disposition of rocks in the area. In addition to these two faults several strike slip, normal and reverse faults are present in the area.

The area has been deformed to several anticlines and synclines. Asymmetric isoclinal folding is also conspicuous mostly in Mesozoic and tertiary rocks. Secondary folding of small

magnitude can be observed axial conformity with the main fold structure. The interaction of the above mentioned faults accompanied by a complex chain of tight folding has given rise to the overturning of rock strata.

1.7 Structure of the Project Area

Major thrust faults Khair Abad Thrust is passing above the Mnaki Formation overlying by Utch Khattak Formation (PEUK) and Manki Formation. The Cherat Trust Fault is also passing parallel to the Khair Abad Thrust Fault. Some localized faults are also present near the project area.

1.7.1 Abutments of Dam

Both the Right and left abutment of the proposed dam are on the same Formation which is Known Manki Formation. In some places Quaternary deposits cover rocks of reservoir area on both left and right abutments. The right and left abutments have jointed rocks which are exposed on both sides. These rocks have a dip of 40-65^0. The rock trend is across the dam axis, which is in the favor of construction of a dam.

1.7.2 The Structural Analysis of Dam

The general strike of the area as a whole and the dam site is particular is North-West and dip towards North East with angle of dip, range from 45 to 65^0 degree. The axis of the dam is almost parallel to the direction of the rocks exposed at both the abutments up and down stream of the dam site rarely the dip changes from north towards East. However the area shows North-South compression similar to the compresinol forces throughout the tectonics of Pakistan.

1.7.3 The Main Wall of the Dam

As stated earlier the area of the dam is almost parallel to the strike of the rocks exposed on both the abutments. This will be very much similar to the reconstruction of the ridge, which has been cut by the water of stream.

1.8 Dam Site Geology

1.8.1 Surface Geology

Surface geological mapping of the dam site area has been carried out in detail and has been plotted and presented in (Fig 5.1). The exposed lithology on both the abutments as well in the stream channel has been shown in the map. Nullah bed is covered with overburden where as rock is well exposed on the abutments. General trend of rocks is in North West direction and plunging in north east. The rocks are slightly too moderately weathered.

1.8.2 Sub surface geology

For sub surface geological investigation 5 bore holes of variable depth has been drilled at both abutments and nullah bed i.e. two on left abutment one on right abutment and two in nullah bed. The bore hole logs are placed at annex and a detail summary of drilling is also exhibited at table no 6. Summary of each bore hole is also attached.

A geological cross section along the dam axis has been prepared (Fig 5.3) which shows bore hole location.

1.8.3 Left Abutment

The bed rock exposed on left abutment is Phyllite of Manki Formation. The rock at the left abutment is covered by overburden up to one meter. The bed rock is yellowish gray on weathered surface and smoke gray on fresh surface. It is closely jointed and fractured. Two sets of joints have been observed. The rock is slightly too moderately weathered. General trend of rocks is in NW plunge in NE. In order to explore the sub surface geology of left abutment two bore holes SKD-3 and SKD-5 has been drilled up to the depth of 24 meter and 20 meter respectively. Lugeon values are high at shallow depth and decreases with depth. During the process of drilling water pressure tests were conducted at different levels. The average lugeon value is low which indicate that the subsurface stratum is slightly permeable. The bore hole logs are placed at Annex for reference and examination. The core recovery percentage is good but RQD percentage is extremely poor i.e. almost zero.

1.8.4 Nullah Channel Area

From the surface geological map (Fig no 5.1) it is evident that the main stream channel is covered with overburden material which is mainly alluvial deposits consisting of pebbles, gravels sand, silt and clayey material. In order to know the sub surface condition and expected thickness of overburden at nullah bed 2 bore holes SKD-2 and SKD-4 has been vertically drilled up to the depth of 15 meter and 10 meter respectively.

From the bore hole logs (Ref. Annex) that the bed rock has been encountered at the depth of 12 meter at the at the dam axis and at 4 meter at 50 meter upstream of the dam axis in SKD-4. The overburden material consists of gravels, sand, silt and clay. The core recovery percentage is poor and RQD percentage is extremely poor. Summary of the core recovery and RQD is attached as table NO. 2 and table NO.4. Water pressure tests have been conducted at SKD-4 and the Lugeon values are low which shows that the stratum is slightly permeable.

1.8.5 Right Abutment

The bed rock exposed on right abutment is Phyllite of Manki Formation. It is yellowish gray on weathered surface and smoke gray on fresh surface. It is closely jointed and fractured. Two sets of joints have been observed. The rock is slightly too moderately weathered. General trend of rocks is in NW plunge in NE. In order to explore the sub surface geology of left abutment borehole No. SKD-1 has been drilled up to the depth of 22 meters. Lugeon values are high at shallow depth and decreases with depth. During the process of drilling, several water pressure tests were conducted at different levels. The average lugeon value is low which indicate that the subsurface stratum is slightly permeable. The bore hole logs are placed at Annex for reference and examination. The core recovery percentage is good but RQD percentage is extremely poor i.e. almost zero.

1.8.6 Reservoir Area

The reservoir area is located just upstream of the proposed dam axis, between the dam axis and the confluence of the main stream of the area. The stream is open to make a sufficient space for the storage of water. The rocks exposed at both the banks of the stream are medium hard, foliated rocks, namely argillite. This is a good fortune that sufficient water could be stored even with low height of the dam. In the reservoir area the exposed rocks are Phyllites of Manki Formation. The strike of the beds remains the same. On the basis of water pressure tests and permeability tests it is clear that grouting will be required.

1.8.7 Command Area

Command area is mainly composed of Piedmont and fan deposits which are derived from the weathering of different Formations in that area. These deposits are loose and unconsolidated. Gravels and scree are also observed on the upper surface.

1.9 Construction Material

The required sources for construction material are as under:

Clay

Clay deposits are present near the dam site in command area. These deposits are covered by about one meter stream deposits. However, fine quality of clay is available at Azem Gari Jahangira 10km from dam site. These clay deposits are huge and are used by the locals. Samples were tested in CMTL Lahore, results are annexed. Silt is also present which can be used as shoulder material.

Sand

There are no nearby sand deposits. The sand has to be supplied from Nizampur area about 2 to 4 km from Attock Bridge over Indus River. This sand is used in all sort of construction in the Peshawar. The sand is greenish color, fine to course grained. Two samples were tested in CMTL Lahore results are annexed.

Coarse Aggregate

Pebbles and Gravels size Aggregate abundantly available; Limestone quarries are at the Project area. Two samples were tested in CMTL Lahore results are annexed.

RipRap

Crush plants are at a distance of 5km from dam axis to south west near Pataw Bala village. Two samples were tested in CMTL Lahore results are annexed.

Cement

The nearest cement factory is at a distance of about 12km from the project area. The name of this cement factory is Cherat cement.

Steel

Many factories are working in Peshawar, Taxila, and Islamabad.

Water

There is no perennial flow in the nullah the nearest water source is tube wells which are in a radius of 1 to 2 km from the dam site.

Environmental Assessment

ENVIRONMENTAL ASSESSMENT

1.1 General

Shah Kaleem dam is proposed to be constructed in the mountainous part of Khyber PakhtunKhwa. In this part there are small valleys incised by small and big torrent streams. The available pieces of land are under rain fed (barani) cultivation but their full potential is not being realized because of rain not always falling at the required time and in the required quantity. Improved yields can be had by bringing these lands under irrigation by using runoff from rainfall. This is proposed to be achieved by creating water storage of rainfall runoff by construction of dams on streams at appropriate locations. To make use of this potential for agricultural development, Directorate General Small Dams, Irrigation Department selected a dam site in district Nowshehra. In compliance with the provisions of Pakistan Environmental Protection Act 1997 and in fulfilment of the requirements of Consultancy Agreement, this Report presents Initial Environmental Examination (IEE) of Shah Kaleem Dam Project.

1.2 Shah Kaleem Dam Project

Located on Pitao Khwar in district Nowshehra, Shah Kaleem Dam Project besides providing flood control, will irrigate lands .The stream bed elevation is 1125.3 ft. above mean sea level. It will have gross storage of 646 acre ft. Based on 60% reduction of gross storage, the life of the dam is estimated at 60 years. The 300 ft. wide ogee type spillway will be located on the left hand side of the dam designed for a surcharge of 8.9 ft.

1.3 Legal Framework

Pakistan Environmental Act 1997 under Section 12 requires preparation and submission of environmental impact assessment (EIA) reports by proponents of all development projects and obtains approval from the relevant government agency before commencement of construction or operation.

Pakistan Environmental Protection Agency issued August 2000 "Policy and procedures for filing, review and approval of environmental assessment." This policy document includes schedules A, B and C defining development projects in terms of requirements for Initial Environmental Examination and Environmental Impact Assessment. Included in the list of projects under schedule B are dams with storage volume less than 40,565 acre ft., irrigation schemes serving less than 37,065 acres and small scale irrigation systems. Shah Kaleem

Dam Project, therefore, falls under schedule B. Accordingly, Initial Environmental Examination Report for Shah Kaleem Dam Project has been prepared for submission to and approval of the provincial Environmental Protection Agency Peshawar.

1.4 Environmental Baseline

1.4.1 Physiography

Physiographically the proposed Shah Kaleem Dam site area is situated where the mountains are medium high and become high at east. Flood plains of Nowshehra are present in the north east river Kabul runs parallel to these plains. The irrigated area is composed of Quaternary deposits. Climatically the area lies in the region characterized by cold in the winter and very hot in the summer.

1.4.2 Geology

The Shah Kaleem dam is located in mountainous region belonging to Attock - Cherat Ranges. The rocks exposed in the area range from Paleozoic to Cenozoic ages. The solid rocks of mountains are mainly composed of Slates, Phyllite, Argillites, Limestone, Quartz tic Slates and Quartzite.

1.4.3 Land Use

The land areas of the project lie on right and left side of Pitao Khwar. At present arable farming is practiced in Nowshehra District due to scarcity of water; rainfed agriculture, irrigation by using wells and flood-water cultivation resulting in low yields. Some tracts of land are used for grazing, though perpetual grazing has resulted in very poor condition of grazing lands and even complete elimination of palatable plant species. An existing system of Tube well irrigation is also practiced in the project area.

1.4.4 Water Resources

Besides wells, number of springs and streams flow throughout the district providing clean water for drinking and irrigation. The hydrological conditions are good with respect to runoff generation. The average annual rainfall at the catchment is about 17.6 inches. Mean annual runoff is 1320 acre-ft. Water quality is fit for irrigated agriculture. It can be rendered fit even for drinking purposes after necessary treatment.

1.4.5 Flora and Fauna

The flora of the project area is conspicuous by deciduas forest, bushes and shrubs. There are no endangered species of wild life animals including those of birds.

1.4.6 Socio – Economic Environment

There are four villages considered under the influence of Shah Kaleem Dam Project. The population of these villages is 9500. Facilities in terms of potable water are limited whereas access to electricity is 90%.Health facilities are poor. At present 1 BHU and a private hospital exist in the project area. Regional economy is largely dependent on agriculture with small number of industrial units.

1.5 Impact Assessment

Assessment of impact of each project component on the physical, biological and socio-economic environment has been undertaken in respect of project construction and much longer period of project operation using impact matrixes based On Asian Development Bank Guidelines.

1.5.1 Construction Phase Impacts

Project impacts during construction phase are negative but short lived and site specific. Environmentally, they are significant in terms of land use effect, which would result in acquisition of 4.6 acres of cultivated land, demolition/relocation of, 1 no. of well, 1 no. of Tube well, and relocation of electric poles. These entire infrastructures would be submerged by the creation of dam reservoir. The project construction will offer benefits in terms of employment opportunities to local population.

6.5.2 Operation Phase Impacts

Significant environmental impacts during operation stage of the project are positive. During project operation benefits will accrue in terms of agricultural expansion, employment opportunities for locals and overall improvement in economy of the project area.

1.6 Mitigation Measures

Shah Kaleem Dam is environment friendly as it will cause minimal environment impacts during construction and operation stages of the project. Mitigation measures have been identified wherever required. In particular, compensatory tentative amount of Rs.4.21 million would be provided for land, wells, Electric Poles and access road to be overtaken for project implementation.

1.7 Environmental Management and Monitoring Plan

The initial environmental examination of the project indicates no significant environmental impacts (SEI's) except for acquisition of cultivated land, loss of built up property, cutting of trees, relocation of electric poles, relocation of one School and a graveyard during the construction phase of the project. It is important that an environmental management

programme (EMP) is pursued during construction and operation phase of the project. This will involve development of guidelines for monitoring environmental parameters related to land acquisition, built up property, relocation of utility services/infrastructure, cultural property, water resources particularly their quality and quantity and meteorology particularly rain fall record through installation of rain gauges. The monitoring work may be undertaken by the concerned authorities in the vicinity of dam site.

POLICY AND PROCEDURES FOR FILING, REVIEW AND APPROVAL OF ENVIRONMENTAL ASSESSMENT PAKISTAN ENVIRONMETHAL PROTECTION AGENCY 2000

Schedule A

List of Project Requiring an EIA

The projects in Schedule A are generally major projects and have the potential to affect a large number of people. They also include projects in environmentally sensitive areas. The impact of such projects may be irreversible and could lead to significant changes in land use and the social, physical and biological environment.

Agriculture & Livestock

No EIA's required unless a specific proposal designated by the Responsible Authority, which could be the result of significant impacts being discovered at the IEE Stage.

Energy

- Thermal Power Generation over 200 MW
- Hydroelectric Power Generation over 50MW
- Petroleum Refineries
- Major Power transmission lines (above 66kv) Grid Stations
- Nuclear Power Plants

Manufacturing & Processing

- Major manufacturing of chemicals, pesticides of fertilizer
- Petrochemical complexes
- Major tanning and leather finishing
- Man-made fibers and resin projects greater than 10 crore rupees in value
- Industrial Estates (including export processing zones)
- Large scale food processing such as sugar mills, refineries, breweries, distilleries, soft drinks, milk and dairy products greater than 10 crore rupees in value
- Large scale industrial plants such as: synthetic resins, breweries distilleries, soft drinks, paperboard containers & boxes, plastic & dyes, oils & fats greater than 1 crore rupees in value
- Cements plants

Mining & Mineral Processing

- Major mineral development including; mining & processing of coal, gold, copper, iron and precious stones
- Major smelting plants
- Major non- ferrous metals, iron and steel rolling

Transport

- Major ports and Harbors development
- Major Airports
- Federal or Provincial Highways or major roads greater than 5 crore rupees in value.
- Maintenance (rebuilding or reconstruction of existing roads is expected from the requirement of an EIA).
- Major railway works

Water Management; Dams, Irrigation & Flood Protection

- Dams and reservoirs with a maximum storage volume greater than 50 million cubic meters or a surface area greater than 8 square kilometers
- Irrigation and drainage serving more than 15,000 hectares

Water Supply & Treatment

- Major urban water supply infrastructure, including major head works and treatment plants.

Waste Disposal

Waste disposal and/or storage of hazardous or toxic wastes (including landfill sites, incineration of hospital toxic waste)

Waste disposal facilities for domestic or industrial wastes, where more than 10,000 cubic meters of waste will handle annually

Urban development & Tourism

- Land use studies and urban plans (large cities)
- Large scale tourism developments

Environmentally Sensitive Areas

Any project which will be situated in an environmentally sensitive or critical area should be carefully investigated, and the results communicate to the Responsible Authority, who will advise whether an EIA is necessary (see "Guidelines for sensitive and critical areas").

Any other projects that the EPA may require.

Schedule B

List of Project Requiring an IEE

These projects include those where those where the rage of environmental issues is comparatively narrow and the issues can be understood and managed through less extensive analysis. These are projects not generally located in environmentally sensitive areas or smaller proposals in sensitive areas.

Agriculture and Livestock

- Agro-industrial installation: large poultry farms and beef cattle lots
- Repacking, formulation or warehousing of agricultural produce

Energy

- Thermal Power Generation less than 200MW
- Hydroelectric Power Generation less than 50 MW
- Electrical Transmission lines (11 kV or smaller), and large distribution projects
- Major waste to energy generation projects
- Oil and gas transmission systems
- Oil and gas extraction including exploration, production, gathering systems, Separation and storage

Mining & Mineral Processing

- Commercial extraction of sand, gravel, limestone, clay and other minerals not Included in Schedule A.
- Crushing, grinding and separating processes
- Minor smelting Plants

Transport

- Ports and Harbors Developments for ships less than 500 gross tons
- Federal or Provincial Highways (except maintenance, rebuilding or reconstruction of existing metalled roads) less than 5 crore rupees in value.

Water Management; Dams, Irrigation & Flood Protection

- Dams and Reservoirs with a storage volume less than 50 million cubic meters or a surface area less than 8 square kilometers
- Irrigation and Drainage serving less than 15,000 hectares
- Small-scale irrigation systems

Water Supply & Treatment

- Minor head works and small systems

Waste disposal

- Waste disposal facility for dame site or industrial wastes, where less than 10,000 cubic meters of waste will handled annually

Urban Development & Tourism

- Urban development projects, including large rural hotels, schools and universities
- Public facilities which have significant off-site impacts (i.e hospital wastes)
- Housing Estates

Any other projects that the EPA may require

Schedule C

List of Project Requiring an IEE

Essentially Schedule 'C' combines everything not in Schedules 'A' and 'B'. As is the case for 'A' and 'B' projects, Schedule 'C' projects are also subject to review if they are situated in an environmentally sensitive or critical area. No attempt is made here to detail these projects, however some illustrative examples are provided below:

- Construction of homes, offices and small commercial buildings, subjects to compliance with existing zoing laws;
- Reconstruction/ rehabilitation of roads including sealing;
- On-farm dams;
- Projects promoting energy efficiency; and
- Lining of existing canals and/or watercourses.

Here is provision within Schedule C for Responsible Authorities to issue industry specific guidelines WHO.

Annexure– 2

SMALL DAMS PROJECTS K.PK

Proforma for Data Collection During Site Visit

- Site No. and Name
- Stream Name
- Tehsil Name
- Population Upstream and Downstream of Dam Site
- Village Names
- Populations
- Tribes/Cast
- Groundwater

Depth

Quality (Saline etc.)

- Climate

Met Data from Nearest Met Station

- Biological environment

Flora and Fauna

Agriculture

- Vegetables
- Fruits

Livestock

Fisheries

- Economy

Employment Classes
Occupations
Income

- Civic Amenities

Housing (class, Pucca, Kutcha Houses)

Water Supply and Sanitation

Education (Schools).

- Culture

Archaeological Sites

Mosques

Education of women

- Assets Submergence by dam Reservoir

Submergence of Total Land Area (Ares)
Private Land

State Owned Land

Agricultural Area (cost/Acre):

- Irrigated
- Rainfed
- Wasteland

Residential Area (cost/Acre)

No. of Villages

No. of houses (cost/House)

Population (No. of People Displaced and Needing Resettlement)

No. of Trees

- Archaeological Site

Shrines
Mosques

- Infrastructure

Existing (Nearest Major Road)

- Using PRA, Interviews of Locals

Annexure 3

EXPLANATION OF IRRIGATION WATER QUALTLITY TERMINOLOGY

Electrical Conductivity (EC)

The total concentration of soluble salts in water can be adequately expressed in terms of electrical conductivity (EC) for the purpose of diagnosis and classification. The EC value can be readily and precisely measured by electronic procedure. The EC is conventionally measured in mmho's / cm which is equivalent to dS/m or mS/cm. many field and laboratory meters have been devised to accurately measure this parameter. Different crops have different salt tolerance. The use of high salt content water is very much related with the soil permeability and overall soil drainage condition. Provision of drains to leach away the excess salts and keep the system sustainable is a prerequisite of an irrigation Project. To get rid of excess salts, leaching requirement is calculated.

pH

It is defined as the antilogarithm of hydrogen ions concentration in gram equivalent per litre and stands for the measure of alkalinity or acidity of any solution. On a scale from 0-14, 7 represent neutrality. Numbers less than 7 signify increasingly greater acidic reaction and numbers grater than 7indicate increasingly basic or alkaline reaction. At various pH levels different elements (crop nutrients) are more active than the other ones. Uptake of nutrients by crops is greatly determined by the pH levels. Certain pH levels are highly toxic for certain crops as well as aquatic life.

Sodium Adsorption (SAR)

The soluble inorganic constituents of irrigation water react with soils as ions rather than as molecule. The principal cations are calcium, magnesium and sodium with generally small quantities of potassium ordinarily present. The principal anions are carbonate, bicarbonate, sulphate and chloride with nitrate and fluoride occurring in low concentrations. The alkali hazard involved in the use of irrigation water is detemined by the absolute and relative concentrations of the cations. If the proportion of sodium is high, the alkali hazard is high and conversely, if calcium and magnesium predominate the hazard is low. Alkali soils are formed by accumulation of exchangeable sodium and are often characterized by poor tilth and low permeability apart from the toxic effects of sodium. The ratio (SAR) of sodium versus divalent cations is expressed as:

$$AR = Na / \sqrt{\frac{(Ca+Mg)}{2}}$$

Where Na, Ca & Mg represent the concentration of sodium, & Magnesium in milli quivalents per liter.

Residual sodium Carbonate (RSC)

The sodicity or alkali hazard of irrigation water is not only reflected by the sodium adsorption ratio but is also adjudged by residual sodium carbonate. The RSC is employed as an index sodicity and represents excess quantity of carbonate and bicarbonate ions compared to calcium and magnesium contents in irrigation water. It is worked out by the following equation:

$RSC = (HCO3 + CO3) - (Ca + Mg)$

All values being in miliequivalents per litre. RSC values in most of the cases work out to be negative or zero.

Chloride

In the irrigation water, chloride may be toxic. It is not absorbed by the soil and is readily taken up by plant through accumulation in the leaves. If the chloride concentration in the leaves exceeds the tolerance of the crop, injury symptoms develop such as leave burn of dyeing of leave tissue. Many tree crops are sensitive to chloride; they may show injury when chloride (dry weight) in the leaf tissue is above 0.3 %. Stone fruit, Strawberries and some cultivars of Citrus

Cost Estimates

SHAHKALEEM DAM
DISTRICT NOWSHERA
SUMMARY OF COST

S No.		Description	Amount Rs.(Million)	
A	PRELIMINARIES			
	i	Land acquisition and trees and in built area	30.00	
	ii.	Relocation of Power Line out of Reservoir.	5.00	
		Sub Total A	**35.00**	
B	WORKS			
	i.	Dam Embankment	213.46	
	ii.	Spillway & Spill Channel	~~189.60~~	170.82
	iii.	Intake & Outlets Structure	13.40	
	iv.	Electrification Dam Embankment	2.02	
	v.	Irrigation System	38.42	
	vi	Construction of Inspection Hut /Sub Engineer Office	1.65	
	vii	Relocation of existing Shingle Track out of Reservoir	35.53	
		Sub Total B	~~494.08~~	475.30
C	GENERAL			
	i	Consultancy Charges for construction supervision as per actual Bid +Escalation	34.00	@15% 5.1(m)
	ii.	Escalation on specified material & labour (6.5%)	~~32.12~~	30.90
		Sub Total C	~~66.12~~	64.90
		Grand Total A+B+C	~~595.200~~	

575.20

SHAHKALEEM DAM
DISTRICT NOWSHERA
BILL OF QUANTITIES

Bill No. 1: Embankment Dam

Item	MRS 2013 Item Code	Description	Unit	Quantity	Rate (Rs)	Amount (Rs)
1.1	03-56	Clearing and Stripping	M^2	21,569	20.940	451,655
1.2		Excavation under the dam toe i/c disposal of excavated material to any lead/lift				
i.	03-68-a	Excavation for core trench of Dam Embankment/ Spillway/Intake & Outlet Structure and Irrigation System upto a minimum depth of 35 ft in shingle gravel including removing of excavated material by machinery in 1 KM radius	M^3	11,601	247.630	2,872,780
ii.	03-68-b	Excavation for core trench of Dam Embankment/ Spillway/Intake & Outlet Structure and Irrigation System upto design depth in Soft Rock/Shale requiring 20% blasting i/c removing of material from outside of the structure area	M^3	13,921	342.140	4,763,040
iii.	03-68-c	Excavation for core trench of Dam Embankment/ Spillway/Intake & Outlet Structure and Irrigation System upto design depth in Medium Hard Rock requiring 50% blasting i/c removing of material from outside of the structure are	M^3	20,882	406.24	8,483,095
1.3	03-65	Provide , Place & compact shoulder material (sandy / silty gravel) in Dam Embankment, of specified grading, leveling / dressing i/c haulage for obtaining of 95% modified ASHTHO dry density. (zone -4)	M^3	159696 ~~153,530~~	356.40	56915654 ~~54,718,056~~
1.4	19-28-a	Providing and Laying stone pitching for top layer only : On slope (zone -6)	M^3	15,175	2,976.460	45,167,012
1.5	19-25	Providing and Laying stone pithcing/filling, dry hand packed in pitching & aprons	M^3	928	1,805.290	1,675,309
1.6	03-66	Provide , Place & compact Fine Filter in chimney drain vertical / horizontal on downstream of clay core (zone - 2)	M^3	6,655	1,329.38	8,847,504
1.7	03-67	Provide , Place & compact Coarse Filter (well graded gravel) in chimney drain vertical / horizontal on downstream of fine filter i/c leveling, moistening etc (zone -3)	M^3	15,605	789.54	12,320,835
1.8	03-64	Provide, place and compact impervious clay core in dam embankment of specified grading, permiability i/c leveling dressing and haulage obtaining 95% modified ASHTO dry density	M^3	55,482	395.71	21,954,610
1.9	03-18-a	Transportation of earth/Rock all types beyond 250 m and upto 500 m	M^3	16,644	108.82	1,811,251
1.10	03-18-b	Transportation of earth all types for every 100m extra lead beyond 500m upto 1.5 km	M^3	16,644	168.60	2,806,258
1.11	03-18-c	Transportation of earth all types for every 500m extra lead beyond 1.5 km. upto 8 km	M^3	33,289	199.29	6,634,153
1.12	NSI	Drilling of 2" Dia bore hole for Grout Curtain.	M	1,000	4,500.00	4,500,000
1.13	NSI	Providing And Filling Cement Slurry / Bentonite grout curtain through bore hole including pressure test.	Bag	1,750	1,250.00	2,187,500
1.14	16-28-b	Excavation for Slurry Trench through Percussion/rotary drilling.1 m dia	M	1,500	7,780.84	11,671,260
1.15	NSI	Cement Bentonite Slurry for Filling of Slurry Trench	M	1,500	14,000.00	21,000,000
1.16	24-43 ~~NSI~~	Providing and install required instrumentation i.e. stand pipe piezometer.	~~Nos.~~ M	350 ~~8~~	350 ~~75,000~~.00	2,13,458 ~~600,000~~

SHAHKALEEM DAM
DISTRICT NOWSHERA
BILL OF QUANTITIES

Bill No. 1: Embankment Dam

Item	MRS 2013 Item Code	Description	Unit	Quantity	Rate (Rs)	Amount (Rs)
1.17	NSI	P&F Surface Maker	Nos.	8	5,000.00	40,000
1.18	NSI	Slope Indicator	Nos.	8	20,000.00	160,000
1.19	NSI	Settlement gauges	Nos.	8	18,000.00	144,000
1.20	26-05	Providing and fixing boundary piller including paint etc.	Nos.	150	742.760	111,414
1.21	26-16-b	P&F Barbed wire fencing with 4 Horizantal & 2 cross wire with PCC 1:4:8 base 12"x12"x21"	M	950	571.070	542,517
Total carried over to Summary						213,462,248

213463406

213.46

SHAH KALEEM DAM
DISTRICT NOWSHERA
BILL OF QUANTITIES

Bill No. 2: Spillway & Spill Channel

Item	MRS 2013 Item Code	Description	Unit	Quantity	Rate (Rs)	Amount (Rs)
2.1		Bulk excavation of Approach Channel for Spillway and exit channel including dressing, disposal of excavated material to lead of 1.5Km				
2.1 i)	03-68-a	Excavation for core trench of Dam Embankment/Spillway/Intake & Outlet Structure and Irrigation System upto a minimum depth of 35 ft in shingle gravel including removing of excavated material by machinery in 1 KM radius	M^3	29,251	247.63	7,243,540
2.2 ii)	03-68-c	Excavation for core trench of Dam Embankment/ Spillway/Intake & Outlet Structure and Irrigation System upto design depth in Medium Hard Rock requiring 50% blasting i/c removing of material from outside of the structure area	M^3	23,933	406.24	9,722,548
2.3 iii)	03-68-b	Excavation for core trench of Dam Embankment/ Spillway/Intake & Outlet Structure and Irrigation System upto design depth in Soft Rock/Shale requiring 20% blasting i/c removing of material from outside of the structure area	M^3	~~79,777~~ 74586	342.140	~~27,294,807~~ 25518854
2.2	03-60-c	Structural backfill using Common Material available at (site retaining walls)	M^3	4,927	326.79	1,610,120
2.3	06-06-d-03	Reinforced cement concrete work as in dams, spillways, weirs, barrages, cross drainage works and other hydrolic structures using crushed stone aggregate (screening & washing) and coarse sand i/c costof all labour and material and 'all kinds of form works, moulds, shuttering lifting/ pumping, curing, rendering and finishing the exposed surface, cast in situ/precast excluding the cost of steel reinforcement and labour for bending binding also excludig cost of additives which have to be paid separately. Type C (1:2:4)	M^3	~~5,921~~ 5052	9,206.24	~~54,514,394~~ 46509924
2.4	06-07-b	Supply & fabricate M.S. reinforcement for cement concrete (Hot rolled deformed bars Grade 60)	Tonne	396 ~~472~~	119,471.42	47360860 ~~56,361,255~~
2.5	19-28-a	Providing and Laying stone pitching for top layer only : On slope	M^3	7,208	2,976.46	21,454,209
2.6	06-05-i	Plain Cement Concrete including placing, compacting, finishing & curing (Ratio 1:4:8)	M^3	807	4,860.62	3,922,437
~~2.7~~	NSI	Drilling , grouting, Installation and tieing of Anchors bars 08 # reinforcement of structure complete.	Rm	236	5,905.80	1,395,000
2.8	24-18-b-03	Providing and Laying cut, joint, test, disinfect PVC pipe line BSS Class 'C'working pressure : 4" i/d	Rm	234	689.66	161,380
2.9	24-18-a-02	Providing and Laying cut, joint, test, disinfect PVC pipe line BSS Class 'B'working pressure : 4" i/d	Rm	786	562.63	442,250
2.10 ~~3.1~~	14-79-b	Supply and fixing of 1.0 HP Monoblock water pump 1.25"x1" single phase upto 90 ft head (Type SE) i/c all accessories.	Nos	1	15,049.43	15,049
~~3.11~~	24-16-a-01	Providing and Laying cut, joint, test & disinfect GI pipe line Using heavy quality GI Pipe : 4" Dia	Rm	5	2,338.05	11,340
~~3.12~~	23-08-b	RCC manhole cover 22" dia with: 3"x3"x1/4" angle iron frame, 22" i/d complete	Nos	1	14,531.29	14,531
	RETAINING WALL					
~~3.13~~	03-68-b	Excavation for core trench of Dam Embankment/ Spillway/Intake & Outlet Structure and Irrigation System	M^3	325	342.14	111,196
~~3.14~~	06-05-i	Plain Cement Concrete including placing, compacting, finishing & curing (Ratio 1:4:8)	M^3	98	4,860.62	473,910
~~3.16~~	03-36-c	PCC 1:3:6 in mass concrete less formwork using 30% boulders	M^3	950	4,312.40	4,096,780
~~3.17~~	06-38-~~a~~ (b)	Erecting & removing formwork to concrete in any shape / position (Horizontal)	M^2	1760 ~~2,000~~	428.15 ~~376.80~~	753540 ~~753,600~~
		Total carried over to Summary				~~189,598,347~~ 170817352

170.82

SHAH KALEEM DAM
DISTRICT NOWSHERA
BILL OF QUANTITIES

Bill No. 2: Spillway & Spill Channel

Item	MRS 2013 Item Code	Description	Unit	Quantity	Rate (Rs)	Amount (Rs)
2.1		Bulk excavation of Approach Channel for Spillway and exit channel including dressing, disposal of excavated material to lead of 1.5Km				
2.1 i)	03-68-a	Excavation for core trench of Dam Embankment/Spillway/Intake & Outlet Structure and Irrigation System upto a minimum depth of 35 ft in shingle gravel including removing of excavated material by machinery in 1 KM radius	M^3	29,251	247.63	7,243,540
2.2 ii)	03-68-c	Excavation for core trench of Dam Embankment/ Spillway/Intake & Outlet Structure and Irrigation System upto design depth in Medium Hard Rock requiring 50% blasting i/c removing of material from outside of the structure area	M^3	23,933	406.24	9,722,548
2.3 iii)	03-68-b	Excavation for core trench of Dam Embankment/ Spillway/Intake & Outlet Structure and Irrigation System upto design depth in Soft Rock/Shale requiring 20% blasting i/c removing of material from outside of the structure area	M^3	~~79,777~~ 74586	342.140	~~27,294,807~~ 25518854
2.2	03-60-c	Structural backfill using Common Material available at (site retaining walls)	M^3	4,927	326.79	1,610,120
2.3	06-06-d-03	Reinforced cement concrete work as in dams, spillways, weirs, barrages, cross drainage works and other hydrolic structures using crushed stone aggregate (screening & washing) and coarse sand i/c costof all labour and material and all kinds of form works, moulds, shuttering lifting/ pumping, curing, rendering and finishing the exposed surface, cast in situ/precast excluding the cost of steel reinforcement and labour for bending binding also excludig cost of additives which have to be paid separately. Type C (1:2:4)	M^3	~~5,921~~ 5052	9,206.24	~~54,514,394~~ 46509924
2.4	06-07-b	Supply & fabricate M.S. reinforcement for cement concrete (Hot rolled deformed bars Grade 60)	Tonne	396 ~~472~~	119,471.42	47360860 ~~56,361,255~~
2.5	19-28-a	Providing and Laying stone pitching for top layer only : On slope	M^3	7,208	2,976.46	21,454,209
2.6	06-05-i	Plain Cement Concrete including placing, compacting, finishing & curing (Ratio 1:4:8)	M^3	807	4,860.62	3,922,437
2.7	NSI	Drilling , grouting, Installation and tieing of Anchors bars 08 # reinforcement of structure complete.	Rm	236	5,905.80	1,395,000
2.8	24-18-b-03	Providing and Laying cut, joint, test, disinfect PVC pipe line BSS Class 'C'working pressure : 4" i/d	Rm	234	689.66	161,380
2.9	24-18-a-02	Providing and Laying cut, joint, test, disinfect PVC pipe line BSS Class 'B'working pressure : 4" i/d	Rm	786	562.63	442,250
2.10 ~~3.1~~	14-79-b	Supply and fixing of 1.0 HP Monoblock water pump 1.25"x1" single phase upto 90 ft head (Type SE) i/c all accessories.	Nos	1	15,049.43	15,049
2.11 ~~3.11~~	24-16-a-01	Providing and Laying cut, joint, test & disinfect GI pipe line Using heavy quality GI Pipe : 4" Dia	Rm	5	2,338.05	11,340
2.12 ~~3.12~~	23-08-b	RCC manhole cover 22" dia with: 3"x3"x1/4" angle iron frame, 22" i/d complete	Nos	1	14,531.29	14,531
	RETAINING WALL					
2.13 ~~3.13~~	03-68-b	Excavation for core trench of Dam Embankment/ Spillway/Intake & Outlet Structure and Irrigation System	M^3	325	342.14	111,196
2.14 ~~3.14~~	06-05-i	Plain Cement Concrete including placing, compacting, finishing & curing (Ratio 1:4:8)	M^3	98	4,860.62	473,910
2.15 ~~3.16~~	03-36-c	PCC 1:3:6 in mass concrete less formwork using 30% boulders	M^3	950	4,312.40	4,096,780
2.16 ~~3.17~~	06-38-~~a~~ (b)	Erecting & removing formwork to concrete in any shape / position (Horizontal)	M^2	1760 ~~2,000~~	428.15 ~~376.80~~	753549 ~~753,600~~
		Total carried over to Summary				~~189,598,347~~ 170817352

170.82

SHAHKALEEM DAM
DISTRICT NOWSHERA
BILL OF QUANTITIES

Bill No. 3: Intake/Outlet Works

Item	MRS 2013 Item Code	Description	Unit	Quantity	Rate (Rs)	Amount (Rs)
3.1		Excavation for Intake/Outlet structures and in trench for laying of pipe etc. including disposal of excavated material				
i)	03-68-c	Excavation for core trench of Dam Embankment/ Spillway/Intake & Outlet Structure and Irrigation System upto design depth in Medium Hard Rock requiring 50% blasting i/c removing of material from outside of the structure are	M^3	4,530	406.24	1,840,267
ii)	03-68-a	Excavation for core trench of Dam Embankment/ Spillway/Intake & Outlet Structure and Irrigation System upto a minimum depth of 35 ft in shingle gravel including removing of excavated material by machinery in 1 KM radius	M^3	10,570	247.63	2,617,449
3.2	03-60-c	Structural backfill using Common Material available at site.	M^3	14,000	326.79	4,575,060
3.3	06-03-b	Cement Concrete (brick/ston ballast, 1.5" to 2"/nullah shingle well graded and cleaned) in foundation & plinth (Ratio 1:4:8)	M^3	15	3,685.90	55,838
3.4	06-06-d-03	Reinforced cement concrete work as in dams, spillways, weirs, barrages, cross drainage works and other hydrolic structures using crushed stone aggregate (screening & washing) and coarse sand i/c costof all labour and material and all kinds of form works, moulds, shuttering lifting/ pumping, curing, rendering and finishing the exposed surface, cast in situ/precast excluding the cost of steel reinforcement and labour for bending binding also excludig cost of additives which have to be paid separately. Type C (1:2:4)	M^3	127	9,206.24	1,166,233
3.5	06-07-b	Supply & fabricate M.S. reinforcement for cement concrete (Hot rolled deformed bars Grade 60)	Tonne	10	119,471.42	1,157,786
3.6	23-03-a-07	Providing and Laying RCC pipe sewers complete As per ASTM C-76-79, Class II : 30" i/d, Wall B	RM	70	5,501.20	385,084
3.7	NSI	Supply and fix trashrack for intake as per drawing, specification and direction of the Engineer Incharge.	Nos	3	60,000.00	180,000
3.8	NSI	Providing and placing gate valve at outlet of conduit all accessories.	Nos	1	750,000.00	750,000
3.9	NSI	Providing and placing 2' dia butterfly valve with all accessories.	Nos.	1	250,000.00	250,000
3.10	NSI	Providing and placing 1' dia butterfly valve with all accessories. (for drinking water supply)	Nos.	1	150,000.00	150,000
3.11	06-05-f	Plain Cement Concrete including placing, compacting, finishing & curing (Ratio 1:2:4)	M^3	42	6,469.09	271,702
		Total carried over to Summary				13,399,419

SHAH KALEEM DAM

DISTRICT NOWSHERA

Bill No 4 : Irrigation System

S. No	Description of Item	AMOUNT (Rs)
1	Irrigation Channel	31,313,579
2	Aqueduct 01 No	1,207,231
3	Falls 07 Nos	2,477,560
4	Tail Cluster Outlets 01 No	38,968
5	Water shed Crossing (Pipe Culverts 05 Nos)	897,773
6	Pipe outlet 04 Nos	150,935
7	Syphon 01 No	2,338,760
	TOTAL:	38,424,806

SHAHKALEEM DAM
DISTRICT NOWSHERA
BILL OF QUANTITIES

Bill No. 4.1: Irrigation Channel

Item	MRS 2013 Item Code	Description	Unit	Quantity	Rate (Rs)	Amount (Rs)
4.1.1		Earth Excavation in Irrigation Channels including clearing grubbing and disposal of Excavated Material				
i.	03-10-d	in Shingle/Gravel	M^3	48,213	321.86	15,517,836
4.1.3	06-05-h	Plain Cement Concrete including placing, compacting, finishing & curing (Ratio 1:3:6)	M^3	200.00	5,603.70	1,120,740
4.1.4	06-36-c	PCC 1:3:6 in mass concrete less formwork using 30% boulders	M^3	2,500.00	4,312.40	10,781,000
4.1.5	03-60-c	Structural backfill using Common Material available at site	M^3	1,200.0	326.79	392,148
4.1.6	06-38-a	Erecting & removing formwork to concrete in any shape / position (Horizontal)	M^3	9,293.7	376.80	3,501,855
Total carried over to Summary						31,313,579

4.2: Cost Estimate of Aqueducts

Item	MRS 2013 Item Code	Description	Unit	Quantity	Rate (Rs)	Amount (Rs)
4.2.1	03-10-d	Earth excavation in irrigation channels/drains & disposal up to 25m. & dressing : in Shingle/Gravel	m^3	60	321.86	19,266
4.2.2	03-60-c	Structural backfill using Common Material available at site	m^3	3	326.79	978
4.2.3	06-05-h	Plain Cement Concrete including placing, compacting, finishing & curing (Ratio 1:3:6)	m^3	6	5603.70	31,622
4.2.4	11-09-a	Cement plaster 1:4 up to 20' height 3/4" thick	m2	52	167.44	8,696
4.2.5	06-06-d-03	Reinforced cement concrete work as in dams, spillways, weirs, barrages, cross drainage works and other hydrolic structures using crushed stone aggregate (screening & washing) and coarse sand i/c costof all labour and material and all kinds of form works, moulds, shuttering lifting/ pumping, curing, rendering and finishing the exposed surface, cast in situ/precast excluding the cost of steel reinforcement and labour for bending binding also excludig cost of additives which have to be paid separately. Type C (1:2:4)	m^3	60	9,206.24	550,441
4.2.6	06-07-b	Supply & fabricate M.S reinforcement for cement concrete (hot rolled deformed bars Grade 60)	Tonne	5	119,471.42	571,456
4.2.7	19-28-a	Providing and Laying stone pitching for top layer only : On slope	m^3	8	2,976.46	24,773
Total carried over to Summary						1,207,231

4.3: Cost Estimate of Falls

Item	MRS 2013 Item Code	Description	Unit	Quantity	Rate (Rs)	Amount (Rs)
4.3.1	03-10-d	Earth excavation in irrigation channels/drains & disposal upto 25m. & dressing : in Shingle/Gravel	M^3	113.31	321.86	36,469
4.3.2	03-60-c	Structural backfill using Common Material available at site	M^3	28.33	326.79	9,257
4.3.3	06-05-i	Plain Cement Concrete including placing, compacting, finishing & curing (Ratio 1:4:8)	m^3	15.48	4860.62	75,234
4.3.4	06-05-h	Plain Cement Concrete including placing, compacting,finishing & curing (Ratio 1:3:6)	M^3	30.94	5603.70	173,354
4.3.5	06-05-f	Plain Cement Concrete including placing, compacting,finishing & curing (Ratio 1:2:4)	M^3	3.93	6469.09	25,435
4.3.6	24-40	Supplying and Fixing PVC Water Stopper 8" wide 3/8" thick	M	43.40	787.75	34,188
		TOTAL AMOUNT FOR (01 No)				353,937
		TOTAL AMOUNT FOR (07 Nos)				2,477,560

4.4: Cost Estimate of Tail Cluster Outlet

Item	MRS 2013 Item Code	Description	Unit	Quantity	Rate (Rs)	Amount (Rs)
4.4.1	03-10-d	Earth excavation in irrigation channels/drains & disposal upto 25m. & dressing : in Shingle/Gravel	m3	10	321.86	3,062
4.4.2	03-60-c	Structural backfill using Common Material available at site	m3	0.48	326.79	155
4.4.3	06-05-f	Plain Cement Concrete including placing, compacting, finishing & curing (Ratio 1:2:4)	m3	7.4	4860.62	35,750
TOTAL AMOUNT FOR 01 NO						38,968

4.5: Cost Estimate of Pipe Culvert

Item	MRS 2013 Item Code	Description of Item	Unit	Rate (Rs)	Quantity	Amount (Rs.)
4.5.1	03-60-a	Structural Excavation in Common Material	m^3	218.85	8.2	1,792
4.5.2	03-60-c	Structural backfill using Common Material available at site	m^3	326.79	1.6	535
4.5.3	06-05-i	Plain Cement Concrete including. placing compaction. finishing &curing (ratio1:4:8)	m^3	4,860.62	4.1	19,898
4.5.4	06-05-h	Plain Cement Concrete including placing, compacting, finishing & curing (Ratio 1:3:6)	m^3	5,603.70	4.7	26,416
4.5.5	06-06-d-03	Reinforced cement concrete work as in dams, spillways, weirs, barrages, cross drainage works and other hydrolic structures using crushed stone aggregate (screening & washing) and coarse sand i/c costof all labour and material and all kinds of form works, moulds, shuttering lifting/ pumping, curing, rendering and finishing the exposed surface, cast in situ/precast excluding the cost of steel reinforcement and labour for bending binding also excludig cost of additives which have to be paid separately. Type C (1:2:4)	m^3	9,206.24	6.1	55,707
4.5.6	06-07-b	Supply & fabricate M.S. reinforcement for cement concrete (Hot rolled deformed bars Grade 60)	tonne	119471.42	0.47	55,665
4.5.7	16-23-c	Reinforced Concrete Pipe Culvert (AASHTO M-170) Dia: 760mm	m	4,544.64	4.3	19,542
		Sub-Total:				179,555
		Total for 5 Nos Culverts				897,773

4.6: Cost Estimate of Pipe Outlet

Item	MRS 2013 Item Code	Description	Unit	Quantity	Rate (Rs)	Amount (Rs)
4.6.1	03-23-d	Excavation in Foundation of Building, bridges etc complete in shingle/gravel	m3	8	203.84	267
4.6.2	06-05-h	Plain Cement Concrete including placing, compacting,finishing & curing (Ratio 1:3:6)	m3	2.7	5603.70	15,222
4.6.3	06-06-d-03	Reinforced cement concrete work as in dams, spillways, weirs, barrages, cross drainage works and other hydrolic structures using crushed stone aggregate (screening & washing) and coarse sand i/c costof all labour and material and all kinds of form works, moulds, shuttering lifting/ pumping, curing, rendering and finishing the exposed surface, cast in situ/precast excluding the cost of steel reinforcement and labour for bending binding also excludig cost of additives which have to be paid separately. Type C (1:2:4)	m3	0.13	9,206.24	1,181
4.6.4	06-07-b	Supply & fabricate M.S. reinforcement for cement concrete (Hot rolled deformed bars Grade 60)	m3	0.01	119,471.42	1,180
4.6.5	16-23-c	Reinforced Concrete Pipe Culvert (AASHTO M-170) Dia: 760mm	m	4	4544.64	16,622
4.6.6	19-27	Providing and Laying stone pitching with hammer dressed stones on surface, laid in courses	m3	1.22	2669.93	3,261
TOTAL AMOUNT FOR 01 NO						37,734
TOTAL AMOUNT FOR 04 NOS						150,935

4.7: Cost Estimate of Syphon

Item	MRS 2013 Item Code	Description of Item	Unit	Rate (Rs)	Quantity	Amount (Rs.)
4.7.1	03-60-a	Structural Excavation in Common Material	m3	218.85	431	94,333
4.7.2	03-60-c	Structural backfill using Common Material available at site	m3	326.79	80	26,267
4.7.3	06-05-i	Plain Cement Concrete including. placing compaction. finishing &curing (ratio1:4:8)	m3	4,860.62	15	71,591
4.7.4	06-06-d-03	Reinforced cement concrete work as in dams, spillways, weirs, barrages, cross drainage works and other hydrolic structures using crushed stone aggregate (screening & washing) and coarse sand i/c costof all labour and material and all kinds of form works, moulds, shuttering lifting/ pumping, curing, rendering and finishing the exposed surface, cast in situ/precast excluding the cost of steel reinforcement and labour for bending binding also excludig cost of additives which have to be paid separately. Type C (1:2:4)	m3	9,206.24	100	918,887
4.7.5	06-07-b	Supply & fabricate M.S. reinforcement for cement concrete (Hot rolled deformed bars Grade 60)	tonn	119,471.42	8	953,968
4.7.6	23-03-a-07	Providing and Laying RCC pipe sewers complete As per ASTM C-76-79, Class II : 30" i/d, Wall B	m	5,501.20	34	184,435
4.7.7	19-27	Providing and Laying stone pitching with hammer dressed stones on surface, laid in courses	m3	2,669.93	33	89,277
		Total carried over to Summary				2,338,760

SHAH KALEEM DAM
DISTRICT NOWSHERA
BILL OF QUANTITIES

Bill No. 5 :Electrification of Dam Embankment

Item No	MRS 2013 Item Code	Description	Unit	Quantity	Rate (Rs)	Amount (Rs)
5.1	15-40-a-01	S/FG. I.Tubular st. light pole 8' of 5" dia 7' 4",5' of 3" dia single arm of 5' of 1.5" dia.	Nos	11	33,927.40	373,201
5.2	15-35-b	S/F pole mounted street light complete for fitting 125/250 watt mercury lamp Phillips mad.	Nos	10	3,952.40	39,524
5.3	15-47-b	Wiring of main and sub main in 2 single core pvc insulated and sheathed cable 7-29	M	400	210.19	84,076
5.4	15-47-d	Wiring of main and sub main in 2 single core pvc insulated and sheathed cable 7-64	M	60	772.18	46,331
5.5	15-47-c	Wiring of main and sub main in 2 single core pvc insulated and sheathed cable 7-44	M	663	434.31	287,948
5.6	15-75-b	S&E cubical type factory fabricated floor/wall mounting steel main boar complete.	Nos	1	55,095.50	55,096
5.7	15-42	S& E 2'x2'x1/8" copper plate I/c revitting to copper tape & placing in mixture of salt etc.	Nos	11	5,785.48	63,640
5.8	15-02-a-07	Supply and Erection PVC pipe for wiring purpose complete On surface including clamps etc: 3" i/d	M	349	212.67	74,222
5.9	NSI	Provide install make necessary connection and carryout testing transformer 1KVA 0.415KVA and 0.5 KVA pole fitted with fuse link ,platform pole outgoing HCCBTP100 AMP at a location near dam site.	Each	1	1,000,000	1,000,000
		Total carried over to Summary				2,024,037

SHAH KALEEM DAM
DISTRICT NOWSHERA
BILL OF QUANTITIES

Bill No. 6 :Construction of Inspection Hut /Sub Engineer Office

S.No	MRS 2013 Item Code	Description	Unit	Quantity	Rate (Rs)	Amount (Rs)
6.1	03-23-d	Excavation in foundation of building, bridges etc complete : in shingle/gravel	m^3	94	203.84	19,134
6.2	06-03-b	Cement Concrete (brick/stone ballast, 1.5" to 2"/nullah shingle well graded and cleaned) in foundation & plinth (Ratio 1:4:8)	m^3	20	3,685.90	73,602
6.3	06-05-i	Plain Cement Concrete including placing, compacting, finishing & curing (Ratio 1:4:8) under floor	m^3	13	4,860.62	61,202
6.4	07-04-a-03	Pacca brick work in foundation and plinth in Cement, sand mortar 1:4	m^3	33	6,132.83	204,978
6.5	06-22-a-02	Damp proof course of cem. conc. 1:2:4 including bitumen coat, 1 layer polythene & 1 coat bitumen (2" thick)	m^2	18	504.92	9,133
6.6	07-05-a-05	Pacca brick work in ground floor Cement, sand mortar 1:6	m^3	51	6,257.00	321,997
6.7	06-06-a-03	RCC in roof slab, beam, column & other structural members, insitu or precast. Type C (1:2:4)	m^3	22	8,168.74	183,615
6.8	06-07-c	Supply & fabricate M.S. reinforcement for cement concrete (Hot rolled deformed bars Grade 40)	Tonne	1.12	110,134.80	123,779
6.9	10-15-e	Provide & lay topping of concrete 1:2:4, including surface finishing & dividing in panels : 2" thick	m^2	83	495.60	40,968
6.10	10-43-d	Providing and Fixing marble strip 2" wide and 3/8" thick for dividing the floor into panels .	m	322	22.69	7,312
6.11	11-12-b	Cement plaster 1:6, upto 20' height 1/2" thick	m^2	303	167.63	50,772
6.12	11-10-b	Cement plaster 3/8" thick under soffit of RCC roof slabs only upto 20' height : (1:3)	m^2	123	208.31	25,598
6.13	11-18-b	Cement pointing struck joints, on walls, upto 20' height : Ratio 1:3	m^2	131	184.59	24,120
6.14	13-30-a	Preparing surface and painting with emulsion paint : First coat	m^2	25	113.13	2,789
6.15	11-22	Priming coat of chalk under distemper	m^2	303	15.71	4,758
6.16	11-23-a-03	Distempering New surface : Three coats	m^2	303	57.66	17,464
6.17	03-16-a	Filling, watering and ramming earth under floor with surplus earth from foundation, etc	m^3	25	76.63	1,930
6.18	07-30	Supplying and filling sand under floor or plugging in wells	m^3	8	1,010.63	8,475
6.19	25-47-b	Supplying and Fixing 18 SWG MS Sheet Gate with angle iron frame (2"x2"x3/16") with side window, lock, painting etc	m^2	7	6,508.74	48,437
6.20	25-39-b-02	Providing and Fixing steel windows 18 gauge with openable glazed panels With 22 SWG wire gauze	m^2	7	5,794.02	41,194
6.21	25-47-a	Supplying and Fixing 18 SWG MS Sheet Door with angle iron frame (1.5"x1.5"x1/8"), bolt, hinges, paint etc complete	m^2	10	4,838.79	47,263
6.22	14-03-a	Providing and Fixing glazed earthen ware WC squatting type with built-in foot rests : White	No	2	1,485.20	2,970
6.23	14-05-a-01	Providing and Fixing glazed earthen ware WHB complete Size 22"x16" : White with pedestal	No	3	2,516.70	7,550
6.24	14-18-a	P/F best quality 5 mm glass shelf 24" x 5" with chromium plated brackets and railing	No	2	634.27	1,269

SHAH KALEEM DAM
DISTRICT NOWSHERA
BILL OF QUANTITIES

Bill No. 6 :Construction of Inspection Hut /Sub Engineer Office

S.No	MRS 2013 Item Code	Description	Unit	Quantity	Rate (Rs)	Amount (Rs)
6.25	14-17	Providing and Fixing best quality 5mm mirror 22"x16" size	No	2	796.3	1,593
6.26	14-16-a	Providing and Fixing CP towel rail : 24" long, 3/4" dia	No	2	651.03	1,302
6.27	14-15	Providing and Fixing CP toilet paper holder	No	2	439.28	879
6.28	14-20-a	Providing and Fixing Plastic soap dish	No	2	185.18	370
6.29	14-10-a	P/F glazed earthen ware low down flushing cistern 3 gallons	No	2	1,954.05	3,908
6.30	14-06-a	P/F stainless steel sink with drain boared size 48" x 24" I/C brackets, waste pipe etc.	No	1	3,303.20	3,303
6.31	14-27	Providing and Fixing CP mixing valve for WHB, sink or shower	No	3	2,115.13	6,345
6.32	14-26-b	P/F C-P shower rose 3/4"x6"	No	2	508.25	1,017
6.33	14-32-b	P/F "P" trap including G-1 Grating and Pcc chamber 4"glazed	No	7	309.3	2,165
6.34	24-16-c-03	Providing and laying 1" dia G.I. Pipe	m	21	399.08	8,514
6.35	24-16-c-02	Providing and laying 3/4" dia G.I. Pipe	m	6	294.93	1,798
6.36	24-16-c-01	Providing and laying 1/2" dia G.I. Pipe	m	12	213.74	2,606
6.37	14-69-b-03	P/F Polyethylene Water Tank 500 gallons	No	1	27,292.58	27,293
6.38	23-10	Septic tank inner size (7'x2'x5')	No	1	15,593.16	15,593
6.39	23-11	Soakage pit 6 ft dia and 15 ft deep complete	No	1	14,372.05	14,372
6.40	15-02-a-08	E/F cutt joint, test pvc pipe line 4" dia	m	4	253.22	1,003
6.41	14-37-b	S/F CI main hole with frame complete 18" dia	No	10	1,883.51	18,835
6.42	14-28-a	P/F gun metal peet /gate wall 1" dia	No	4	1,327.60	5,310
6.43	14-39-a	P/F brass stop /bib cock 1/2" dia	No	8	179.13	1,433
		Electrification				-
6.44	15-02-b-03	S/E pvc pipe for wiring purpose complete in recessed in wall I/C chase etc. 1" internal dia	m	61	162.82	9,925
6.45	15-50	Wiring of light / fan / call bell point in 3-29 pvc insulated cable in pvc pipe recessed	No	50	1,014.60	50,730
6.46	15-51	Wiring of 2/3 pin 5 AMP plug point in 3/029 pvc insulated cable in pvc pipe recessed	No	17	607.11	10,321
6.47	15-69-a	S/E pvc best quality exhaust fan complete with shutter & regulator 12" sweep	No	5	2,289.25	11,446
6.48	15-68-c	S/E best Quality ceiling fan complete with G-I rod canopy blade & regulator 56" sweep	No	6	3,045.08	18,270
6.49	15-75-b	Floor S/E cubical type factory fabricated floor / wall mounted main board steel complete recessed	No	1	55,095.50	55,096
6.5	15-56-b	Supply and Erection white round globe with holder, gallery & 100 Watt bulb complete : 8" dia.	No	10	394.02	3,940
6.51	15-24-b	S/E tube light rod and choke complete 40 watt	set	8	477.36	1,087
6.52	15-47-b	Wiring of main & sub-main in 2 single core PVC insulated & sheathed cable : 7/0.029	m	100	210.19	21,019
6.53	14-80-c	Supply and fixing of 2.0 HP Monoblock water pump 2"x2" size 1 stage SE model single phase for 65 ft head with all accessories and fittings.	No	1	16,767.03	16,767
		Total carried over to Summary				1,646,549

SHAHKALEEM DAM
DISTRICT NOWSHERA

RELOCATION OF EXISTING SHINGLE TRACK OUT OF RESERVOIR

SUMMARY OF THE BILLS

S. No	Bill No	Description of Item	AMOUNT (Rs.)
1	1	EARTH WORK	15,913,092
2	2	SUB BASE & BASE COURSE	3,064,108
3	4 (A)	ROAD STRUCTURE (RETAINING WALLS)	11,482,787
4	4 (B)	ROAD STRUCTURE (CULVERTS)	5,069,117
GRAND TOTAL:			35,529,104

SHAHKALEEM DAM

DISTRICT NOWSHERA

RELOCATION OF EXISTING SHINGLE TRACK OUT OF RESERVOIR

BILL NO. 1. EARTH WORK

S. No	Item No.	Description of Item	Unit	Rate MRS 2013	BOQ	
					Quantity	Amount (Rs.)
1	03-56	Clearing & Grubbing	m^2	20.94	11,300	236,622
2	03-57-a	Removal of Tree : Girth 150mm - 300 mm including	NO	449.86	50	22,493
3	03-57-b	Removal of Tree : Girth 300mm - 600mm including removal of stump & backfilling with sand	NO	899.71	23	20,693
4	03-58	Compaction of Natural Ground	m^2	18.17	11,300	205,321
5	03-59-b	Roadway Excavation in Surplus / Unsuitable Rock Material	m^3	534.27	4,992	2,666,959
6	03-61-a	Formation of Embankment from Roadway Excavation in Common Material including compaction by power roller.	m^3	310.39	10,608	3,292,473
7	03-61-c	Formation of Embankment from Borrow Excavation in Common Material including compaction by power roller.	m^3	618.40	15,266	9,440,510
8	16-10	Scarifying/Dismantling old road surface, including removal of debris within one chain (NHA specified)	m^2	23.35	1,200	28,020
		Sub-Total				15,913,092

BILL NO. 2. SUB-BASE AND BASE-COURSE

S. No	Item No.	Description of Item	Unit	Rate MRS 2013	BOQ	
					Quantity	Amount (Rs.)
1	03-62-b	Sub grade Preparation	m^2	84.85	7,300	619,405
2	16-03-a	Granular Sub Base course usin pit run gravel including shoulder	m^3	1,065.23	2,295	2,444,703
		Sub-Total				3,064,108

SHAHKALEEM DAM

DISTRICT NOWSHERA

RELOCATION OF EXISTING SHINGLE TRACK OUT OF RESERVOIR

BILL NO 4 A : RETAINING WALL

Sr. No	Item No.	Description of Item	Unit	Rate MRS 2013	BOQ	
					Quantity	Amount (Rs.)
1	03-60-a	Structural Excavation in Common Material	m^3	218.85	1,125	246,206
2	03-60-c	Structural backfill using Common Material available at site	m^3	326.79	281	91,910
3	06-05-f	Plain Cement Concrete incl. placing, compacting, finishing & curing (Ratio 1:2:4) in Copping.	m^3	6,469.09	12.5	80,864
4	06-05-i	Plain Cement Concrete including. placing compaction.finishing &curing (ratio1:4:8)	m^3	4,860.62	135	656,184
5	08-01-d-03	Random rubble masonry in foundn. & plinth in cement, sand mortar : Ratio 1:6	m^3	5,016.45	2,013	10,095,606
6	11-19-c-02	Pointing flush on stone work, upto 20' height On stone work raised : in c/s mortar 1:3	m^2	271.32	1150.00	312,018
		Sub-Total				11,482,787

BILL NO 4 B : Culvert

Sr. No	Item No.	Description of Item	Unit	Rate MRS 2013	BOQ	
					Quantity	Amount (Rs.)
1	03-60-a	Structural Excavation in Common Material	m^3	218.85	36	7,849
2	03-60-c	Structural backfill using Common Material available at site	m^3	326.79	11	3,516
3	06-05-f	Plain Cement Concrete including. placing compaction. finishing &curing (ratio1:2:4)	m^3	6,469.09	20	130,758
4	06-05-i	Plain Cement Concrete including. placing compaction. finishing &curing (ratio1:4:8)	m^3	4,860.62	43	208,039
5	06-06-a-03	RCC in roof slab, beam, column & other structural members, insitu or precast. Type C (1:2:4)	m^3	8168.74	9	71,637
6	06-07-b	Supply & fabricate M.S. reinforcement for cement concrete (Hot rolled deformed bars Grade 60)	tonn	119471.42	0.67	79,626
7	07-04-a-03	Pacca brick work in foundation and plinth in Cement, sand mortar 1:4	m^3	6,132.83	55	334,739
8	11-09-a	Cement plaster 1:4 upto 20' height 3/8" thick	m^2	167.44	52	8,687
		Sub-Total:				844,853
		Total for 6 No Culverts				5,069,117

Economic Analysis

Table – 12.1

Derivation of Standard Conversion Factor

Description	2003-04	2004-05	2005-06	2006-07	2007-08	Average
Total Import (M)*	897825	1223079	1711158	1851806	1979103	1532594
Total Exports (X)*	709036	854088	984841	1029312	940484	903552
Imports Duties*	90940	117243	138200	132200	154000	126516.6
Sales Tax on Imports*	220607	235533	294600	309228	375000	286993.6
Subsidies on Imports*	62500	57800	86300	74010	373300	130782
Exports Duties (Tx)*	45823	58670	55000	71575	98000	65814
SCF**	0.89	0.90	0.90	0.91	0.98	0.92

SCF = (M+X)/(M+Tm)+(X-Tx)

M= CIF value of imports

X= FOB value of exports

Tm=Net value of taxes on imports

Tx= Net value of taxes on exports

Tm =	282728
M + X =	*2436146*
M + Tm =	*1815322*
X - Tx =	*837739*
(M+Tm)+(X-Tx) =	*2653061*
S C F =	*0.92*

* Source: Economic Survey 2006-07.

** Source: Ministry of Finance, Islamabad.
Note: Import subsidy includes subsidies on Wheat and Sugar.

Table - 12.2

Import Parity Price of Maiz

1 US$ =PAK Rs. 84

Sr. #	Description	Unit	Economic
1	World Bank Commodity Price	U.S $/MT	282.79
2	Quality Adjustment Factor	Factor	0.9
3	Adjusted to Pakistani Standard	U.S $/MT	258.75
4	Freight and Marine Insurance from Canadian port to Karachi	U.S $	33.00
5	c.i.f. Price at Karachi	U.S $/MT	291.75
6	c.i.f. Price at Karachi	RS/MT	24,507.24
7	Transportation and Handling Charges from Karachi to Nowshera	Rs/MT	4,600.00
8	Equivalent Value at Nowshera	Rs/MT	29,107.24
9	Transportation Charges from Nowshera to Project Area	Rs/MT	55.20
10	Value at project area	Rs/MT	29,162.44
11	Farmgate Price of Maize	Rs/MT	29,217.64
		Rs/Kg	29.22

Source: 1) World Bank Development Prospects- Commodity Price Data Pinksheet- Jan-March 2011. Maize (US), no. 2, yellow, f.o.b. US Gulf ports

2) Consultant's Economic Survey 2011

Table - 12.3

Import Parity Price of Wheat

1 US$ =PAK Rs. 84

Sr. #	Description	Unit	Economic
1	World Bank Commodity Price	U.S $/MT	449.03
2	Quality Adjustment Factor		0.9
3	Adjusted to Pakistani Standard	U.S $/MT	410.86
4	Freight and Marine Insurance from Canadian port to Karachi	U.S $	33.00
5	c.i.f. Price at Karachi	U.S $/MT	443.86
6	c.i.f. Price at Karachi	RS/MT	37,284.45
7	Transportation and Handling Charges from Karachi to Nowshera	Rs/MT	4,600.00
8	Equivalent Value at Nowshera	Rs/MT	41,884.45
9	Transportation Charges from Nowshera to Project Area	Rs/MT	55.20
10	Value at project area	Rs/MT	41,939.65
10	Farmgate Price of Wheat	Rs/MT	41,994.85
		Rs/Kg	41.99

Source 1) World Bank Development Prospects - Commodity Price Data Pinksheet - Jan-Marrch 2011. Wheat (Canadian), no. 1, Western Red Spring (CWRS), in store, St. Lawrence, export price

2) Consultant's Economic Survey 2011

Table - 12.4

Import Parity Price of Urea

1 US$ = PAK Rs. 84

Sr. #	Description	Unit	Economic
1	World Bank Commodity Price	US $/ MT	353.35
2	Freight and Marine Insurance to Karachi	US $/ MT	38.50
3	c.i.f. Price at Karachi	US $/MT	391.85
4	c.i.f. Price at Karachi	Rs/MT	32,915.40
5	Transportation and Handling Charges from Karachi to Nowshera	Rs/MT	4,600.00
6	Equivalent Value at Nowshera	Rs/MT	37,515.40
7	Transportation Charges from Nowshera to Project Area	Rs/MT	55.20
8	Value at project area	Rs/MT	37,570.60
9	Equivalent Farmgate Price	Rs/MT	37,625.80
10	Farmgate Price per bag (One bag of 50 Kg)	Rs/bag	1,881.29
11	Farmgate Price of Nitrogen	Rs/P Kg	81.8

Source: 1) World Bank Development Prospects - Commodity Price Data Pinksheet - Jan-March 2011. Urea f.o.b. Eastern Europe onwards f.o.b. blacksea.
2) Consultant's Economic Survey 2011

Table - 12.5

Import Parity Price of DAP (Phosphate)

1 US$ = PAK Rs. 84

Sr. #	Description	Unit	Economic
1	World Bank Commodity Price	US $/ MT	601.67
2	Freight and Marine Insurance to Karachi	US $/ MT	38.50
3	c.i.f. Price at Karachi	US $/MT	640.17
4	c.i.f. Price at Karachi	Rs/MT	53,774.28
5	Transportation and Handling Charges from Karachi to Nowshera	Rs/MT	4,600.00
6	Equivalent Value at Nowshera	Rs/MT	58,374.28
7	Transportation Charges from Nowshera to Project Area	Rs/MT	55.20
8	Value at project area	Rs/MT	58,429.48
9	Equivalent Farmgate Price	Rs/MT	58,484.68
10	Farmgate Price per bag (One bag of 50 Kg)	Rs/bag	2,924.23
11	Less Value of Nitrogen @ 9 kg per bag	Rs/bag	736.16
12	Farmgate Price of P_2O_5	Rs/P Kg	95.1

Source: 1) World Bank Development Prospects - Commodity Price Data Pinksheet - Jan-March 2011. DAP (diammonium phosphate), standard size, bulk, spot, f.o.b. US Gulf.

2) Consultant's Economic Survey 2011

Table - 12.6

Import Parity Price of Potash (Potassium)

1 US$ = PAK Rs. 84

Sr. #	Description	Unit	Economic
1	World Bank Commodity Price	US $/ MT	374.17
2	Freight and Marine Insurance to Karachi	US $/ MT	38.50
3	c.i.f. Price at Karachi	US $/MT	412.67
4	c.i.f. Price at Karachi	Rs/MT	34,664.28
5	Transportation and Handling Charges from Karachi to Nowshera	Rs/MT	4,600.00
6	Equivalent Value at Nowshera	Rs/MT	39,264.28
7	Transportation Charges from Nowshera to Project Area	Rs/MT	55.20
8	Value at project area	Rs/MT	39,319.48
9	Equivalent Farmgate Price	Rs/MT	39,374.68
10	Farmgate Price per bag (One bag of 50 Kg)	Rs/bag	1,968.73
11	Farmgate Price of K	Rs/K Kg	78.7

Source: 1) World Bank Development Prospects - Commodity Price Data Pinksheet - Jan-March 2011. Potassium chloride (muriate of potash), standard grade, spot, f.o.b Vancouver.

2) Consultant's Economic Survey 2011

Table: 12.7

TOTAL VALUE OF PRODUCTION -SHAH KALEEM (Million Rs.)

S.#	Crops	Years of development			
		Base	Year 1	Year 2	Year 3
1	Maize	1.225	4.066	5.259	6.121
2	K.Fodder	0.000	0.516	0.969	1.257
3	K. Vegetables	0.000	4.521	8.125	10.982
4	Sugarcane	0.000	5.557	11.126	14.403
5	K.Oilseeds	0.000	0.000	0.000	0.000
6	Wheat	3.819	9.214	11.405	13.806
7	R. Vege. (Onion)	0.000	6.356	11.342	13.742
8	Other	0.000	0.000	0.000	0.000
9	Orchards(Plums)*	0.000	0.788	1.425	1.828
	N. V. P OF CROPS	5.044	30.231	48.217	59.412
	N. V. P OF ORCHARDS		60.200	60.836	61.239

* For Orchards Year 1,2&3 represents Year 6,8&10 respectively

Table: 12.9
FISHERIES BENEFITS

S.#	Description	Unit	Qty
1	Reservoir Area	Acre	30
2	Depth	m	62.0
3	Volume	AF	1762
4	Run off	AF	2008
5	Fertility	Moderate	
6	Fish Fingerling stocking Rate	Per Acre	650
7	Total Seed Stocking	No.	19500
8	Mortality	%	30%
9	Growth @ 1Kg / per Year	Kg	13650
10	Fishing Efforts	%	70%
11	Estimated Catch / ter	Kg	9555
12	Average Rate (Market Price)	Rs. / Kg	110
13	Total Value	Mill. Rs.	1.051

Source: Directorate of Fisheries WAPDA
Publications of Fisheries Department
Consultants Economic Survey

Table: 12.10 A

Shah Kalim Dam Project

Derivation of Benefit Cost Ratio, Net Present Worth and PIRR

Construction Period = 2 Years

Project Year	Project Benefits (Million Rupees)	Project Cost (Million Rupees)	Cash Flow (Million Rupees)	D.F @ 10%	Present Worth (Million Rupees)		Net Present Worth of Cash Flow (Million Rupees)
					Costs	Benefits	10%
1	0.000	290.828	-290.828	0.909	264.360	0.000	-264.360
2	0.000	305.525	-305.525	0.826	252.360	0.000	-252.360
3	55.162	1.630	53.532	0.751	1.220	41.430	40.210
4	73.149	1.630	71.519	0.683	1.110	49.960	48.850
5	84.343	1.630	82.713	0.621	1.010	52.380	51.370
6	84.343	1.630	82.713	0.564	0.920	47.570	46.650
7	84.343	1.630	82.713	0.513	0.840	43.270	42.430
8	84.343	1.630	82.713	0.467	0.760	39.390	38.630
9	85.131	1.630	83.501	0.424	0.690	36.100	35.410
10	85.339	1.630	83.709	0.386	0.630	32.940	32.310
11	85.547	1.630	83.917	0.350	0.570	29.940	29.370
12	85.755	1.630	84.125	0.319	0.520	27.360	26.840
13	85.963	1.630	84.333	0.290	0.470	24.930	24.460
14	85.963	1.630	84.333	0.263	0.430	22.610	22.180
15	86.171	1.630	84.541	0.239	0.390	20.590	20.200
16	86.171	1.630	84.541	0.218	0.360	18.790	18.430
17	86.171	1.630	84.541	0.198	0.320	17.060	16.740
18	86.171	1.630	84.541	0.180	0.290	15.510	15.220
19	86.171	1.630	84.541	0.164	0.270	14.130	13.860
20	86.171	1.630	84.541	0.149	0.240	12.840	12.600
21	86.171	1.630	84.541	0.135	0.220	11.630	11.410
22	86.171	1.630	84.541	0.123	0.200	10.600	10.400
23	86.171	1.630	84.541	0.112	0.180	9.650	9.470
24	86.171	1.630	84.541	0.102	0.170	8.790	8.620
25	86.171	1.630	84.541	0.092	0.150	7.930	7.780
26	86.171	1.630	84.541	0.084	0.140	7.240	7.100
27	86.171	1.630	84.541	0.076	0.120	6.550	6.430
28	86.171	1.630	84.541	0.069	0.110	5.950	5.840
29	86.171	1.630	84.541	0.063	0.100	5.430	5.330
30	86.171	1.630	84.541	0.057	0.090	4.910	4.820
31	86.171	1.630	84.541	0.052	0.080	4.480	4.400
32	86.171	1.630	84.541	0.047	0.080	4.050	3.970
33	86.171	1.630	84.541	0.043	0.070	3.710	3.640
34	86.171	1.630	84.541	0.039	0.060	3.360	3.300
35	86.171	1.630	84.541	0.036	0.060	3.100	3.040
36	86.171	1.630	84.541	0.032	0.050	2.760	2.710
37	86.171	1.630	84.541	0.029	0.050	2.500	2.450
38	86.171	1.630	84.541	0.027	0.040	2.330	2.290
39	86.171	1.630	84.541	0.024	0.040	2.070	2.030
40	86.171	1.630	84.541	0.022	0.040	1.900	1.860
41	86.171	1.630	84.541	0.020	0.030	1.720	1.690
42	86.171	1.630	84.541	0.018	0.030	1.550	1.520
Sum	3392.156	661.553	2730.603		529.870	659.010	129.140
					526.64	487.26	

B/C	1.24
NPW	129.1
PIRR	12.4%

Table: 12.10 B
Shah Kalim Dam Project
COST INCREASE OF 10%

Construction Period = 2 Years

Project Benefits (Million Rupees)	Project Cost (Million Rupees)	Cash Flow (Million Rupees)	D.F @ 10%	Present Worth (Million Rupees)	
				Costs	Benefits
0.000	270.127	-270.127	0.909	245.550	0.000
0.000	360.250	-360.250	0.826	297.570	0.000
55.162	1.793	53.369	0.751	1.350	41.430
73.149	1.793	71.356	0.683	1.220	49.960
84.343	1.793	82.550	0.621	1.110	52.380
84.343	1.793	82.550	0.564	1.010	47.570
84.343	1.793	82.550	0.513	0.920	43.270
84.343	1.793	82.550	0.467	0.840	39.390
85.131	1.793	83.338	0.424	0.760	36.100
85.339	1.793	83.546	0.386	0.690	32.940
85.547	1.793	83.754	0.350	0.630	29.940
85.755	1.793	83.962	0.319	0.570	27.360
85.963	1.793	84.170	0.290	0.520	24.930
85.963	1.793	84.170	0.263	0.470	22.610
86.171	1.793	84.378	0.239	0.430	20.590
86.171	1.793	84.378	0.218	0.390	18.790
86.171	1.793	84.378	0.198	0.360	17.060
86.171	1.793	84.378	0.180	0.320	15.510
86.171	1.793	84.378	0.164	0.290	14.130
86.171	1.793	84.378	0.149	0.270	12.840
86.171	1.793	84.378	0.135	0.240	11.630
86.171	1.793	84.378	0.123	0.220	10.600
86.171	1.793	84.378	0.112	0.200	9.650
86.171	1.793	84.378	0.102	0.180	8.790
86.171	1.793	84.378	0.092	0.160	7.930
86.171	1.793	84.378	0.084	0.150	7.240
86.171	1.793	84.378	0.076	0.140	6.550
86.171	1.793	84.378	0.069	0.120	5.950
86.171	1.793	84.378	0.063	0.110	5.430
86.171	1.793	84.378	0.057	0.100	4.910
86.171	1.793	84.378	0.052	0.090	4.480
86.171	1.793	84.378	0.047	0.080	4.050
86.171	1.793	84.378	0.043	0.080	3.710
86.171	1.793	84.378	0.039	0.070	3.360
86.171	1.793	84.378	0.036	0.060	3.100
86.171	1.793	84.378	0.032	0.060	2.760
86.171	1.793	84.378	0.029	0.050	2.500
86.171	1.793	84.378	0.027	0.050	2.330
86.171	1.793	84.378	0.024	0.040	2.070
86.171	1.793	84.378	0.022	0.040	1.900
86.171	1.793	84.378	0.020	0.040	1.720
86.171	1.793	84.378	0.018	0.030	1.550
3392.16	702.10	2690.06		557.58	659.01

B/C	1.2
NPW	101.4
PIRR	11.8%

Table: 12.10 C

Shah Kalim Dam Project

REDUCTION IN BENEFITS OF 10%

Construction Period = 2 Years

Project Benefits (Million Rupees)	Project Cost (Million Rupees)	Cash Flow (Million Rupees)	D.F @ 10%	Present Worth (Million Rupees)	
				Costs	Benefits
0.000	290.828	-290.828	0.909	264.360	0.000
0.000	305.525	-305.525	0.826	252.360	0.000
49.646	1.630	48.016	0.751	1.220	37.280
65.834	1.630	64.204	0.683	1.110	44.960
75.909	1.630	74.279	0.621	1.010	47.140
75.909	1.630	74.279	0.564	0.920	42.810
75.909	1.630	74.279	0.513	0.840	38.940
75.909	1.630	74.279	0.467	0.760	35.450
76.618	1.630	74.988	0.424	0.690	32.490
76.805	1.630	75.175	0.386	0.630	29.650
76.992	1.630	75.362	0.350	0.570	26.950
77.179	1.630	75.549	0.319	0.520	24.620
77.366	1.630	75.736	0.290	0.470	22.440
77.366	1.630	75.736	0.263	0.430	20.350
77.554	1.630	75.924	0.239	0.390	18.540
77.554	1.630	75.924	0.218	0.360	16.910
77.554	1.630	75.924	0.198	0.320	15.360
77.554	1.630	75.924	0.180	0.290	13.960
77.554	1.630	75.924	0.164	0.270	12.720
77.554	1.630	75.924	0.149	0.240	11.560
77.554	1.630	75.924	0.135	0.220	10.470
77.554	1.630	75.924	0.123	0.200	9.540
77.554	1.630	75.924	0.112	0.180	8.690
77.554	1.630	75.924	0.102	0.170	7.910
77.554	1.630	75.924	0.092	0.150	7.130
77.554	1.630	75.924	0.084	0.140	6.510
77.554	1.630	75.924	0.076	0.120	5.890
77.554	1.630	75.924	0.069	0.110	5.350
77.554	1.630	75.924	0.063	0.100	4.890
77.554	1.630	75.924	0.057	0.090	4.420
77.554	1.630	75.924	0.052	0.080	4.030
77.554	1.630	75.924	0.047	0.080	3.650
77.554	1.630	75.924	0.043	0.070	3.330
77.554	1.630	75.924	0.039	0.060	3.020
77.554	1.630	75.924	0.036	0.060	2.790
77.554	1.630	75.924	0.032	0.050	2.480
77.554	1.630	75.924	0.029	0.050	2.250
77.554	1.630	75.924	0.027	0.040	2.090
77.554	1.630	75.924	0.024	0.040	1.860
77.554	1.630	75.924	0.022	0.040	1.710
77.554	1.630	75.924	0.020	0.030	1.550
77.554	1.630	75.924	0.018	0.030	1.400
3052.94	661.55	2391.39		529.87	593.09

B/C	1.1
NPW	63.2
PIRR	11.2%

Table: 12.10 D
Shah Kalim Dam Project
COST INCREASE AND REDUCTION OF BENEFITS

Construction Period = 2 Years

Project Benefits (Million Rupees)	Project Cost (Million Rupees)	Cash Flow (Million Rupees)	D.F @ 10%	Present Worth (Million Rupees)	
				Costs	Benefits
0.000	270.127	-270.127	0.909	245.550	0.000
0.000	360.250	-360.250	0.826	297.570	0.000
49.646	1.793	47.853	0.751	1.350	37.280
65.834	1.793	64.041	0.683	1.220	44.960
75.909	1.793	74.116	0.621	1.110	47.140
75.909	1.793	74.116	0.564	1.010	42.810
75.909	1.793	74.116	0.513	0.920	38.940
75.909	1.793	74.116	0.467	0.840	35.450
76.618	1.793	74.825	0.424	0.760	32.490
76.805	1.793	75.012	0.386	0.690	29.650
76.992	1.793	75.199	0.350	0.630	26.950
77.179	1.793	75.386	0.319	0.570	24.620
77.366	1.793	75.573	0.290	0.520	22.440
77.366	1.793	75.573	0.263	0.470	20.350
77.554	1.793	75.761	0.239	0.430	18.540
77.554	1.793	75.761	0.218	0.390	16.910
77.554	1.793	75.761	0.198	0.360	15.360
77.554	1.793	75.761	0.180	0.320	13.960
77.554	1.793	75.761	0.164	0.290	12.720
77.554	1.793	75.761	0.149	0.270	11.560
77.554	1.793	75.761	0.135	0.240	10.470
77.554	1.793	75.761	0.123	0.220	9.540
77.554	1.793	75.761	0.112	0.200	8.690
77.554	1.793	75.761	0.102	0.180	7.910
77.554	1.793	75.761	0.092	0.160	7.130
77.554	1.793	75.761	0.084	0.150	6.510
77.554	1.793	75.761	0.076	0.140	5.890
77.554	1.793	75.761	0.069	0.120	5.350
77.554	1.793	75.761	0.063	0.110	4.890
77.554	1.793	75.761	0.057	0.100	4.420
77.554	1.793	75.761	0.052	0.090	4.030
77.554	1.793	75.761	0.047	0.080	3.650
77.554	1.793	75.761	0.043	0.080	3.330
77.554	1.793	75.761	0.039	0.070	3.020
77.554	1.793	75.761	0.036	0.060	2.790
77.554	1.793	75.761	0.032	0.060	2.480
77.554	1.793	75.761	0.029	0.050	2.250
77.554	1.793	75.761	0.027	0.050	2.090
77.554	1.793	75.761	0.024	0.040	1.860
77.554	1.793	75.761	0.022	0.040	1.710
77.554	1.793	75.761	0.020	0.040	1.550
77.554	1.793	75.761	0.018	0.030	1.400
3052.94	702.10	2350.84		557.58	593.09

B/C	1.1
NPW	35.5
PIRR	10.6%

Table-A1:ECONOMICS GROSS MARGINS - MAIZE
SHAH KALIM DAM PROJECT

S. No.	Description	Unit	Base Year	Years of development		
				Year 1	Year 2	Year 3
	Crop Gross Return					
1	Yield	Kg	486	716	812	870
	Rate	Rs/Kg	29.22	29.22	29.22	29.22
	Sub Total	Rs	14200	20932	23736	25419
2	By Products	Kg	972	1433	1625	1740
	Rate	Rs/Kg	2.76	2.76	2.76	2.76
	Sub Total	Rs	2683	3955	4484	4802
	Gross Production Value	**Rs**	**16882**	**24886**	**28221**	**30222**
	Crop Production Expenses					
	Cultural Practices					
1	Ploughings	No	2.0	3.0	3.7	4.0
	Rate	Rs/ Pass	207.00	207.00	207.00	207.00
	Sub Total	Rs	414	621	773	828
2	Planking	No	0	0	0	0
	Rate	Rs/ Pass	0	0	0	0
	Sub Total	Rs	0	0	0	0
3	Seed	Kg	12.0	12	12	12
	Rate	Rs/Kg	16.56	16.56	16.56	16.56
	Sub Total	Rs	198.72	198.72	198.72	198.72
	Manure and Fertilizer					
4	Urea	Kg	5.0	9.1	10.3	11.0
	Rate	Rs/Kg	81.80	81.80	81.80	81.80
	Sub Total	Rs	409	741	840	900
5	DAP	Kg	0.0	0.0	0.0	0.0
	Rate	Rs/Kg	95.13	95.13	95.13	95.13
	Sub Total	Rs	0	0	0	0
6	K_2SO_4	Kg	18.9	21.5	23.0	0.0
	Rate	Rs/Kg	78.75	78.75	78.75	78.75
	Sub Total	Rs	1491.459	1691.319	1811.235	0
7	FYM	Kg	300	300	300	300
	Rate	Rs/Kg	0.20	0.20	0.20	0.20
	Sub Total	Rs	59.4	59.4	59.4	59.4
	Plant Protection Measures					
8	Granules	Kg	0	0	0	0
	Rate	Rs/Kg	0	0	0	0
	Sub Total	Rs	0	0	0	0
9	Sprays	No	0	1	1	1
	Area Sprayed	%	0	20	23	24
	Rate	Rs/ Spray	299	299	299	299
	Sub Total	Rs	0	60	68	72
	Labour Requirements		11.2	16.5	18.7	20.0
10	Hired Labour	Mandays	3.4	4.9	5.6	6.0
	Rate	Rs/Day	184	184	184	184
	Sub Total	Rs	617	909	1031	1104
11	Family Labour	Mandays	7.8	11.5	13.1	14.0
	Rate	Rs/Day	184	184	184	184
	Sub Total	Rs	1439	2121	2405	2576
	Cost Summary	Rs	4628	6402	7187	5738
	Gross Margins	Rs	12254	18484	21034	24484
	Cost as % of GPV	%	27	26	25	19
	Cropped Area	Acres	100	220	250	250
	Total Value of Production	Rs. (Million)	1.225	4.066	5.259	6.121

Table-A.2-ECONOMIC GROSS MARGINS - Kh. Fodder
SHAH KALIM DAM PROJECT

S. #	Description	Unit	Base Year	Years of development		
				Year 1	Year 2	Year 3
	Crop Gross Return					
1	Yield	Kg	0	5400	7650	9000
	Rate	Rs/Kg	2.76	2.76	2.76	2.76
	Sub Total	Rs	0	14904	21114	24840
2	By Products	Kg	0	0	0	0
	Rate	Rs/Kg	0.00	0.00	0.00	0.00
	Sub Total	Rs	0	0	0	0
Gross Production Value		**Rs**	**0**	**14904**	**21114**	**24840**
	Crop Production Expenses					
	Cultural Practices					
1	Ploughings	No	0.0	2.5	2.6	3.0
	Rate	Rs/ Pass	207.00	207.00	207.00	207.00
	Sub Total	Rs	0	518	528	621
2	Planking	No	0	0	0	0
	Rate	Rs/ Pass	0	0	0	0
	Sub Total	Rs	0	0	0	0
3	Seed	Kg	30.0	30	30	30
	Rate	Rs/Kg	14.72	14.72	14.72	14.72
	Sub Total	Rs	441.6	441.6	441.6	441.6
	Manure and Fertilizer					
4	Urea	Kg	0.0	0.0	0.0	0.0
	Rate	Rs/Kg	81.80	81.80	81.80	81.80
	Sub Total	Rs	0	0	0	0
5	DAP	Kg	0.0	0.0	0.0	0.0
	Rate	Rs/Kg	95.13	95.13	95.13	95.13
	Sub Total	Rs	0	0	0	0
6	K_2SO_4	Kg	13.2	18.7	22.0	0.0
	Rate	Rs/Kg	78.75	78.75	78.75	78.75
	Sub Total	Rs	1039.492	1472.613	1732.486	0
7	FYM	Kg	0	300	300	300
	Rate	Rs/Kg	0.20	0.20	0.20	0.20
	Sub Total	Rs	0	59.4	59.4	59.4

Table-A.2-ECONOMIC GROSS MARGINS - Kh. Fodder
SHAH KALIM DAM PROJECT

Plant Protection Measures						
8	Granules	Kg	0	0	0	0
	Rate	Rs/Kg	0	0	0	0
	Sub Total	Rs	0	0	0	0
9	Sprays	No	0	0	0	0
	Area Sprayed	%	0	20	23	24
	Rate	Rs/ Spray	299	299	299	299
	Sub Total	Rs	0	0	0	0
Labour Requirements			0.0	9.0	12.8	15.0
10	Hired Labour	Mandays	0.0	2.7	3.8	4.5
	Rate	Rs/Day	184	184	184	184
	Sub Total	Rs	0	497	704	828
11	Family Labour	Mandays	0.0	6.3	8.9	10.5
	Rate	Rs/Day	184	184	184	184
	Sub Total	Rs	0	1159	1642	1932
Cost Summary		Rs	1481	4147	5107	3882
Gross Margins		Rs	-1481	10757	16007	20958
Cost as % of GPV		%	0	28	24	16
Cropped Area		Acres	0	48	60	60
Total Value of Production		**Rs. (Million)**	**0.000**	**0.516**	**0.960**	**1.257**

Table-A3: ECONOMIC GROSS MARGINS - K. VEG. - SHAH KALIM DAM PROJECT

S. No.	Description	Unit	Base Year	Years of development		
				Year 1	Year 2	Year 3
	Crop Gross Return					
1	Yield	Kg	0	4080	5780	6800
	Rate	Rs/Kg	16.56	16.56	16.56	16.56
	Sub Total	Rs	0	67565	95717	112608
2	By Products	Kg	0	0	0	0
	Rate	Rs/Kg	0	0	0	0
	Sub Total	Rs	0	0	0	0
	Gross Production Value	Rs	0	67565	95717	112608
	Crop Production Expenses					
	Cultural Practices					
1	Ploughings	No	0.0	3.0	3.4	4.0
	Rate	Rs/ Pass	207	207	207	207
	Sub Total	Rs	0	621	704	828
2	Planking	No	0	0	0	0
	Rate	Rs/ Pass	0	0	0	0
	Sub Total	Rs	0	0	0	0
3	Seed	Kg	0.00	12	12	12
	Rate	Rs/Kg	16.56	16.56	16.56	16.56
	Sub Total	Rs	0	198.72	198.72	198.72
	Manure and Fertilizer					
4	Urea	Kg	0	13	18	21
	Rate	Rs/Kg	81.80	81.80	81.80	81.80
	Sub Total	Rs	0	1031	1460	1718
5	DAP	Kg	0	6	9	10
	Rate	Rs/Kg	95.13	95.13	95.13	95.13
	Sub Total	Rs	0	571	809	951
6	K_2SO_4	Kg	0	48	56	0
	Rate	Rs/Kg	78.75	78.75	78.75	78.75
	Sub Total	Rs	0	3748.47	4409.964	0
7	FYM	Kg	0	300	300	300
	Rate	Rs/Kg	0.20	0.20	0.20	0.20
	Sub Total	Rs	0	59.4	59.4	59.4
	Plant Protection Measures					
8	Granules	Kg	0	0	0	0
	Rate	Rs/Kg	0	0	0	0
	Sub Total	Rs	0	0	0	0
9	Sprays	No	0	3	3	3
	Area Sprayed	%	0	45	64	75
	Rate	Rs/ Spray	299	299	299	299
	Sub Total	Rs	0	404	572	673
	Labour Requirements					
10	Hired Labour	Mandays	0.0	24.0	34.0	40.0
	Rate	Rs/Day	0.0	7.2	10.2	12.0
	Sub Total	Rs	184	184	184	184
11	Family Labour	Mandays	0	1325	1877	2208
	Rate	Rs/Day	0.0	16.8	23.8	28.0
	Sub Total	Rs	184	184	184	184
	Cost Summary	Rs	0	3091	4379	5152
	Gross Margins	Rs	0	11049	14468	11788
	Cost as % of GPV	%	0	56516	81248	100820
	Cropped Area	Acres	0	16	15	10
	Total Value of Production	Rs. (Million)	0.000	80	100	100
				4.521	8.125	10.082

Table-A4: ECONOMIC GROSS MARGINS - SUGARCANE SHAH KALIM DAM PROJECT

S. No.	Description	Unit	Base Year	Years of development		
				Year 1	Year 2	Year 3
	Crop Gross Return					
1	Yield	Kg	0	12600	17850	21000
	Rate	Rs/Kg	5.75	5.75	5.75	5.75
	Sub Total	Rs	0	72450	102638	120750
2	By Products	Kg	0	2520	3570	4200
	Rate	Rs/Kg	2.76	2.76	2.76	2.76
	Sub Total	Rs	0	6955	9853	11592
Gross Production Value		Rs	0	79405	112491	132342
	Crop Production Expenses					
Cultural Practices						
1	Ploughings	No	0.0	3.0	3.4	5.0
	Rate	Rs/ Pass	207	207	207	207
	Sub Total	Rs	0	621	704	1035
2	Planking	No	0	0	0	0
	Rate	Rs/ Pass	0	0	0	0
	Sub Total	Rs	0	0	0	0
3	Seed	Kg	0	3200	3200	3200
	Rate	Rs/Kg	5.52	5.52	5.52	5.52
	Sub Total	Rs	0	17664	17664	17664
Manure and Fertilizer					56	
4	Urea	Kg	0	19	27	32
	Rate	Rs/Kg	81.80	81.80	81.80	81.80
	Sub Total	Rs	0	1570	2225	2617
5	DAP	Kg	0	0	0	0
	Rate	Rs/Kg	95.13	95.13	95.13	95.13
	Sub Total	Rs	0	0	0	0
6	K_2SO_4	Kg	0	54	63	0
	Rate	Rs/Kg	78.75	78.75	78.75	78.75
	Sub Total	Rs	0	4217.028	4961.21	0
7	FYM	Kg	0	300	300	300
	Rate	Rs/Kg	0.20	0.20	0.20	0.20
	Sub Total	Rs	0	59.4	59.4	59.4
Plant Protection Measures						
8	Granules	Kg	0	0	0	0
	Rate	Rs/Kg	0	0	0	0
	Sub Total	Rs	0	0	0	0
9	Sprays	No	0	1	1	1
	Area Sprayed	%	0	45	64	75
	Rate	Rs/ Spray	299	299	299	299
	Sub Total	Rs	0	135	191	224
Labour Requirements			0.0	48.0	68.0	80.0
10	Hired Labour	Mandays	0.0	14.4	20.4	24.0
	Rate	Rs/Day	184	184	184	184
	Sub Total	Rs	0	2650	3754	4416
11	Family Labour	Mandays	0.0	33.6	47.6	56.0
	Rate	Rs/Day	184	184	184	184
	Sub Total	Rs	0	6182	8758	10304
Cost Summary		Rs	0	33098	38316	36320
Gross Margins		Rs	0	46307	74175	96022
Cost as % of GPV		%	0	42	150	27
Cropped Area		Acres	0	120	150	150
Total Value of Production		Rs. (Million)	0.000	5.557	11.126	14.403

Table-A.5: ECONOMIC GROSS MARGINS - WHEAT
SHAH KALIM DAM PROJECT

S. No.	Description	Unit	Base Year	Years of development		
				Year 1	Year 2	Year 3
Crop Gross Return						
1	Yield	Kg	445	808	959	1050
	Rate	Rs/Kg	41.99	41.99	41.99	41.99
	Sub Total	Rs	18688	33932	40284	44095
2	By Products	Kg	445	808	959	1050
	Rate	Rs/Kg	2.76	2.76	2.76	2.76
	Sub Total	Rs	1228	2230	2648	2898
Gross Production Value		Rs	19916	36162	42931	46993
Crop Production Expenses						
Cultural Practices						
1	Ploughings	No	2.0	3.0	3.7	4.0
	Rate	Rs/ Pass	207	207	207	207
	Sub Total	Rs	414	621	756	828
2	Planking	No	0	0	0	0
	Rate	Rs/ Pass	0	0	0	0
	Sub Total	Rs	0	0	0	0
3	Seed	Kg	40	40	40	40
	Rate	Rs/Kg	23.92	23.92	23.92	23.92
	Sub Total	Rs	956.8	956.8	956.8	956.8
Manure and Fertilizer						
4	Urea	Kg	9	17	20	22
	Rate	Rs/Kg	81.80	81.80	81.80	81.80
	Sub Total	Rs	763	1385	1644	1799
5	DAP	Kg	9	0	0	0
	Rate	Rs/Kg	95.13	95.13	95.13	95.13
	Sub Total	Rs	887	0	0	0
6	K_2SO_4	Kg	33	39	43	0
	Rate	Rs/Kg	78.75	78.75	78.75	78.75
	Sub Total	Rs	2605.779	3093.556	3386.222	0
7	FYM	Kg	0	200	250	300
	Rate	Rs/Kg	0.20	0.20	0.20	0.20
	Sub Total	Rs	0	39.6	49.5	59.4
Plant Protection Measures						
8	Granules	Kg	0	0	0	0
	Rate	Rs/Kg	0	0	0	0
	Sub Total	Rs	0	0	0	0
9	Sprays	No	0	1	1	1
	Area Sprayed	%	0	45	64	75
	Rate	Rs/ Spray	299	299	299	299
	Sub Total	Rs	0	135	191	224
Labour Requirements			8.5	15.4	18.3	20.0
10	Hired Labour	Mandays	2.5	4.6	5.5	6.0
	Rate	Rs/Day	184	184	184	184
	Sub Total	Rs	468	850	1009	1104
11	Family Labour	Mandays	5.9	10.8	12.8	14.0
	Rate	Rs/Day	184	184	184	184
	Sub Total	Rs	1092	1982	2353	2576
Cost Summary		Rs	7186	9062	10345	7548
Gross Margins		Rs	12730	27100	32586	39445
Cost as % of GPV		%	36	25	24	16
Cropped Area		Acres	300	340	350	350
Total Value of Production		Rs. (Million)	3.819	9.214	11.405	13.806

Table-A.6: ECONOMIC GROSS MARGINS - R.VEGE (Onion)
SHAH KALIM DAM PROJECT

S. No.	Description	Unit	Base Year	Years of development		
				Year 1	Year 2	Year 3
Crop Gross Return						
1	Yield	Kg	0	2400	3400	4000
	Rate	Rs/Kg	36.80	36.80	36.80	36.80
	Sub Total	Rs	0	88320	125120	147200
2	By Products	Kg	0	0	0	0
	Rate	Rs/Kg	0.00	0.00	0.00	0.00
	Sub Total	Rs	0	0	0	0
Gross Production Value		Rs	0	88320	125120	147200
Crop Production Expenses						
Cultural Practices						
1	Ploughings	No	0.0	3.0	3.4	4.0
	Rate	Rs/ Pass	207	207	207	207
	Sub Total	Rs	0	621	704	828
2	Planking	No	0	0	0	0
	Rate	Rs/ Pass	0	0	0	0
	Sub Total	Rs	0	0	0	0
3	Seed	Grams	0	0	0	0
	Rate	Rs/Kg	404.80	404.80	404.80	404.80
	Sub Total	Rs	0	0	0	0
Manure and Fertilizer						
4	Urea	Kg	0	11	16	19
	Rate	Rs/Kg	81.80	81.80	81.80	81.80
	Sub Total	Rs	0	932	1321	1554
5	DAP	Kg	0	5	8	9
	Rate	Rs/Kg	95.13	95.13	95.13	95.13
	Sub Total	Rs	0	514	728	856
6	K_2SO_4	Kg	26	37	43	0
	Rate	Rs/Kg	78.75	78.75	78.75	78.75
	Sub Total	Rs	2031.733	2878.289	3386.222	0
7	FYM	Kg	0	200	250	300
	Rate	Rs/Kg	0.20	0.20	0.20	0.20
	Sub Total	Rs	0	39.6	49.5	59.4
Plant Protection Measures						
8	Granules	Kg	0	0	0	0
	Rate	Rs/Kg	0	0	0	0
	Sub Total	Rs	0	0	0	0
9	Sprays	No	0	1	1	1
	Area Sprayed	%	0	45	64	75
	Rate	Rs/ Spray	299	299	299	299
	Sub Total	Rs	0	135	191	224
Labour Requirements			0.0	20.4	28.9	34.0
10	Hired Labour	Mandays	0.0	6.1	8.7	10.2
	Rate	Rs/Day	184	184	184	184
	Sub Total	Rs	0	1126	1595	1877
11	Family Labour	Mandays	0.0	14.3	20.2	23.8
	Rate	Rs/Day	184	184	184	184
	Sub Total	Rs	0	2628	3722	4379
Cost Summary		Rs	2032	8873	11697	9778
Gross Margins		Rs	-2032	79447	113423	137422
Cost as % of GPV		%	0	10	9	7
Cropped Area		Acres	0	80	100	100
Total Value of Production		Rs. (Million)	0.000	6.356	11.342	13.742

Table-A.7: ECONOMIC GROSS MARGINS - ORCHARDS(Plums) SHAH KALIM DAM PROJECT

S. No.	Description	Unit	Base Year	Years of development		
				Year 1	Year 2	Year 3
	Crop Gross Return					
1	Yield	Kg	0	2880	4080	4800
	Rate	Rs/Kg	23.00	23.00	23.00	23.00
	Sub Total	Rs	0	66240	93840	110400
2	By Products	Kg	0	0	0	0
	Rate	Rs/Kg	0.00	0.00	0.00	0.00
	Sub Total	Rs	0	0	0	0
	Gross Production Value	Rs	0	66240	93840	110400
	Crop Production Expenses					
	Cultural Practices					
1	Ploughings	No	0	2	2	2
	Rate	Rs/ Pass	207	207	207	207
	Sub Total	Rs	0	414	414	414
2	Planking	No	0	0	0	0
	Rate	Rs/ Pass	0	0	0	0
	Sub Total	Rs	0	0	0	0
3	Seed	Grams	0	100	100	0
	Rate	Rs/Kg	404.80	404.80	404.80	404.80
	Sub Total	Rs	0	40.48	40.48	0
	Manure and Fertilizer					
4	Urea	Kg	0	24	34	40
	Rate	Rs/Kg	81.80	81.80	81.80	81.80
	Sub Total	Rs	0	1963	2781	3272
5	DAP	Kg	48	9	13	15
	Rate	Rs/Kg	95.13	95.13	95.13	95.13
	Sub Total	Rs	4566	856	1213	1427
6	K_2SO_4	Kg	48	68	80	0
	Rate	Rs/Kg	78.75	78.75	78.75	78.75
	Sub Total	Rs	3779.969	5354.96	6299.95	0.00
7	FYM	Kg	0	200	250	300
	Rate	Rs/Kg	0.20	0.20	0.20	0.20
	Sub Total	Rs	0	39.6	49.5	59.4
	Plant Protection Measures					
8	Granules	Kg	0	0	0	0
	Rate	Rs/Kg	0	0	0	0
	Sub Total	Rs	0	0	0	0
9	Sprays	No	0	2	2	2
	Area Sprayed	%	0	60	85	100
	Rate	Rs/ Spray	299	299	299	299
	Sub Total	Rs	0	359	508	598
	Labour Requirements					
10	Hired Labour	Mandays	0.0	13.0	18.4	21.6
	Rate	Rs/Day	184	184	184	184
	Sub Total	Rs	0	2385	3378	3974
11	Family Labour	Mandays	0.0	30.2	42.8	50.4
	Rate	Rs/Day	184	184	184	184
	Sub Total	Rs	0	5564	7883	9274
	Cost Summary	Rs	8346	16976	22567	19018
	Gross Margins	Rs	-8346	49264	71273	91382
	Cost as % of GPV	%	0	26	20	17
	Cropped Area	Acres	0	16	20	20
	Total Value of Production	Rs. (Million)	0.000	0.788	1.425	1.828

Table 12.11
SHAHKALEEM DAM
DISTRICT NOWSHERA
SUMMARY OF COST

S No.		Description	Amount Rs.(Million)
A	PRELIMINARIES		
	i	Land acquisition and trees and in built area	30.00
	ii.	Relocation of Power Line out of Reservoir.	5.00
		Sub Total A	**35.00**
B	WORKS		
	i.	Dam Embankment	213.46
	ii.	Spillway & Spill Channel	189.60
	iii.	Intake & Outlets Structure	13.40
	iv.	Electrification Dam Embankment	2.02
	v.	Irrigation System	38.42
	vi	Construction of Inspection Hut /Sub Engineer Office	1.65
	vii	Relocation of existing Shingle Track out of Reservoir	35.53
		Sub Total B	**494.08**
C	GENERAL		
	i	Consultancy Charges for construction supervision as per actual Bid +Escalation	34.00
	ii.	Escalation on specified material & labour (6.5%)	32.12
		Sub Total C	**66.12**
		Grand Total A+B+C	**595.200**

SHAH KALIM DAM

Table 12.12 A- Year Wise cost & Benefits of the Dam

Million Rs.

Year	Benefits				Costs			Benefits	Costs	Net Benefits				Year
	Agri.	Fisheries	Drinking Water	Total	Capital	O&M	Total	10 % less	10 % Over	Case I	Case II	Case III	Case IV	
2011	0.000	0.000	0.000	0.000	225.859	0.000	225.859	0.000	248.445	-225.859	-225.859	-248.445	-248.445	1
2012	0.000	0.000	0.000	0.000	312.277	0.000	312.277	0.000	343.504	-312.277	-312.277	-343.504	-343.504	2
2013	25.186	1.051	28.925	55.162	0.000	1.630	1.630	49.646	1.793	53.532	48.016	53.369	47.853	3
2014	43.173	1.051	28.925	73.149	0.000	1.630	1.630	65.834	1.793	71.519	64.204	71.356	64.041	4
2015	54.367	1.051	28.925	84.343	0.000	1.630	1.630	75.909	1.793	82.713	74.279	82.550	74.116	5
2016	54.367	1.051	28.925	84.343	0.000	1.630	1.630	75.909	1.793	82.713	74.279	82.550	74.116	6
2017	54.367	1.051	28.925	84.343	0.000	1.630	1.630	75.909	1.793	82.713	74.279	82.550	74.116	7
2018	54.367	1.051	28.925	84.343	0.000	1.630	1.630	75.909	1.793	82.713	74.279	82.550	74.116	8
2019	55.155	1.051	28.925	85.131	0.000	1.630	1.630	76.618	1.793	83.501	74.988	83.338	74.825	9
2020	55.363	1.051	28.925	85.339	0.000	1.630	1.630	76.805	1.793	83.709	75.175	83.546	75.012	10
2021	55.571	1.051	28.925	85.547	0.000	1.630	1.630	76.992	1.793	83.917	75.362	83.754	75.199	11
2022	55.779	1.051	28.925	85.755	0.000	1.630	1.630	77.179	1.793	84.125	75.549	83.962	75.386	12
2023	55.987	1.051	28.925	85.963	0.000	1.630	1.630	77.366	1.793	84.333	75.736	84.170	75.573	13
2024	55.987	1.051	28.925	85.963	0.000	1.630	1.630	77.366	1.793	84.333	75.736	84.170	75.573	14
2025	56.195	1.051	28.925	86.171	0.000	1.630	1.630	77.554	1.793	84.541	75.924	84.378	75.761	15
2026	56.195	1.051	28.925	86.171	0.000	1.630	1.630	77.554	1.793	84.541	75.924	84.378	75.761	16
2027	56.195	1.051	28.925	86.171	0.000	1.630	1.630	77.554	1.793	84.541	75.924	84.378	75.761	17
2028	56.195	1.051	28.925	86.171	0.000	1.630	1.630	77.554	1.793	84.541	75.924	84.378	75.761	18
2029	56.195	1.051	28.925	86.171	0.000	1.630	1.630	77.554	1.793	84.541	75.924	84.378	75.761	19

Table: 12.12- B SUMMARY OF ECONOMIC RESULTS
SHAH KALIM DAM

Rate of Discount	12%	Case I	Case II	Case III	Case IV
Present Worth of Benefits		531.41	478.27	531.41	478.27
Present Worth of Costs		461.32	461.32	507.45	507.45
Net Present Worth		70.09	16.95	23.96	-29.18
B/C Ratio		1.15	1.04	1.05	0.94
FIRR		13.7%	12.4%	12.5%	11.3%

Table: 12.13 A

Economic and Financial Prices

Output

(Rupees)

S.No.	Kharif	Unit	Economic	Financial
1	Maize	Kg	29.22	12.70
2	Maize Stalks	Kg	2.8	3.00
3	K.Fodder	Kg	2.8	3.00
4	K. Vegetables	Kg	16.6	18.00
5	K.Pulses	Kg	46.0	50.00
6	K.Oilseeds	Kg	49.5	53.85
7	By Product	Kg	1.8	2.00
8	Sugarcane	Kg	5.8	6.25
9	By Product	Kg	2.8	3.00
10	Wheat	Kg	41.99	23.75
11	Wheat Straw	Kg	2.8	3.00
12	R. Vegetables	Kg	36.8	40.00
13	Onion	Kg	20.2	22.00
14	Orchards	Kg	23.0	25.00

Inputs (Seed)

(Rupees)

		Unit	Economic	Financial
	Kharif			
1	Maize	Kg	16.6	18.00
2	K.Fodder	Kg	14.7	16.00
3	K. Vegetables	Kg	121.4	132.00
4	K.Pulses	Kg	50.6	55.00
5	K.Oilseeds	Kg	55.2	60.00
6	Sugarcane	Kg	5.5	6.00
7	Wheat	Kg	23.9	26.00
8	R. Vegetables	Kg	151.8	165.00
9	Onion	Kg	404.8	440.00
10	Orchards	Plant	20.2	22.00
	Fertilizers			
11	Nitrogen	Kg	81.8	47.83
12	Phosphate	Kg	95.1	134.78
13	Potash	Kg	78.7	108.00
14	FYM	Kg	0.2	0.22
	Chemicals			
15	Pesticides	Per Spray	299.0	325.00
16	Granules		414.0	450.00
17	Sprays		322.0	350.00

Source: 1. Consultant's Economic Survey

2. Burue of Statistics, P& D Department Government of Khyber Pakhtunkhwa - Nowshera

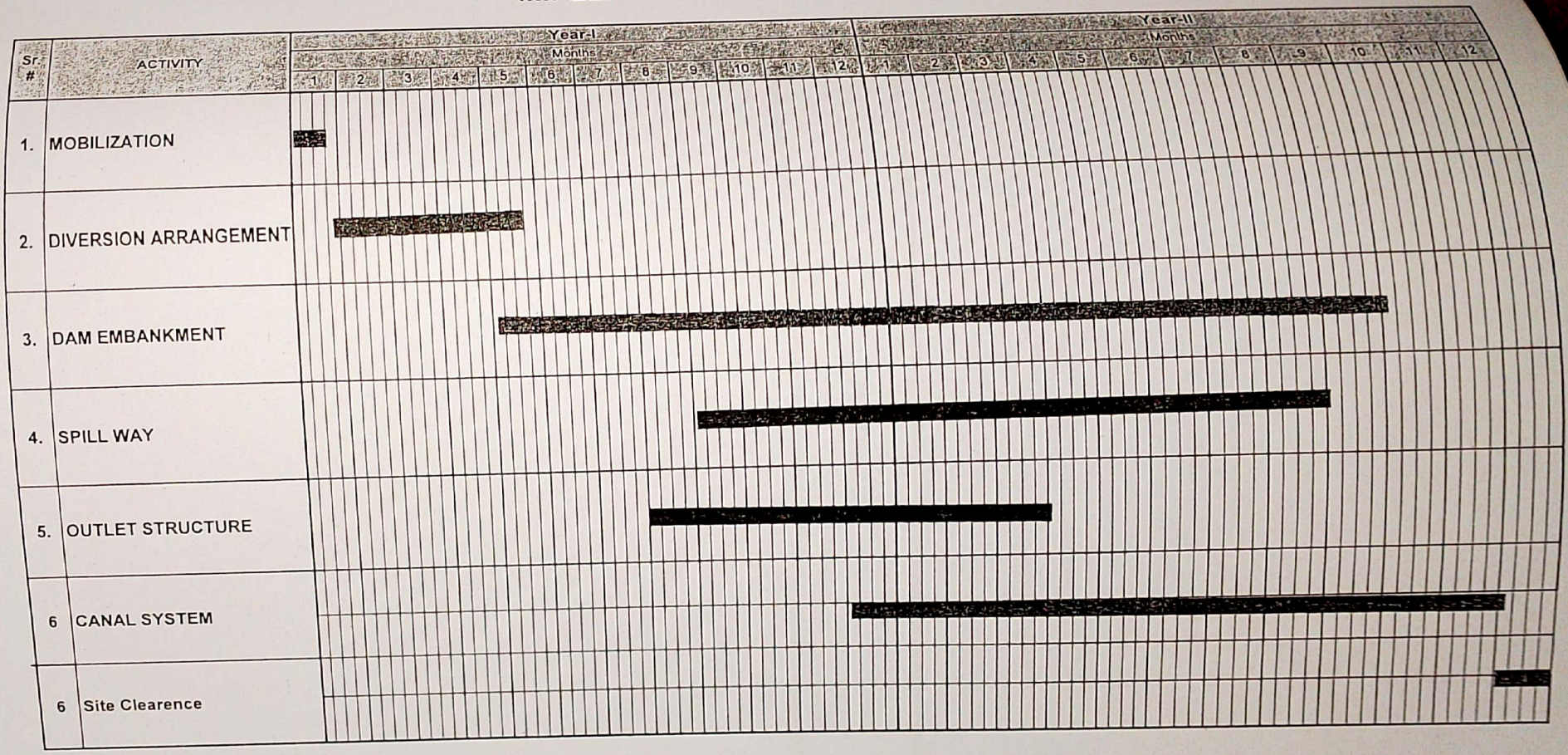
Table: 12.14 B
Economic and Financial Prices
Output

	Farm Labour			
1	Hired	Per Day	184.0	200.00
2	Family	Per Day	184.0	200.00
3	Tractor Hours	Per Hour	414.0	450.00
4	**Miscellaneous**			
5	Wheat harvesting	Per Day	276.0	300.00
6	Cane harvesting	Per Day	276.0	300.00
7	Wheat threshing	Per Hour	276.0	300.00
	Marketing Charges			
	Packing Charges			
8	Jute Bag	Per Bag	50.6	55.00
9	Wooden Crate	Per Crate	10.1	11.00
10	Fruit Basket	Per Basket	20.2	22.00
11	Vegetable Basket	Per Basket	20.2	22.00
	Transportation			
12	Nowshera- Karachi	100Kg	423.2	460.00
13	Karachi - Nowshera	100Kg	423.2	460.00
14	Loading/unloading	100Kg	5.5	6.00
15	Project Area- Nowshera	100Kg	13.8	15.00
16	Nowshera- Project Area	100Kg	13.8	15.00
17	Loading/unloading	100Kg	13.8	15.00

Source: 1. Consultant's Economic Survey
2. Burue of Statistics, P& D Department Government of Khyber

Activity Schedule

SATTI KALLI DAM PROJECT
IMPLEMENTATION SCHEDULE



Annexes

Annex- I (DRO Performa)

i) **Estimate for Land acquisition**

2.Gharmumkin/BanjarQadeem = 71 Acres(560 kanals)

Rate per kanal for BanjarQadeem = Rs.52173

(As per DOR notification district Nowshera)

Total Cost = 560*52173

=29634264

Say 30 Million

گوشوارہ انتقلات | اوسط یکسالہ قسم نل چاہی از 1/10/8 لغایت 1/1/11 موضع جلوزی تحصیل

نمبر شمار	نمبر انتقال	تاریخ تصدیق	نمبر منتقلہ	قیمت	کیفیت
1	3429	15-6-10	2-11-0	30000/-	
2	3430	15-6-10	8-11-0	30000/-	
		میزان	1-3-1	60000/=	

جناب عالی!

بمطابق اوسط یکسالہ قسم نل چاہی قیمت فی مرلہ =/2608 روپے

" 52173/= " " " " " کی کنال

پٹواری حلقہ

Annex - II (Bore Hole Logs)

ELCON (Regd)
Geotechnical Investigation, Dam, Pile Foundation, Ground Water, Hydro Construction, Roads & CMI Work.

BOREHOLE NO.: SKD - 01

ROCK FABRIC TYPE		GRAIN SIZE		MM
M	Massive	VF	Very Fine	<0.06
B	Bedded / Banded	F	Fine	0.06-0.2
CB	Cross-bedded	M	Medium	0.2-0.6
L	Laminated	C	Coarse	0.6-2.0
F	Foliated	VC	Very Coarse	>2.0
C	Cleaved	Beds/Laminations		mm
S	Schistose	tn	Thin	<1.00
G	Gneissose	Tk	Thick	>3.00

ROUGHNESS			
Sl	Slickensided		
Sm	Smooth		
SR	Slightly Rough		
M	Medium Rough		
R	Rough		
VR	Very Rough		
P	Planar	Sl	Stepped
U	Undulating		

DISCONTINUITY SPACING		
EC	E.Closely	<0.02m
VC	V.Closely	0.02-0.06m
C	Closely	0.06-0.2m
M	Medium	0.2-0.6m
W	Widely	0.6-2.0m
VW	V.widely	2.0-6.0m
EW	E.widely	<0.02m
V	Very	E (Extremely)

WEATHERING	
T	Transported Soil
R	Residual Soil
C	Completely
H	Highly
M	Moderately
S	Slightly
U	Unweathered

ROCK STRENGTH – MPa And DISCONTINUITY WALL HARDNESS		
VL	Very Low	1-25
L	Low	25-50
M	Medium	50-100
H	High	100-200
VH	Very High	>200

Project: Shah Kaleem Small Dam
Site: Shah Kaleem Dam, Nowshera
Easting: 3128668.518
Northing: 1082333.90
Elevation: 360 m
Angle: Vertical
Final Depth: 22 M
Drilling Co.: ELCON
Driller: Khalid Khan
Location: Right Abutment
BH # 1
Page: 1 of 3
Date Started: 25-12-2008
Date Ended: 29-12-2008
Machine: Straight Rotary
Logged: Muhammad Jamil

Run No	Core Recovery %	R.Q.D %	Drilling Method	Drilling Medium	Fluid Recovery %	Bit Type	Grain Size (mm)	Type	Type	Joint Depth (m)	Joint Angle (°)	Joint Spacing	Roughness	Wall Hardness	Fill type	Fill Thickness (mm)	Water Pressure Test: Test Number	Time Duration (Min)	Pressure (Psi)	Water (Lub)	Lugeon Result	Constant Head Permeability Test: Test Number	q	E	HC	K	Lithic Sample	Sample For Lab (M)	GENERAL DESCRIPTION
1	100%	0%	Rotary Drilling	Water	97%	NQ Diamond Drilling Bit	F	F	Joint	0.87 to 0.90	30°	VC	R	VL	Clay	0.5mm	1	15	10	6.33	18.712								Top of bed rock. Phyllite, moderately to highly weather, very closely jointed, gray in color, foliated, highly fragmented and very low in strength.
2	100%	0%					F	F	Joint	1.28 to 1.35	75°	VC	R	VL	Clay	0.5mm		15	15	7.22									Phyllite, moderately to highly weather, very closely jointed, gray in color, foliated, highly fragmented and very low in strength.
3	100%	0%					F	F	Joint	1.92 to 1.96	35°	VC	R	VL	Clay	0.5mm		15	20	8.29									Phyllite, moderately to highly weather, very closely jointed, gray in color, foliated, highly fragmented and very low in strength.
4	90%	0%					F	F	Joint	2.63 to 2.68	80°	VC	R	VL	Clay	0.5mm		15	15	7.12									Phyllite, moderately to highly weather, very closely jointed, gray in color, foliated, highly fragmented and very low in strength.
5	90%	0%					F	F	Joint	—	—	VC	R	VL	Clay	0.5mm		15	10	6.2									Phyllite, moderately to highly weather, very closely jointed, gray in color, foliated, highly fragmented and very low in strength.
6	90%	0%					F	F	Joint	3.96 to 3.99	30°	VC	R	VL	Clay	0.5mm	2	15	13	6.55	15.598								Phyllite, moderately to highly weather, very closely jointed, gray in color, foliated, highly fragmented and very low in strength.
7	95%	0%					F	F	Joint	4.04 to 4.10	40°	VC	R	VL	Clay	0.5mm		15	18	7.66									Phyllite, moderately to highly weather, very closely jointed, gray in color, foliated, highly fragmented and very low in strength.
8	90%	0%			87%		F	F	Joint	5.28 to 5.33	80°	VC	R	VL	Clay	0.5mm		15	23	8.71									Phyllite, moderately to highly weather, very closely jointed, gray in color, foliated, highly fragmented and very low in strength.
9	85%	0%					F	F	Joint	—	—	VC	R	VL	Clay	0.5mm		15	18	7.4									Phyllite, moderately to highly weather, very closely jointed, gray in color, foliated, highly fragmented and very low in strength.
10	85%	0%			84%		F	F	Joint	5.92 to 5.96	45°	VC	R	VL	Clay	0.5mm		15	13	6.42									Phyllite, moderately to highly weather, very closely jointed, gray in color, foliated, highly fragmented and very low in strength.
11	85%	0%					F	F	Joint	6.30 to 6.37	70°	VC	R	VL	Clay	0.5mm	3	15	18	6.86	13.67								Phyllite, moderately to highly weather, very closely jointed, gray in color, foliated, highly fragmented and very low in strength.
12	80%	0%			81%		F	F	Joint	6.40 to 6.48	80°	VC	R	VL	Clay	0.5mm		15	21	7.97									Phyllite, moderately to highly weather, very closely jointed, gray in color, foliated, highly fragmented and very low in strength.
																		15	26	9.11									Phyllite, moderately to highly weather, very closely jointed, gray in color, foliated, highly fragmented and very low in strength.
																		15	21	7.8									Phyllite, moderately to highly weather, very closely jointed, gray in color, foliated, highly fragmented and very low in strength.
																		15	16	6.72									Phyllite, moderately to highly weather, very closely jointed, gray in color, foliated, highly fragmented and very low in strength.
																		15	19	7.1									Phyllite, moderately to highly weather, very closely jointed, gray in color, foliated, highly fragmented and very low in strength.

Weathering	Strength	REMARKS	Elevation (m)	Depth (m)
Fresh, Slightly, Moderately, Highly, Completely	Very Low, Low, Medium, High, Very High	Rock Comprise of Quartz, mica, Feldspar. At places Qtz inclusion are present. Due to the development of sidelite and chloride along the cleavage plane, which import silky Sheen to the rock. The mineral of preferentially oriented due to the compressional stresses of the tectonic. Fresh core surfaces are gray but at places in brownish tint, due to the weathering.	360	0

ELCON (Regd)
Geotechnical Investigation, Dam, Pile Foundation, Ground Water, Hydro Construction, Roads & Civil Work

BOREHOLE NO.: SKD - 01

ROCK FABRIC TYPE		GRAIN SIZE		MM
M	Massive	VF	Very Fine	<0.06
B	Bedded / Banded	F	Fine	0.06-0.2
CB	Cross-bedded	M	Medium	0.2-0.6
L	Laminated	C	Coarse	0.6-2.0
F	Foliated	VC	Very Coarse	>2.0
C	Cleaved	Beds/Laminations		mm
S	Schistose	tn	Thin	<100
G	Gneissose	Tk	Thick	>300

ROUGHNESS		DISCONTINUITY SPACING		
Sl	Slickensided	EC	E.Closely	<0.02m
Sm	Smooth	VC	V.Closely	0.02-0.06m
SR	Slightly Rough	C	Closely	0.06-0.2m
M	Medium Rough	M	Medium	0.2-0.6m
R	Rough	W	Widely	0.6-2.0m
VR	Very Rough	VW	V.widely	2.0-6.0m
P	Planar / Sl / Stepped	EW	E.widely	>6.0m
U	Undulating	V	Very / E	Extremely

WEATHERING	
T	Transported Soil
R	Residual Soil
C	Completely
H	Highly
M	Moderately
S	Slightly
U	Unweathered

ROCK STRENGTH – MPa And DISCONTINUITY WALL HARDNESS		
VL	Very Low	1-25
L	Low	25-50
M	Medium	50-100
H	High	100-200
VH	Very High	>200

Project:	Shah Kaleem Small Dam
Site:	Shah Kaleem Distt. Nowshera
Easting:	3128668.518
Northing:	1082333.90
Elevation:	360 m
Angle:	Vertical
Final Depth:	22 M
Drilling Co.:	ELCON
Driller:	Khalid Khan
Location:	Right Abutment
BH #	1
Page:	2 of 3
Date Started:	25-12-2008
Date Ended:	29-12-2008
Machine:	Straight Rotary
Logged:	Muhammad Jamil

Drilling and Recovery							Rock Fabric		Discontinuities								Water Pressure Test				Constant Head Permeability Test							GENERAL DESCRIPTION	Weathering					Strength				REMARKS	Elevation (m)	Depth (m)
Run No	Core Recovery %	R.Q.D %	Drilling Method	Drilling Medium	Fluid Recovery %	Bit Type	Bedding (mm)	Type	Type	Joint Depth (m)	Joint Angle (°)	Joint Spacing	Roughness	Wall Hardness	Infill Type	Infill Thickness	Test Number	Time Duration (Min)	Pressure (PSI)	Water (Lit)	Lugeon Result	Test Number	Q	E	HC	K	Little Bubbles	Lands for Lab Test	Soil: Soil type: colour, consistency, structure, origin Rock: Rock type: weathering, joint spacing, colour, fabric, strength	Fresh	Slightly	Moderately	Highly	Completely	Very Low	Low	Medium	High	Very High				
13	78%	0%	Rotary Drilling	Water	80%	NQ Diamond Drilling Bit	F	F	Joint	—	—	VC	R	VL	Clay	4.5mm	4	15	24	8.2	14.058							Phyllite, moderately to highly weather, very closely jointed, gray in color, foliated, highly fragmented and very low in strength.											Rock Comprise of Quartz, mica, Feldspar. At places Qtz inclusion are present. Due to the development of silicite and chloride along the cleavage plane, which import silky Sheen to the rock. The mineral of preferentially oriented due to the compressional stresses of the tectonic. Fresh core surfaces are gray but at places its brownish tint, due to the weathering.		350	10
14	75%	0%					F	F	Joint	11.15 to 11.18	30°	VC	R	VL	Clay	4.5mm		15	29	9.41								Phyllite, moderately to highly weather, very closely jointed, gray in color, foliated, highly fragmented and very low in strength.														11
15	75%	0%					F	F	Joint	—	—	VC	R	VL	Clay	4.5mm		15	24	8.13								Phyllite, moderately to highly weather, very closely jointed, gray in color, foliated, highly fragmented and very low in strength.														12
																		15	19	6.97								Phyllite, moderately to highly weather, very closely jointed, gray in color, foliated, highly fragmented and very low in strength.														
16	80%	0%			78%		F	F	Joint	—	—	VC	R	VL	Clay	4.5mm	5	15	22	15.4	12.534							Phyllite, moderately to highly weather, very closely jointed, gray in color, foliated, highly fragmented and very low to low in strength.														13
							F	F	Joint	13.65 to 13.72	75°	VC	R	VL-L	Clay	4.5mm		15	27	18.9								Phyllite, moderately to highly weather, very closely jointed, gray in color, foliated, highly fragmented and very low to low in strength.														
17	80%	0%																15	32	22.4								Phyllite, moderately weather, very closely jointed, gray in color, foliated, highly fragmented and low to medium in strength.														14
							F	F	Joint	14.70 to 14.74	35°	VC	R	VL-L	Clay	4.5mm		15	27	18.9																				
18	80%	0%																15	22	15.4																				
							F	F	Joint	16.0 to 16.9	85°	VC	R	L-M	—	—	6	15	25	7.76	11.33							Phyllite, moderately weather, very closely jointed, gray in color, foliated, highly fragmented and low to medium in strength.														15
19	80%	0%			78%													15	30	8.79								Phyllite, moderately weather, very closely jointed, gray in color, foliated, highly fragmented and low to medium in strength.														
							F	F	Joint	—	—	VC	R	L-M	—	—		15	35	10								Phyllite, moderately weather, very closely jointed, gray in color, foliated, highly fragmented and low to medium in strength.														16
20	75%	0%																15	25	8.65																				
							F	F	Joint	17.20 to 17.24	40°	VC	R	L-M	—	—		15	30	7.6								Phyllite, moderately weather, very closely jointed, gray in color, foliated, highly fragmented and low to medium in strength.														17
21	70%	0%					F	F	Joint	17.49 to 17.67	70°	VC	R	L-M	—	—																								
22	65%	0%															7	15	28	8	8.15							Phyllite, moderately weather, very closely jointed, gray in color, foliated, highly fragmented and low to medium in strength.														18
							F	F	Joint	18.80 to 18.87	70°	VC	R	L-M	—	—		15	33	9.25																				
23	70%	0%																15	38	10.44								Phyllite, moderately weather, very closely jointed, gray in color, foliated, highly fragmented and low to medium in strength.														19
																		15	33	9.08																				
24	75%	0%			73%		F	F	Joint	19.80 to 19.86	80°	VC	R	L-M	—	—		15	28	7.8																				20

ELCON (Regd)
Geotechnical Investigation, Dam, Pile Foundation, Ground Water, Hydro Construction, Roads & Civil Work.

BOREHOLE NO.: SKD - 01

ROCK FABRIC TYPE		GRAIN SIZE		MM	ROUGHNESS		DISCONTINUITY SPACING			WEATHERING	
M	Massive	VF	Very Fine	<0.06	Sl	Slickensided	EC	E.Closely	<0.02m	T	Transported Soil
B	Bedded / Banded	F	Fine	0.06-0.2	Sm	Smooth	VC	V.Closely	0.02-0.06m	R	Residual Soil
CB	Cross-bedded	M	Medium	0.2-0.6	SR	Slightly Rough	C	Closely	0.06-0.2m	C	Completely
L	Laminated	C	Coarse	0.6-2.0	M	Medium Rough	M	Medium	0.2-0.6m	H	Highly
F	Foliated	VC	Very Coarse	>2.0	R	Rough	W	Widely	0.6-2.0m	M	Moderately
C	Cleaved	Beds/Laminations		mm	VR	Very Rough	VW	V.widely	2.0-6.0m	S	Slightly
S	Schistose	In	Thin	<100	P	Planar / St / Stepped	EW	E.widely	>6.0m	U	Unweathered
G	Gneissose	Tk	Thick	>200	U	Undulating	V	Very / E			

ROCK STRENGTH – MPa And DISCONTINUITY WALL HARDNESS		
VL	Very Low	1-25
L	Low	25-50
M	Medium	50-100
H	High	100-200
VH	Very High	>200

Project: Shah Kaleem Small Dam
Site: Shah Kaleem Distt. Hangu
Easting: 312888.518
Northing: 1097222.90
Elevation: 260 m
Angle: Vertical
Final Depth: 22 M
Drilling Co.: ELCON
Driller: Khalid Khan
Location: Right Abutment
Grid # 1
Page: 2 of 2
Date Started: 25-12-2008
Date Ended: 29-12-2008
Machine: Straight Rotary
Logged: Muhammad Jamil

Drilling and Recovery							Rock Fabric		Discontinuities							Water Pressure Test				Constant Head Permeability Test						GENERAL DESCRIPTION	Weathering				Strength				REMARKS			
Depth (m)	Run No	Core Recovery %	R.Q.D %	Drilling Medium	Drilling Method	Fluid Recovery %	Bit Type	Bands (m m)	Type	Type	Joint Depth (m)	Joint Angle (°)	Joint Spacing	Roughness	Wall Hardness	Fill Type	Fill Thickness (mm)	Test Number	Time Duration (Min)	Pressure (PSI)	Water (Lit)	Lugeon Pressure	Test Number	Q	E	HC	K	Lithologic Sample	Soil: Soil type: colour, consistency, structure, origin Rock: Rock type: weathering, joint spacing, colour, fabric, strength	Fresh	Slightly	Moderately	Highly	Completely	Very Low	Low	Medium	High	Very High	Elevation (m)	Depth (m)
20																																						340 20
21	26	80%	0%			70%		F	F	Joint	20.23 to 20.28	50°	VC	R	L-M	—	—											Phyllite, slightly to moderately weather, very closely jointed, gray in color, foliated, highly fragmented and medium in strength.												21
22	26	80%	0%					F	F	Joint	25.11 to 25.16	50°	VC	R	L-M	—	—											Phyllite, slightly to moderately weather, very closely jointed, gray in color, foliated, highly fragmented and medium in strength.											338	22
23																																						

ELCON (Regd)
Geotechnical Investigation, Dam, Pile Foundation, Ground Water, Hydro Construction, Roads & Civil Work

BOREHOLE NO.: SKD - 2

ROCK FABRIC TYPE		GRAIN SIZE		MM
M	Massive	VF	Very Fine	<0.06
B	Bedded / Banded	F	Fine	0.06-0.2
CB	Cross-bedded	M	Medium	0.2-0.6
L	Laminated	C	Coarse	0.6-2.0
F	Foliated	VC	Very Coarse	>2.0
C	Cleaved	Beds/Laminations		mm
S	Schistose	In	Thin	<100
G	Gneissose	Tk	Thick	>300

ROUGHNESS		
Sl	Slickensided	
Sm	Smooth	
SR	Slightly Rough	
M	Medium Rough	
R	Rough	
VR	Very Rough	
P	Planar	Sl Stepped
U	Undulating	

DISCONTINUITY SPACING		
EC	E.Closely	<0.02m
VC	V.Closely	0.02-0.06m
C	Closely	0.06-0.2m
M	Medium	0.2-0.6m
W	Widely	0.6-2.0m
VW	V.widely	2.0-6.0m
EW	E.widely	<0.02m
V	Very	E Extremely

WEATHERING	
T	Transported Soil
R	Residual Soil
C	Completely
H	Highly
M	Moderately
S	Slightly
U	Unweathered

ROCK STRENGTH – MPa And DISCONTINUITY WALL HARDNESS		
VL	Very Low	1-25
L	Low	25-50
M	Medium	50-100
H	High	100-200
VH	Very High	>200

Project: Shah Kaleem Dam
Site: Shah Kaleem Dam, Hontara
Easting: 3128532.286
Northing: 1082420.968
Elevation: 343 m
Angle: Vertical
Final Depth: 15 M
Drilling Co.: ELCON
Driller: Khalid Khan
Location: Main Dam
BH # 2
Page 1 of 2
Date Started: 01-12-08
Date Ended: 02-12-08
Machine: Straight Rotary
Logged: Muhammad Jamil

Drilling and Recovery								Rock Fabric		Discontinuities							Water Pressure Test					Constant Head Permeability Test						GENERAL DESCRIPTION	Weathering				Strength					REMARKS	Elevation (m)	Depth (m)
Depth (m)	Run No	Core Recovery %	R.Q.D %	Drilling Medium	Drilling Method	Fluid Recovery %	Bit Type	Drain Bits (m m)	Type	Type	Joint Depth (m)	Joint Angle (°)	Joint Spacing	Roughness	Wall Hardness	Fill Type (m Thickness)	Test Number	Time Duration (m)	Pressure (PSI)	Water (L/M)	Lugeon Result	Test Number	m	q	HC	K	Lithic Sample	Sample For Lab Test		Fresh	Slightly	Moderately	Highly	Completely	Very Low	Low	Medium	High	Very High			
0																																									343	0
1						97%																1	39.8	11.05	390cm	1.01310 cm/sec																1
2	1																																									2
3	2					93%																																				3
4	3																																									4
5	4			Water		90%																2	57.72	16.03	690cm	0.03310 cm/sec																5
6	5				Rotary Drilling		NQ Diamond Drilling Bit																																			6
7						87%																																				7
8	6																					3	100.69	27.96	990cm	0.00310 cm/sec																8
9	7					86%																																				9
10	8																																								333	10

Gravels cover, consists of sand, boulders, pebbles, cobbles, clay, and rock fragments. Gravels are rounded to sub-rounded and angular to sub-anglar.

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Geotechnical Investigation, Dam, Pile Foundation, Ground Water, Hydro Construction, Roads & Civil Work.

BOREHOLE NO.: SKD - 2

ROCK FABRIC TYPE		GRAIN SIZE		MM
M	Massive	VF	Very Fine	<0.06
B	Bedded / Banded	F	Fine	0.06-0.2
CB	Cross-bedded	M	Medium	0.2-0.6
L	Laminated	C	Coarse	0.6-2.0
F	Foliated	VC	Very Coarse	>2.0
C	Cleaved	Beds/Laminations		mm
S	Schistose	In	Thin	<100
G	Gneissose	Tk	Thick	>300

ROUGHNESS		DISCONTINUITY SPACING		
Sl	Slickensided	EC	E.Closely	<0.02m
Sm	Smooth	VC	V.Closely	0.02-0.06m
SR	Slightly Rough	C	Closely	0.06-0.2m
M	Medium Rough	M	Medium	0.2-0.6m
R	Rough	W	Widely	0.6-2.0m
VR	Very Rough	VW	V.widely	2.0-6.0m
U	Undulating	EW	E.widely	>6.0m
		V	Very E	Extremely

WEATHERING	
T	Transported Soil
R	Residual Soil
C	Completely
H	Highly
M	Moderately
S	Slightly
U	Unweathered

ROCK STRENGTH – MPa And DISCONTINUITY WALL HARDNESS		
VL	Very Low	1-25
L	Low	25-50
M	Medium	50-100
H	High	100-200
VH	Very High	>200

Project: Shah Kaleem Dam
Site: Shah Kaleem Dist. Hangu
Easting: 312853.256
Northing: 1062420.698
Elevation: 243 m
Angle: Vertical
Final Depth: 15 M
Drilling Co.: ELCON
Driller: Khalid Khan
Logged: Muhammad Jamil
Page: 2 of 2
Date Started: 01-12-09
Date Ended: 02-12-09
Machine: Straight Rotary

Drilling and Recovery								Rock Fabric		Discontinuities							Water Pressure Test					Constant Head Permeability Test							GENERAL DESCRIPTION	Weathering				Strength				REMARKS	Elevation (m)	Depth (m)
Depth (m)	Run No	Core Recovery %	R.Q.D %	Drilling Medium	Drilling Method	Fluid Recovery %	Bit Type	Drain Hole (m x)	Type	Type	Joint Depth (m)	Joint Angle (°)	Joint Spacing	Roughness	Wall Hardness	Fill Type	Fill Thickness (mm)	Test Number	Time Duration (min)	Pressure (Psi)	Water (Lit)	Lugeon Result	Test Number	q	E	HC	K	Lines Sample	Sample For Lab (Y/N)	Soil: Soil type: colour, consistency, structure, origin Rock: Rock type: weathering, joint spacing, colour, fabric, strength	Fresh	Slightly	Moderately	Highly	Completely	Very Low	Low	Medium	High	Very High			
10																																								333	10
11	9					80%		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	127.33	36.35	1290CM	0.70x10⁻⁵cm/sec			Gravels cover, consists of sand, boulders, pebbles, cobbles, clay, and rock fragments. Gravels are rounded to sub-rounded and angular to sub-anglar. Top of bed rock at 12.00m depth.												331	11
12	10																																								12
13	11																																								
13	12	90%	0%	Water	Rotary Drilling	75%	NQ Diamond Drilling Bit	F	F	Joint	12.56 to 12.69	30°	VC	VR	L-M	Clay	5.0mm	1	15	10	1.7	4.132								Phyllite, moderately to slightly weathered, very closely jointed, gray in color, foliated, highly fragmented and very medium in strength.													13
																			15	15	2.5																				
13	13	90%	0%					F	F	Joint	13.30 to 13.7	70°	VC	VR	L-M	Clay	5.0mm		15	20	3.34									Phyllite, moderately to slightly weathered, very closely jointed, gray in color, foliated, highly fragmented and very medium in strength.													14
																			15	15	2.4																				
15	14	80%	0%			70%		F	F	Joint	14.50 to 14.63	30°	VC	VR	L-M	Clay	5.0mm		15	10	1.6									Phyllite, moderately to slightly weathered, very closely jointed, gray in color, foliated, highly fragmented and very medium in strength.												328	15

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Geotechnical Investigation, Dam, Pile Foundation, Ground Water, Hydro Construction, Roads & Civil Work.

BOREHOLE NO.: SKD - 03

ROCK FABRIC TYPE		GRAIN SIZE		MM
M	Massive	VF	Very Fine	<0.06
B	Bedded / Banded	F	Fine	0.06-0.2
CB	Cross-bedded	M	Medium	0.2-0.6
L	Laminated	C	Coarse	0.6-2.0
F	Foliated	VC	Very Coarse	>2.0
C	Cleaved	Beds/Laminations		mm
S	Schistose	tn	Thin	<100
G	Gneissose	Tk	Thick	>300

ROUGHNESS		DISCONTINUITY SPACING		
Sl	Slickensided	EC	Extremely Close	<0.05m
Sm	Smooth	VC	Very Close	0.05-0.3m
SR	Slightly Rough	C	Closely	0.3-0.5m
M	Medium Rough	M	Medium	0.5-0.3m
R	Rough	W	Widely	0.3-3.0m
VR	Very Rough	VW	Very Widely	3.0-5.0m
P	Planar Bl Stepped	EW	Extremely	<5.0m
U	Undulating	V	Very E	Extremely

WEATHERING	
T	Transported Soil
R	Residual Soil
C	Completely
H	Highly
M	Moderately
S	Slightly
U	Unweathered

ROCK STRENGTH – MPa And DISCONTINUITY WALL HARDNESS		
VL	Very Low	1-25
L	Low	25-50
M	Medium	50-100
H	High	100-200
VH	Very High	>200

Project: Shah Kaleem Dam
Site: Shah Kaleem Dam, Hoshiara
Easting: 317745.255
Northing: 1097428.410
Elevation: 268 m
Angle: Vertical
Final Depth: 24 M
Drilling Co.: ELCON
Driller: Khalid Khan
Location: Left Abutment
Sht # 2
Page: 1 of 2
Date Started: 08-05-2018
Date Ended: 19-05-2018
Machine: Straight Rotary
Logged: Muhammad Jamil

Drilling and Recovery							Rock Fabric	Discontinuities								Water Pressure Test					Constant Head Permeability Test							GENERAL DESCRIPTION	Weathering					Strength					REMARKS		Elevation (m)	Depth (m)
Depth (m)	Run No	Core Recovery %	R.Q.D %	Drilling Medium	Drilling Method	Fluid Recovery %	Bit Type	Distance (m)	Type	Type	Joint Depth (m)	Joint Angle (°)	Joint Spacing	Roughness	Wall Hardness	Fill Type	Test Number	Time Duration (m)	Pressure (Psi)	Water (Lit)	Lugeon Result	Test Number	Q	E	HC	K	Lugeon Bundle	Sample For Lab (M)	Soil: Soil type: colour, consistency, structure, origin Rock: Rock type: weathering, joint spacing, colour, fabric, strength	Fresh	Slightly	Moderately	Highly	Completely	Very Low	Low	Medium	High	Very High				
1	1																												Soil cover with small rocks fragments and gravels. Gravels are rounded to sub-rounded.													365	0
																													Top of bed rock at 1.00m depth.													367	1
2	2	70%	0%	Water	Rotary Drilling	98%	NQ Diamond Drilling Bit	F	F	Joint	1.70 to 1.79	80°	VC	VR	L	Clay													Phyllite, highly weathered, very closely jointed, gray in color, foliated, highly fragmented and low in strength.														
3	3	60%	0%					F	F	Joint	2.30 to 2.33	35°	VC	VR	L	Clay	1	15	10	5.73	15.794								Phyllite, highly weathered, very closely jointed, gray in color, foliated, highly fragmented and low in strength.														
4	4	60%	0%			95%		F	F	Joint	—	—	VC	VR	L	Clay		15	15	8.9									Phyllite, highly weathered, very closely jointed, gray in color, foliated, highly fragmented and low in strength.														
																		15	20	7.93									Phyllite, highly weathered, very closely jointed, gray in color, foliated, highly fragmented and low in strength.														
5	5	60%	0%					F	F	Joint	3.87 to 3.90	30°	VC	VR	L-M	Clay		15	15	8.83									Phyllite, highly weathered, very closely jointed, gray in color, foliated, highly fragmented and low in strength.														
																		15	10	5.6									Phyllite, highly weathered, very closely jointed, gray in color, foliated, highly fragmented and low in strength.														
6	6	90%	0%			91%		F	F	Joint	4.18 to 4.21	60°	VC	VR	L-M	Clay	2	15	13	5.93	12.67								Phyllite, highly weathered, very closely jointed, gray in color, foliated, highly fragmented and low in strength.														
																		15	18	7.14									Phyllite, highly weathered, very closely jointed, gray in color, foliated, highly fragmented and low in strength.														
7	7	100%	0%					F	F	Joint	5.70 to 5.77	70°	VC	VR	L-M	Clay		15	23	8.1									Phyllite, highly weathered, very closely jointed, gray in color, foliated, highly fragmented and low in strength.														
																		15	18	7.00									Phyllite, highly weathered, very closely jointed, gray in color, foliated, highly fragmented and low in strength.														
																		15	13	5.77									Phyllite, highly weathered, very closely jointed, gray in color, foliated, highly fragmented and low in strength.														
7	8	95%	0%					F	F	Joint	6.86 to 6.91	45°	VC	VR	L-M	Clay													Phyllite, highly weathered, very closely jointed, gray in color, foliated, highly fragmented and low in strength.														
8	9	100%	10%					F	F	Joint	7.92 to 7.96	40°	VC	VR	L-M	Clay	3	15	16	6.15	10.734								Phyllite, moderately to highly weathered, very closely jointed, gray in color, foliated, highly fragmented and low to medium in strength.														
						88%												15	21	7.27									Phyllite, moderately to highly weathered, very closely jointed, gray in color, foliated, highly fragmented and low to medium in strength.														
9	10	95%	0%					F	F	Joint	8.28 to 8.37	25°	VC	VR	L-M	Clay		15	26	8.37									Phyllite, moderately to highly weathered, very closely jointed, gray in color, foliated, highly fragmented and low to medium in strength.														
																		15	18	7.2									Phyllite, moderately to highly weathered, very closely jointed, gray in color, foliated, highly fragmented and low to medium in strength.														
10	11	100%	0%					F	F	Joint	8.80 to 8.85	80°	VC	VR	L-M	Clay		15	21	6.01									Phyllite, moderately to highly weathered, very closely jointed, gray in color, foliated, highly fragmented and low to medium in strength.														

ELCON (Regd)
Geotechnical Investigation, Dam, Pile Foundation, Ground Water, Hydro Construction, Roads & Civil Work.

BOREHOLE NO.: SKD - 03

ROCK FABRIC TYPE		GRAIN SIZE		MM
M	Massive	VF	Very Fine	<0.06
B	Bedded / Banded	F	Fine	0.06-0.2
CB	Cross-bedded	M	Medium	0.2-0.6
L	Laminated	C	Coarse	0.6-2.0
F	Foliated	VC	Very Coarse	>2.0
C	Cleaved	Beds/Laminations		mm
S	Schistose	In	Thin	<100
G	Gneissose	Tk	Thick	>300

ROUGHNESS		DISCONTINUITY SPACING		
Sl	Slickensided	EC	E.Closely	<0.02m
Sm	Smooth	VC	V.Closely	0.02-0.06m
SR	Slightly Rough	C	Closely	0.06-0.2m
M	Medium Rough	M	Medium	0.2-0.6m
R	Rough	W	Widely	0.6-2.0m
VR	Very Rough	VW	V.widely	2.0-6.0m
P	Planar / Sl / Stepped	EW	E.widely	>6.0m
U	Undulating	V	Very / E	E.widely

WEATHERING	
T	Transported Soil
R	Residual Soil
C	Completely
H	Highly
M	Moderately
S	Slightly
U	Unweathered

ROCK STRENGTH – MPa And DISCONTINUITY WALL HARDNESS		
VL	Very Low	1-25
L	Low	25-50
M	Medium	50-100
H	High	100-200
VH	Very High	>200

Project: Shah Kaleem Dam
Site: Shah Kaleem Distt. Nowshera
Easting: 312845.856
Northing: 1082428.410
Elevation: 368 m
Angle: Vertical
Final Depth: 24 M
Drilling Co.: ELCON
Driller: Khalid Khan

Location: Left Abutment
BH # 3
Page:2 of 3
Date Started: 06-09-2008
Date Ended: 16-09-2008
Machine: Straight Rotary
Logged: Muhammad Jamil

Depth (m)	Run No.	Core Recovery %	R.Q.D %	Drilling Medium	Drilling Method	Fluid Recovery %	Bit Type	Bit in Site (mm)	Type	Type	Joint Depth (m)	Joint Angle (°)	Joint Spacing	Roughness	Wall Hardness	Fill Type	Fill Thickness (mm)
1	12	100%	0%	Water	Rotary Drilling	87%	NQ Diamond Drilling Bit	F	F	Joint	10.26 to 10.28	30°	VC	VR	L-M	Clay	0.5mm
	13	100%	0%					F	F	Joint	10.90 to 10.95	50°	VC	VR	L-M	Clay	0.5mm
2	14	100%	0%					F	F	Joint	11.40 to 11.43	30°	VC	VR	L-M	Clay	0.5mm
3	15	100%	0%					F	F	Joint	12.96 to 13	40°	VC	VR	L-M	Clay	0.5mm
4	16	100%	0%			86%		F	F	Joint	13.58 to 13.62	40°	VC	VR	L-M	Clay	0.5mm
5	17	100%	0%					F	F	Joint	14.70 to 14.75	50°	VC	VR	L-M	Clay	0.5mm
6	18	100%	0%			82%		F	F	Joint	15.60 to 15.69	35°	VC	VR	L-M	Clay	0.5mm
7	19	100%	0%					F	F	Joint	16.20 to 16.24	40°	VC	VR	L-M	Clay	0.5mm
8	20	90%	0%			78%		F	F	Joint	17.41 to 17.48	60°	VC	VR	L-M	Clay	0.5mm
9	21	85%	0%					F	F	Joint	18.70 to 18.77	75°	VC	VR	L-M	Clay	0.5mm
10	22	90%	0%			75%		F	F	Joint	19.30 to 19.33	30°	VC	VR	L-M	Clay	0.5mm

Discontinuities

Water Pressure Test

Test Number	Time Duration (m)	Pressure (Psi)	Water (Lit)	Lugeon Result
1	15	19	6.69	8.60
	15	24	7.55	
	15	29	8.53	
	15	24	7.41	
	15	19	6.14	
2	15	22	6.81	7.934
	15	27	7.89	
	15	32	8.77	
	15	27	7.81	
	15	22	6.41	
3	15	25	6.81	7.2
	15	30	7.89	
	15	35	9.03	
	15	30	7.9	
	15	25	6.87	

Constant Head Permeability Test: Q, E, HC, K

Lithic Sketch

Sample Test Lab No.

GENERAL DESCRIPTION	Weathering					Strength					REMARKS	Elevation (m)	Depth (m)
Soil: Soil type: colour, consistency, structure, origin Rock: Rock type: weathering, joint spacing, colour, fabric, strength	Fresh	Slightly	Moderately	Highly	Completely	Very Low	Low	Medium	High	Very High			
Phyllite, moderately to highly weathered, very closely jointed, gray in color, foliated, highly fragmented and low to medium in strength.												358	0
Phyllite, moderately to highly weathered, very closely jointed, gray in color, foliated, highly fragmented and low to medium in strength.													1
Phyllite, moderately to highly weathered, very closely jointed, gray in color, foliated, highly fragmented and low to medium in strength.													2
Phyllite, moderately to highly weathered, very closely jointed, gray in color, foliated, highly fragmented and low to medium in strength.													3
Phyllite, moderately to highly weathered, very closely jointed, gray in color, foliated, highly fragmented and low to medium in strength.													4
Phyllite, moderately to highly weathered, very closely jointed, gray in color, foliated, highly fragmented and low to medium in strength.													5
Phyllite, moderately to highly weathered, very closely jointed, gray in color, foliated, highly fragmented and low to medium in strength.													6
Phyllite, moderately to highly weathered, very closely jointed, gray in color, foliated, highly fragmented and low to medium in strength.													7
Phyllite, moderately to highly weathered, very closely jointed, gray in color, foliated, highly fragmented and low to medium in strength.													8
Phyllite, moderately to highly weathered, very closely jointed, gray in color, foliated, highly fragmented and low to medium in strength.													9
Phyllite, moderately to highly weathered, very closely jointed, gray in color, foliated, highly fragmented and low to medium in strength.												348	10

ELCON (Regd)
Geotechnical Investigation, Dam, Pile Foundation, Ground Water, Hydro Construction, Roads & CMI Work.

BOREHOLE NO.: SKD - 03

ROCK FABRIC TYPE		GRAIN SIZE		MM
M	Massive	VF	Very Fine	<0.06
B	Bedded / Banded	F	Fine	0.06-0.2
CB	Cross-bedded	M	Medium	0.2-0.6
L	Laminated	C	Coarse	0.6-2.0
F	Foliated	VC	Very Coarse	>2.0
C	Cleaved	Beds/Laminations		mm
S	Schistose	In	Thin	<100
G	Gneissose	Tk	Thick	>300

ROUGHNESS		DISCONTINUITY SPACING		
Sl	Slickensided	EC	Extremely Close	<0.02m
Sm	Smooth	VC	Very Closely	0.02-0.06m
SR	Slightly Rough	C	Closely	0.06-0.2m
M	Medium Rough	M	Medium	0.2-0.6m
R	Rough	W	Widely	0.6-2.0m
VR	Very Rough	VW	Very Widely	2.0-6.0m
P	Planar St Stepped	EW	Extremely Widely	>6.0m
U	Undulating	V	Very E	Extremely

WEATHERING	
T	Transported Soil
R	Residual Soil
C	Completely
H	Highly
M	Moderately
S	Slightly
U	Unweathered

ROCK STRENGTH – MPa And DISCONTINUITY WALL HARDNESS		
VL	Very Low	1-25
L	Low	25-50
M	Medium	50-100
H	High	100-200
VH	Very High	>200

Project: Shah Kaleem Dam
Site: Shah Kaleem Distt. Nowshera
Easting: 312845.856
Northing: 1082426.410
Elevation: 368 m
Angle: Vertical
Final Depth: 24 M
Drilling Co.: ELCON
Driller: Khalid Khan
Location: Left Abutment
BH # 3
Page 3 of 3
Date Started: 08-09-2008
Date Ended: 18-09-2008
Machine: Straight Rotary
Logged: Muhammad Jamil

Depth (m)	Run No	Core Recovery %	R.Q.D %	Drilling Medium	Drilling Method	Fluid Recovery %	Bit Type	Bit Size (in in.)	Type	Type	Joint Depth (m)	Joint Angle (°)	Joint Spacing	Roughness	Wall Hardness	Fill Type	Fill Thickness (mm)	Test Number	Time Duration (min)	Pressure (Psi)	Water (Lit)	Lugeon Result	Test Number	Q	E	HC	K	Lithic Section	Sample For Lab Test	GENERAL DESCRIPTION	Weathering: Fresh	Slightly	Moderately	Highly	Completely	Strength: Very Low	Low	Medium	High	Very High	REMARKS	Construction Date	Elevation (m)	Depth (m)
20																																												20
21	23	90%	0%	Water	Rotary Drilling	72%	NQ Diamond Drilling Bit	F	F	Joint	20.60 to 20.65	50°	VC	R	L-M	Clay	5.0mm	7	15	28	7.33	4.0								Phyllite, moderately to highly weathered, very closely jointed, gray in color, foliated, highly fragmented, rough and low to medium in strength.														348	21
22	24	90%	0%					F	F	Joint	10.25 to 10.28	30°	VC	R	L-M	Clay	5.0mm		15	33	8.51									Phyllite, moderately to highly weathered, very closely jointed, gray in color, foliated, highly fragmented, rough and low to medium in strength.															22
23	25	80%	0%					—	—	—	—	—	—	—	—	—	—		15	33	8.37									Compacted sand, dark gray in color, including clay small gravels.															23
24	26	60%	0%			70%		—	—	—	—	—	—	—	—	—	—		15	28	7.77									Compacted sand, dark gray in color, including clay small gravels.													344	24

ELCON (Regd)
Geotechnical Investigation, Dam, Pile Foundation, Ground Water, Hydro Construction, Roads & Civil Work.

BOREHOLE NO.: SKD - 04

ROCK FABRIC TYPE		GRAIN SIZE		MM
M	Massive	VF	Very Fine	<0.06
B	Bedded / Banded	F	Fine	0.06-0.2
CB	Cross-bedded	M	Medium	0.2-0.6
L	Laminated	C	Coarse	0.6-2.0
F	Foliated	VC	Very Coarse	>2.0
C	Cleaved	Beds/Laminations		mm
S	Schistose	tn	Thin	<100
G	Gneissose	TK	Thick	>300

ROUGHNESS	
SI	Slickensided
Sm	Smooth
SR	Slightly Rough
M	Medium Rough
R	Rough
VR	Very Rough
P	Planar / St / Stepped
U	Undulating

DISCONTINUITY SPACING		
EC	E.Closely	<0.02m
VC	V.Closely	0.02-0.06m
C	Closely	0.06-0.2m
M	Medium	0.2-0.6m
W	Widely	0.6-2.0m
VW	V.widely	2-6m
EW	E.widely	>6.00m
V	Very / E	

WEATHERING	
T	Transported Soil
R	Residual Soil
C	Completely
H	Highly
M	Moderately
S	Slightly
U	Unweathered

ROCK STRENGTH – MPa And DISCONTINUITY WALL HARDNESS		
VL	Very Low	1-25
L	Low	25-50
M	Medium	50-100
H	High	100-200
VH	Very High	>200

Project: Shah Kaleem Dam
Site: Shah Kaleem Distt. Nowshera
Easting: 3128498.666
Northing: 1082258.975
Elevation: 347 m
Location: Upstream India Bed
BH # 04
Page: 1 of 1
Date Started: 28-11-09
Date Ended: 29-11-09
Machine: Straight Rotary
Logged: Muhammad Jamil
Angle: Vertical
Final Depth: 10 M
Drilling Co.: ELCON
Driller: Khalid Khan

Depth (m)	Run No	Core Recovery %	R.Q.D %	Drilling Medium	Drilling Method	Fluid Recovery %	Bit Type	Bit Size (mm)	Type	Type	Joint Depth (m)	Joint Angle (°)	Joint Spacing	Roughness	Joint Hardness	Water Pressure Test	Lugeon Result	Test Number	m	q	HC	K	Water Table	Sample Taken	GENERAL DESCRIPTION	Weathering	Strength	REMARKS	Elevation (m)	Depth (m)
0–3	1, 2					90%													—	47.97	13.325	490cm	0.7319 cm/sec		Gravels cover, boulder, pebbles cobble, clay, silt, sand, and rock fragments. Gravels are angular, rounded to sub-rounded.				347	0–3
4						85%																			Top of bed rock at 4.00m depth					4
5	3	90%	0%	Water	Rotary Drilling	80%	NQ Diamond Drilling Bit		F	F	Joint	4.70 to 4.80	50°	VC	VR	L	Clay 5mm	1	1.5	1.0	2.56	7.40				Phyllite, moderately weathered, very closely jointed, gray in color, foliated, highly fragmented and low in strength.					5
6	4	100%	0%						F	F	Joint	5.0 to 5.6	60°	VC	VR	L	Clay 5mm		1.5	1.5	2.83				Phyllite, moderately weathered, very closely jointed, gray in color, foliated, highly fragmented and low in strength.					6
									F	F	Joint	6.0 to 6.6	60°	C	R	M-L	Clay 5mm		1.5	2.0	3.34				Phyllite, moderately to slightly weathered, closely jointed, gray in color, foliated, highly fragmented and low to medium in strength.					
7	5	100%	50%			70%			F	F	Joint	6.77 to 6.80	30°	C	R	M-L	Clay 5mm		1.5	1.5	2.78				Phyllite, moderately to slightly weathered, closely jointed, gray in color, foliated, highly fragmented and low to medium in strength.					7
	6	100%	50%																1.5	1.0	2.48				Phyllite, moderately to slightly weathered, closely jointed, gray in color, foliated, highly fragmented and medium in strength.					
8	7	100%	24%			60%			F	F	Joint	7.64 to 7.80	60°	C	R	M	Clay 5mm	2	1.5	1.3	2.60	6.102			Phyllite, moderately to slightly weathered, closely jointed, gray in color, foliated, highly fragmented and medium in strength.					8
9	8	100%	21%			55%			F	F	Joint	8.88 to 9.03	60°	C	R	M	Clay 5mm		1.5	1.8	2.81				Phyllite, moderately to slightly weathered, closely jointed, gray in color, foliated, highly fragmented and medium in strength.					9
10	9	100%	50%			50%			F	F	Joint	9.20 to 9.30	60°	C	R	M	Clay 5mm		1.5	2.3	3.38				Phyllite, moderately to slightly weathered, closely jointed, gray in color, foliated, highly fragmented and medium in strength.					10
																			1.5	1.8	2.78									
																			1.5	1.3	2.49								337	

Weathering: Fresh, Slightly, Moderately, Highly, Completely
Strength: Very Low, Low, Medium, High, Very High

Rock Comprise of Quartz, mica, feldspar. At places Qtz inclusion are present. Due to the development of silicite and chloride along the cleavage plane, which import silky Sheen to the rock. The mineral of preferentially oriented due to the compressional stresses of the tectonic. Fresh core surfaces are gray but at places its brownish tint, due to the weathering.

ELCON (Regd)

Geotechnical Investigation, Dam, Pile Foundation, Ground Water, Hydro Construction, Roads & Civil Work.

BOREHOLE NO.: SKD - 05

ROCK FABRIC TYPE		GRAIN SIZE		MM	ROUGHNESS		DISCONTINUITY SPACING			WEATHERING	
M	Massive	VF	Very Fine	<0.06	Sl	Slickensided	EC	Extremely Close	<6.0cm	T	Transported Soil
B	Bedded / Banded	F	Fine	0.06-0.2	Sm	Smooth	VC	Very Close	6-20cm	R	Residual Soil
CB	Cross-bedded	M	Medium	0.2-0.6	SR	Slightly Rough	C	Close	20-60cm	C	Completely
L	Laminated	C	Coarse	0.6-2.0	M	Medium Rough	M	Medium	0.6-2.0m	H	Highly
F	Foliated	VC	Very Coarse	>2.0	R	Rough	W	Wide	2.0-6.0m	M	Moderately
C	Cleaved	Beds/Laminations		mm	VR	Very Rough	VW	Very Wide	6.0-20m	S	Slightly
S	Schistose	In	Thin	<100	P	Planar Sl Stepped	EW	Extremely Wide	>20m	U	Unweathered
G	Gneissose	Tk	Thick	>300	U	Undulating	V	Very E			

ROCK STRENGTH – MPa And DISCONTINUITY WALL HARDNESS

VL	Very Low	1-25	
L	Low	25-50	
M	Medium	50-100	
H	High	100-200	
VH	Very High	>200	

Project: Shah Kaleem Small Dam
Site: Shah Kaleem Distt. Nowshera
Easting: 3128321.075 — Location: Spillway
Northing: 1082389.409 — BH # 05
Elevation: 368 m — Page:1 of 2
Angle: Vertical — Date Started: 18-12-08
Final Depth: 20 M — Date Ended: 22-12-08
Drilling Co.: ELCON — Machine: Straight Rotary
Driller: Khalid Khan — Logged: Muhammad Jamil

Depth (m)	Run No	Core Recovery %	R.Q.D %	Drilling Medium	Drilling Method	Field Recovery %	Bit Type	Rock Fabric	Discontinuities	Water Pressure Test	Constant Head Permeability Test	GENERAL DESCRIPTION	Weathering	Strength	REMARKS
0–2	1, 2											Soil cover with rock fragments, pebbles, cobbles. Gravels are rounded to sub rounded.			
3	3	90%	0%	Water	Rotary Drilling	95%	NQ Diamond Drilling Bit	F F Joint 2.78 to 2.840 80° VC VR L-M Clay Adam	1: 15 10 4.55; 15 15 5.39; 15 20 6.37; 15 15 5.3; 15 10 4.37	13.734	Top of the bed rock is at 2.00m depth. Phyllite, moderately weathered, very closely jointed, gray in color, foliated, highly fragmented and low to medium in strength.	Slightly–Moderately	Low–Medium	Rock Comprise of Quartz, mica, Feldspar. At places Qtz inclusion are present. Due to the development of siricite and chloride along the clevage plane, which impart silky Sheen to the rock. The mineral of preferentially oriented due to the compressional stresses of the tectonic. Fresh core surfaces are gray but at places its brownish tint, due to the weathering.	NIL
4	4	100%	0%					F F Joint 2.84 to 2.90 80° VC VR L-M Clay Adam			Phyllite, moderately weathered, very closely jointed, gray in color, foliated, highly fragmented and low to medium in strength.				
4–5	5	100%	0%					F F Joint 2.77 to 3.85 80° VC R L-M Clay Adam			Phyllite, moderately weathered, very closely jointed, gray in color, foliated, highly fragmented and low to medium in strength.				
5	6	100%	0%					F F Joint 4.70 to 4.75 80° VC VR L-M Clay Adam			Phyllite, moderately weathered, very closely jointed, gray in color, foliated, highly fragmented and low to medium in strength.				
6	7	100%	0%			92%		F F Joint 5.40 to 5.46 80° VC MR L-M Clay Adam	2: 15 13 4.37; 15 18 5.33; 15 23 6.22; 15 18 5.24; 15 13 4.2	11.2	Phyllite, moderately weathered, very closely jointed, gray in color, foliated, highly fragmented and low to medium in strength.				
7	8	100%	0%					F F Joint 6.3 to 6.9 80° VC MR L-M Clay Adam			Phyllite, moderately weathered, very closely jointed, gray in color, foliated, highly fragmented and low to medium in strength.				
7–8	9	100%	25%					F F Joint 7.36 to 7.39 30° VC MR L-M Clay Adam			Phyllite, moderately weathered, very closely jointed, gray in color, foliated, highly fragmented and low to medium in strength.				
8	10	100%	0%					F F Joint 7.73 to 7.77 40° VC MR L-M Clay Adam			Phyllite, moderately weathered, very closely jointed, gray in color, foliated, highly fragmented and low to medium in strength.				
9	11	100%	0%			90%		F F Joint — — VC MR L-M Clay Adam	3: 15 16 5.17; 15 21 6.16; 10 26 6.95	8.33	Phyllite, moderately weathered, very closely jointed, gray in color, foliated, highly fragmented and low to medium in strength.				
10	12	100%	0%					F F Joint 8.34 to 8.38 80° VC MR L-M Clay Adam			Phyllite, moderately weathered, very closely jointed, gray in color, foliated, highly fragmented and low to medium in strength.				

Elevation (m): 366, 364, 356

ELCON (Regd)
Geotechnical Investigation, Dam, Pile Foundation, Ground Water, Hydro Construction, Roads & Civil Work.

BOREHOLE NO.: SKD - 05

ROCK FABRIC TYPE		GRAIN SIZE		MM	ROUGHNESS		DISCONTINUITY SPACING			WEATHERING	
M	Massive	VF	Very Fine	<0.06	Sl	Slickensided	EC	E.Closely	<0.02m	T	Transported Soil
B	Bedded / Banded	F	Fine	0.06-0.2	Sm	Smooth	VC	V.Closely		T	
CB	Cross-bedded	M	Medium	0.2-0.6	SR	Slightly Rough	C	Closely		R	Residual Soil
L	Laminated	C	Coarse	0.6-2.0	M	Medium Rough	M	Medium		C	Completely
F	Foliated	VC	Very Coarse	>2.0	R	Rough	W	Widely		H	Highly
C	Cleaved	Beds/Laminations		mm	VR	Very Rough	VW	V.widely		M	Moderately
S	Schistose	tn	Thin	<100	P	Planar / St / Stepped	EW	E.widely	<0.02m	S	Slightly
G	Gneissose	Tk	Thick	>200	U	Undulating	V	Very / E		U	Unweathered

ROCK STRENGTH – MPa And DISCONTINUITY WALL HARDNESS

VL	Very Low	1-25
L	Low	25-50
M	Medium	50-100
H	High	100-200
VH	Very High	>200

Project: Shah Kaleem Small Dam
Site: Shah Kaleem Distt. Nowshera

Easting: 3128321.075	Location: Spillway
Northing: 1082399.409	BH # 05
Elevation: 366 m	Page: 2 of 2
Angle: Vertical	Date Started: 18-12-08
Final Depth: 20 M	Date Ended: 22-12-08
Drilling Co.: ELCON	Machine: Straight Rotary
Driller: Khalid Khan	Logged: Muhammad Jamil

Drilling and Recovery / Rock Fabric / Discontinuities

Depth (m)	Run No	Core Recovery %	R.Q.D %	Drilling Medium	Drilling Method	Fluid Recovery %	Bit Type	Grain Size (mm)	Type	Type	Joint Depth (m)	Joint Angle (°)	Joint Spacing	Roughness	Wall Hardness	Infill type	Infill Thickness
10	13	100%	0%	Water	Rotary Drilling	86%	NQ Diamond Drilling Bit	F	F	Joint	10.14 to 10.16	25°	VC	R	L-M	Clay	[illegible]
11	14	100%	0%					F	F	Joint	10.57 to 10.64	75°	VC	R	L-M	Clay	[illegible]
	15	100%	0%					F	F	Joint	11.53 to 11.57	45°	VC	R	L-M	Clay	[illegible]
12	16	100%	0%			85%		F	F	Joint	12.08 to 12.10	66°	VC	R	L-M	Clay	[illegible]
13	17	100%	0%					F	F	Joint	12.65 to 12.68	30°	VC	R	L-M	Clay	[illegible]
14	18	100%	13%			81%		F	F	Joint	13.74 to 13.78	56°	VC	R	L-M	Clay	[illegible]
15	19	100%	23%			78%		F	F	Joint	14.27 to 14.30	30°	VC	R	L-M	Clay	[illegible]
16	20	100%	0%					F	F	Joint	15.22 to 15.26	30°	VC	R	L-M	Clay	[illegible]
	21	100%	0%					F	F	Joint	16.10 to 16.14	40°	VC	R	L-M	Clay	[illegible]
17	22	100%	0%			78%		F	F	Joint	16.59 to 16.62	33°	VC	R	L-M	Clay	[illegible]
	23	100%	0%					F	F	Joint	17.23 to 17.26	40°	C	R	H	Clay	[illegible]
18	24	100%	69%			70%		F	F	Joint	17.83 to 17.88	56°	C	R	H	Clay	[illegible]
19	25	100%	29%					F	F	Joint	18.84 to 18.88	75°	C	R	H	Clay	[illegible]
20	26	100%	50%			65%		F	F	Joint	19.75 to 19.77	20°	C	R	H	Clay	[illegible]

Water Pressure Test

Test Number	Time Duration (Min)	Pressure (PSI)	Water (Ltr)	Lugeon Result
	15	21	5.94	
	15	16	4.92	
4	15	19	5.73	7.934
	15	24	6.76	
	15	29	7.32	
	15	24	6.8	
	15	19	5.6	
5	15	22	6.33	8.398
	15	27	7.37	
	15	32	7.93	
	15	27	7.21	
	15	22	6.21	
6	15	25	6.49	8.198
	15	30	7.55	
	15	35	8.11	
	15	30	7.41	
	15	25	6.4	

Constant Head Permeability Test

Test Number	A	E	HC	K
—	—	—	—	—
—	—	—	—	—
—	—	—	—	—

GENERAL DESCRIPTION

Soil: Soil type: colour, consistency, structure, origin
Rock: Rock type: weathering, joint spacing, colour, fabric, strength

Run No	General Description	Weathering: Fresh	Slightly	Moderately	Highly	Completely	Strength: Very Low	Low	Medium	High	Very High
13	Phyllite, moderately weathered, very closely jointed, gray in color, foliated, highly fragmented and low to medium in strength.			▨					▨		
14	Phyllite, moderately weathered, very closely jointed, gray in color, foliated, highly fragmented and low to medium in strength.			▨					▨		
15	Phyllite, moderately weathered, very closely jointed, gray in color, foliated, highly fragmented and low to medium in strength.			▨					▨		
16	Phyllite, moderately weathered, very closely jointed, gray in color, foliated, highly fragmented and low to medium in strength.			▨					▨		
17	Phyllite, moderately weathered, very closely jointed, gray in color, foliated, highly fragmented and low to medium in strength.			▨					▨		
18	Phyllite, moderately weathered, very closely jointed, gray in color, foliated, highly fragmented and low to medium in strength.			▨					▨		
19	Phyllite, moderately to slightly weathered, very closely jointed, gray in color, foliated, highly fragmented and medium to high in strength.		▨	▨					▨	▨	
20	Phyllite, moderately to slightly weathered, very closely jointed, gray in color, foliated, highly fragmented and medium to high in strength.		▨	▨					▨	▨	
21	Phyllite, moderately to slightly weathered, very closely jointed, gray in color, foliated, highly fragmented and medium to high in strength.		▨	▨					▨	▨	
22	Phyllite, moderately to slightly weathered, very closely jointed, gray in color, foliated, highly fragmented and medium to high in strength.		▨	▨					▨	▨	
23	Phyllite, moderately to slightly weathered, very closely jointed, gray in color, foliated, highly fragmented and medium to high in strength.		▨	▨					▨	▨	
24	Phyllite, moderately to slightly weathered, very closely jointed, gray in color, foliated, highly fragmented and medium to high in strength.		▨							▨	
25–26	Phyllite, moderately to slightly weathered, very closely jointed, gray in color, foliated, highly fragmented and medium to high in strength.		▨							▨	

REMARKS

Rock Comprise of Quartz, mica, Feldspar. At places Qtz inclusion are present. Due to the development of siricite and chloride along the cleavage plane, which impart silky Sheen to the rock. The mineral of preferentially oriented due to the compressional stresses of the tectonic. Fresh core surfaces are gray but at places its brownish tent, due to the weathering.

Cementation	Casing	Elevation (m)	Depth (m)
NIL	NIL	356	10
		346	20

ELCON (Regd)
Geotechnical Investigation, Dam, Pile Foundation, Ground Water, Hydro Construction, Roads & Civil Work.

BOREHOLE NO.: SKD - 05

ROCK FABRIC TYPE		GRAIN SIZE		MM	ROUGHNESS		DISCONTINUITY SPACING			WEATHERING	
M	Massive	VF	Very Fine	<0.06	Sl	Slickensided	EC	E.Closely	<0.02m	T	Transported Soil
B	Bedded / Banded	F	Fine	0.06-0.2	Sm	Smooth	VC	V.Closely	[illegible]	R	Residual Soil
CB	Cross-bedded	M	Medium	0.2-0.6	SR	Slightly Rough	C	Closely	[illegible]	C	Completely
L	Laminated	C	Coarse	0.6-2.0	M	Medium Rough	M	Medium	0.2-0.6m	H	Highly
F	Foliated	VC	Very Coarse	>2.0	R	Rough	W	Widely	0.6-2.0m	M	Moderately
C	Cleaved	Beds/Laminations		mm	VR	Very Rough	VW	V.widely	2.0-6.0m	S	Slightly
S	Schistose	tn	Thin	<100	P	Planar / St / Stepped	EW	E.widely	>6.0m	U	Unweathered
G	Gneissose	Tk	Thick	>300	U	Undulating	V	Very	E Extremely		

ROCK STRENGTH – MPa And DISCONTINUITY WALL HARDNESS

VL	Very Low	1-25
L	Low	25-50
M	Medium	50-100
H	High	100-200
VH	Very High	>200

Project: Shah Kaleem Small Dam
Site: Shah Kaleem Distt. Nowshera
Easting: 3128321.075
Northing: 1082399.409
Elevation: 366 m
Angle: Vertical
Final Depth: 20 M
Drilling Co.: ELCON
Driller: Khalid Khan
Location: Spillway
BH # 05
Page: 2 of 2
Date Started: 18-12-08
Date Ended: 22-12-08
Machine: Straight Rotary
Logged: Muhammad Jamil

Drilling and Recovery

Depth (m): 10 – 20. Drilling Medium: Water. Drilling Method: Rotary Drilling. Bit Type: NQ Diamond Drilling Bit.

Run No	Core Recovery %	R.Q.D %	Fluid Recovery %	Rock Fabric: Grain Size (mm)	Rock Fabric: Type	Discontinuities: Type	Joint Depth (m)	Joint Angle (°)	Joint Spacing	Roughness	Wall Hardness	Fill type	Fill Thickness (mm)	GENERAL DESCRIPTION
13	100%	0%	88%	F	F	Joint	10.14 to 10.16	25°	VC	R	L-M	Clay	[illegible]	Phyllite, moderately weathered, very closely jointed, gray in color, foliated, highly fragmented and low to medium in strength.
14	100%	0%		F	F	Joint	10.57 to 10.64	75°	VC	R	L-M	Clay	[illegible]	Phyllite, moderately weathered, very closely jointed, gray in color, foliated, highly fragmented and low to medium in strength.
15	100%	0%		F	F	Joint	11.13 to 11.17	45°	VC	R	L-M	Clay	[illegible]	Phyllite, moderately weathered, very closely jointed, gray in color, foliated, highly fragmented and low to medium in strength.
16	100%	0%	85%	F	F	Joint	12.05 to 12.10	55°	VC	R	L-M	Clay	[illegible]	Phyllite, moderately weathered, very closely jointed, gray in color, foliated, highly fragmented and low to medium in strength.
17	100%	0%		F	F	Joint	12.65 to 12.66	30°	VC	R	L-M	Clay	[illegible]	Phyllite, moderately weathered, very closely jointed, gray in color, foliated, highly fragmented and low to medium in strength.
18	100%	13%	81%	F	F	Joint	13.74 to 13.78	55°	VC	R	L-M	Clay	[illegible]	Phyllite, moderately weathered, very closely jointed, gray in color, foliated, highly fragmented and low to medium in strength.
19	100%	23%	78%	F	F	Joint	14.27 to 14.30	30°	VC	R	L-M	Clay	[illegible]	Phyllite, moderately to slightly weathered, very closely jointed, gray in color, foliated, highly fragmented and medium to high in strength.
20	100%	0%		F	F	Joint	15.22 to 15.26	30°	VC	R	L-M	Clay	[illegible]	Phyllite, moderately to slightly weathered, very closely jointed, gray in color, foliated, highly fragmented and medium to high in strength.
21	100%	0%		F	F	Joint	16.10 to 16.14	40°	VC	R	L-M	Clay	[illegible]	Phyllite, moderately to slightly weathered, very closely jointed, gray in color, foliated, highly fragmented and medium to high in strength.
22	100%	0%	78%	F	F	Joint	16.59 to 16.62	33°	VC	R	L-M	Clay	[illegible]	Phyllite, moderately to slightly weathered, very closely jointed, gray in color, foliated, highly fragmented and medium to high in strength.
23	100%	0%		F	F	Joint	17.32 to 17.36	40°	C	R	H	Clay	[illegible]	Phyllite, moderately to slightly weathered, very closely jointed, gray in color, foliated, highly fragmented and medium to high in strength.
24	100%	69%	70%	F	F	Joint	17.83 to 17.88	55°	C	R	H	Clay	[illegible]	Phyllite, moderately to slightly weathered, very closely jointed, gray in color, foliated, highly fragmented and medium to high in strength.
25	100%	29%		F	F	Joint	18.84 to 18.89	75°	C	R	H	Clay	[illegible]	Phyllite, moderately to slightly weathered, very closely jointed, gray in color, foliated, highly fragmented and medium to high in strength.
26	100%	50%	65%	F	F	Joint	[illegible]	25°	C	R	H	Clay	[illegible]	

GENERAL DESCRIPTION
Soil: Soil type: colour, consistency, structure, origin
Rock: Rock type: weathering, joint spacing, colour, fabric, strength

Water Pressure Test

Test Number	Time Duration (Min)	Pressure (PSI)	Water (Ltr)	Lugeon Result
	15	21	5.94	
	15	16	4.92	
4	15	19	5.73	7.934
	15	24	6.76	
	15	29	7.32	
	15	24	6.6	
	15	19	5.6	
5	15	22	6.33	8.398
	15	27	7.37	
	15	32	7.93	
	15	27	7.21	
	15	22	6.21	
6	15	25	6.49	8.198
	15	30	7.55	
	15	35	8.11	
	15	30	7.41	
	15	25	6.4	

Constant Head Permeability Test: Test Number, q, E, HC, K

Weathering: Fresh, Slightly, Moderately, Highly, Completely
Strength: Very Low, Low, Medium, High, Very High

Cementation: NIL
Casing: NIL
Elevation (m): 356 – 346
Depth (m): 10 – 20

REMARKS

Rock Comprise of Quartz, mica, Feldspar. At places Qtz inclusion are present. Due to the development of siricite and chloride along the cleavage plane, which import silky Sheen to the rock. The mineral of preferentially oriented due to the compressional stresses of the tectonic. Fresh core surfaces are gray but at places its brownish tent, due to the weathering.

Annex - III (EIA Report)

Environmental Protection Agency
Environment Department
Govt. of NWFP

No. EPA/~~EIA~~ IEE/S-K-DAM/387

Date: 4-02-2010

To

The Director,
Small Dams Organization,
Irrigation Department,
Govt. of NWFP, Peshawar
58-E-1 Canal Road University Town Peshawar.

Subject: **IEE Report of Shah Kaleem Dam District Nowshera.**

I am directed to enclose herewith Legal Environmental Approval/ Decision Note on IEE for construction of Shah Kaleem Dam District Nowshera for your information and further implementation, please.

Deputy Director (EIA)

Decision on IEE

1.	**Name, address of proponent:**	Director, Small Dams Organization Irrigation Department, 58-E-1 Canal road University Town Peshawar. Ph: 091-5844673 Fax: 091-5844673
2.	**Description of project.**	The Shah Kaleem Dam is proposed to be constructed on Shah Kaleem Khawar which is locally known as Pitao Khwar. The life of the Dam is estimated to be more than 30 years. It will have gross storage of 646 AF. The water from the Dam devisor can cater for irrigating 600 acres.
3.	**Location of project.**	The project is located in District Nowshera.
4.	**Date of filing of IEE.**	04/06/2009 EPA (Diary No.1971)

5. After careful review, the Environmental Protection Agency, Govt. of NWFP has decided to accord approval of the Initial Environmental Examination for Shah Kaleem Dam, District Nowshera, in line with the guidelines issued by Pak. EPA and IEE/EIA Regulations, 2000 subject to the following terms & conditions:-

a) The proponent will adopt all precautionary and mitigatory measures identified in IEE report as well as any un-anticipated impacts during the construction and operation phase of project.

b) Proper mitigation measures should be adopted to protect two primary schools (one Boys, one Girls) and Pitao payan village.

c) Tube well & irrigation land should be protected or properly compensated through mutual agreement with owners if any damage occur.

d) Grave yard & electric poles issues should be solved through constitution with local people of area and WAPDA.

e) Present right of way of irrigation should be protected.

f) Land compensation agreement should be provided to this Agency before starting activities on the site.

g) To minimize erosion, afforestation programme should be planed and implemented in the catchments area of the proposed dam.

j) Alternate road should be provided to the people of the area.

6. The proponent shall be liable for correctness and validity of the information supplied by the environmental consultant.
7. The proponent shall be liable for compliance of Sections 13, 14, 17 and 18 of IEE/EIA Regulations, 2000, regarding approval, confirmation of compliance, entry, inspections and monitoring.
8. This approval is accorded only for the construction phase of the project. The proponent will obtain approval for operation of the project in accordance with the Section 13 (2) (b) and Section 18 of the IEE/EIA Regulations, 2000.
9. Any change in the approved project shall be communicated to EPA, NWFP and shall be commenced after obtaining the approval.
10. This approval shall be treated as null and void if all or any of the conditions mentioned above is/are not complied with.
11. This approval does not absolve the proponent of the duty to obtain any other approval or clearance that may be required under any law in force.
12. There is no legal case pending in the courts against the project.
13. In exercise of the power under Section 12 of the Pakistan Environmental Protection Act, 1997, the undersigned is pleased to approve the IEE of Shah Kaleem Dam with above mentioned terms and conditions.

Dated: Peshawar 4-02-2010
Tracking/File.No.EPA/IEE/S-K-Dam/ 387.

DIRECTOR GENERAL
EPA, NWFP.
3rd Floor, SDU Building,
Khyber Road
Peshawar.

Annex - IV (Detail Road Design Calculations)

Detailed Calculations
Shingle Gravel Road

DESIGN SHEET NO. 1

	Design Period is taken 10 years			Minimum Design CBR of Subgrade in %		27
LAYER	Wt 18	R %	Zr	So	Delta "PSI"	Mr "PSI"
Shingle Gravel	2,407,692	90.00	-1.282	0.45	1.7	45,000

LAYER	Layer Coefficient (a) (/inch)	Min. Thickness Provided			Structural No
		mm			Actual
Shingle Gravel	0.41	150.00			1.02
TOTAL SN PROVIDED					2.82

SN required	2.70
SN provided	2.82

Hence Design is OK

Detailed Calculations

DESIGN EQUIVALENT STANDARD AXLE LOADS (DESAL)

TABLE No. 11

Year	Type -1			Type -2			Total Yearly ESAL			CUMULATIVE ESALS
	PROJECTED AADT X 365	Yearly ESALS DAMAGING FACTORS		PROJECTED AADT X365	Yearly ESALS DAMAGING FACTORS		TOTAL	TOTAL	TOTAL ESALS	
		EMPTY 20%	LOADED 80%		EMPTY 20%	LOADED 80%	EMPTY 20%	LOADED 80%		
		0.043	4.956		0.881	0.881	ESALS	ESALS		
2016	73,278	630	290,532	84,189	14,834	59,337	15,464	349,869	365,333	365,333
2017	77,675	668	307,964	89,241	15,724	62,897	16,392	370,861	387,253	752,587
2018	82,335	708	326,442	94,595	16,668	66,671	17,376	393,113	410,489	1,163,075
2019	87,275	751	346,028	100,271	17,668	70,671	18,418	416,699	435,118	1,598,193
2020	92,512	796	366,790	106,287	18,728	74,911	19,523	441,701	461,225	2,059,418
2021	98,062	843	388,798	112,665	19,851	79,406	20,695	468,204	488,898	2,548,316
2022	103,946	894	412,125	119,424	21,043	84,170	21,937	496,296	518,232	3,066,548
2023	110,183	948	436,853	126,590	22,305	89,221	23,253	526,074	549,326	3,615,875
2024	116,794	1,004	463,064	134,185	23,643	94,574	24,648	557,638	582,286	4,198,160
2025	123,801	1,065	490,848	142,236	25,062	100,248	26,127	591,096	617,223	4,815,383
TOTAL	965,861	8,306	3,829,445	1,109,684	195,526	782,106	203,833	4,611,551	4,815,383	

TOTAL DESIGN LIFE ESALS OF 10 YEARS=W18=	4,815,383
50% OF THE ESAL FOR DIRECTIONAL DISTRIBUTION =	2,407,692
100% OF THE ESAL FOR LANE DISTRIBUTION =	2,407,692
TOTAL 18-kip ESALS =W18 =	2,407,692

OR

2.41 Million

Detailed Calculations

PROJECTED ANNUAL AVERAGE DAILY TRAFFIC (PROJECTED AADT)

TABLE No. 10

YEAR	cycle	Motor Cycle	Car	Small Trolly	Pick up	Type -1	Type -2	TOTAL DAILY TRAFFIC VOLUME
2014	841	1578	366	145	166	459	311	3244
GROWTH RATE (AGCR) %				6%				
2015 CONSTRUCTION PERIOD	892	1672	388	153	176	486	431	3438
2016 CONSTRUCTION PERIOD	919	1723	400	158	181	501	444	3542
GENERATED / DIVERTED TRAFFIC %				20%				
2016 BASE YEAR	1169	2191	508	201	231	637	564	4505
2017	1239	2323	539	213	244	675	598	4775
2018	1313	2462	571	226	259	716	634	5062
2019	1392	2610	606	239	275	758	672	5365
2020	1475	2766	642	253	291	804	712	5687
2021	1564	2932	680	269	309	852	755	6029
2022	1658	3108	721	285	327	903	800	6390
2023	1757	3295	765	302	347	958	848	6774
2024	1862	3492	810	320	368	1015	899	7180
2025	1974	3702	859	339	390	1076	953	7611
TOTAL VEHICLES AFTER 10 YEARS DESIGN LIFE	18054	33863	7856	3102	3564	8718	27893	69603

NOTE:

- THE TRAFFIC GROWTH RATE HAS BEEN ADOPTED AS 6% FOR EACH YEAR THROUGHOUT THE DESIGN LIFE (10 YEARS) AS PER JICA AND ROAD NOTE - 31 RECOMMENDATIONS.
- 20% FOR DIVERTED / GENERATED TRAFFIC HAS BEEEN ADDED IN MAIN TRAFFIC OF BASE YEAR.
- THE STRETCH FOR PAVEMENT HAS INCLUDED FOLLOWING DIRECTIONS (BOTH)

PROJECTED ANNUAL AVERAGE DAILY TRAFFIC = AADT x (1+GROWTH RATE / 100) $^{\text{NUMBER OF YEARS}}$

Detailed Calculations

ANNUAL AVERAGE DAILY TRAFFIC (AADT)

TABLE No. 9

DIRECTION: BOTH

DAY/DATE	cycle	Motor Cycle	Car	Small Trolly	Pick up	TOTAL DAILY TRAFFIC VOLUME	Type -1	Type -2
CSV FOR AUGUST	0.900							
WDMF FOR FRIDAY	1.010095							
Friday 15/08/2014	908	1637	374	164	205	519	313	302
WDMF FOR SATURDAY	1.031785							
Saturday 16/08/2014	864	1555	376	151	194	498	304	292
WDMF FOR SUNDAY	1.012595							
Sunday 17/08/2014	804	1602	387	156	186	492	306	282
WDMF FOR MONDAY	0.992005							
Monday 18/08/2014	810	1438	381	149	216	511	295	311
WDMF FOR TUESDAY	0.99278							
Tuesday 19/08/2014	854	1744	383	152	128	427	299	223
WDMF FOR WEDNESDAY	0.988835							
Wednesday 20/08/2014	828	1534	308	119	114	379	265	209
WDMF FOR THURSDAY	0.978315							
Thursday 21/08/2014	821	1534	354	121	120	385	265	213
ANNUAL AVERAGE DAILY TRAFFIC AADT	**841**	**1578**	**366**	**145**	**166**	**459**	**292**	**262**

NOTE:

- REFER TABLE NO. 2 ADT
- FORMULA FOR AADT

AADT = ADT X WDMF + CSV

Detailed Calculations

AVERAGE DAILY TRAFFIC (ADT)

TABLE No. 8

DIRECTION: BOTH

DAY/DATE	cycle	Motor Cycle	Car	Small Trolly	Pick up	TOTAL DAILY TRAFFIC VOLUME
Friday 04/02/2011	809	1459	333	146	183	2930
Saturday 05/02/2011	754	1356	328	132	169	2739
Sunday 06/02/2011	715	1424	344	139	165	2787
Monday 07/02/2011	735	1305	346	135	196	2717
Tuesday 08/02/2011	774	1581	347	138	116	2956
Wednesday 09/02/2011	754	1396	280	108	104	2642
Thursday 10/02/2011	755	1411	326	111	110	2713
AVERAGE DAILY TRAFFIC ADT	757	1419	329	130	149	2783

NOTE:

- REFER TABLE NO. 1 TO TABLE NO. 7 FOR DAILY TRAFFIC COUNT
- FORMULA FOR ADT

ADT = (+FRIDAY+SATURDAY+SUNDAY+MONDAY+TUESDAY+WEDNESDAY+THURSDAY) ÷ 7

TABLE - B

CO-EFFICIENTS OF MONTHLY SEASONAL VARIATIONS (CSV)

STATION	JAN	FEB	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
1.000	0.949	0.968	1.015	1.098	1.007	1.028	1.044	1.068	0.985	0.961	0.944	0.932
2.000	0.929	0.953	1.025	1.152	0.899	1.038	1.077	1.039	1.019	0.990	0.975	0.906
3.000	0.992	0.997	1.011	1.045	1.007	1.009	1.024	0.988	0.998	0.972	0.975	0.982
4.000	0.997	1.031	1.073	1.034	1.021	0.976	0.995	0.952	0.922	0.955	1.035	1.011
5.000	0.988	1.007	1.052	1.061	0.973	0.972	0.975	0.933	1.009	0.996	1.028	1.007
6.000	1.037	1.010	1.037	1.048	0.975	0.954	0.954	0.901	0.932	1.027	1.076	1.048
7.000	1.026	1.016	0.974	1.000	0.986	1.029	1.016	0.920	0.926	1.014	1.056	1.041
8.000	1.041	1.056	1.042	1.010	0.965	0.980	0.941	0.988	0.976	0.958	1.009	1.037
9.000	0.981	0.956	0.981	1.034	0.937	0.946	1.053	1.016	1.089	1.048	1.005	0.947
10.000	0.745	0.745	0.745	0.745	0.745	0.745	0.745	0.745	0.745	0.745	0.745	0.745
11.000	0.908	0.871	0.946	1.096	0.931	1.102	1.204	0.945	1.098	1.012	1.023	0.865
12.000	0.977	0.978	0.982	1.040	0.755	1.024	1.000	1.022	1.009	1.018	1.011	0.984
13.000	0.977	0.980	1.008	1.047	0.942	1.040	1.006	1.038	1.005	1.010	0.998	0.973
14.000	0.999	0.993	0.926	1.003	1.032	1.058	1.033	0.944	0.976	1.031	1.019	0.988
15.000	0.999	1.000	1.006	1.030	0.981	1.007	1.005	0.997	0.989	0.995	0.997	0.992
16.000	1.078	1.053	1.010	1.036	0.982	0.900	0.969	0.993	1.000	1.033	1.000	1.045
17.000	1.004	1.080	1.044	1.061	0.990	0.972	0.887	0.847	0.900	1.044	0.991	1.079
18.000	1.117	1.207	1.164	0.995	0.865	0.916	1.146	1.123	1.090	0.929	0.877	0.897
19.000	0.951	0.972	0.953	1.059	0.909	1.101	0.986	0.946	0.925	0.987	1.047	1.076
20.000	0.981	0.991	0.980	1.054	0.988	1.007	0.999	0.968	0.977	0.988	0.992	0.976
Average	**0.984**	**0.993**	**0.999**	**1.032**	**0.945**	**0.990**	**1.000**	**0.900**	**0.980**	**0.990**	**0.990**	**0.980**

Refer Table:8.2 Page 51 , Traffic Factors for Pakistan - II ,Published by NTRC in 1990

Detailed Calculations

TRAFFIC COUNT RECORD

DAY / DATE: Friday 15/08/2013

DIRECTION: BOTH

TIME	cycle	Motor Cycle	Car	Small Trolly	Pick up
06:00-07:00	82	82	15	11	9
07:00-08:00	35	75	17	9	5
08:00-09:00	81	85	21	7	47
09:00-10:00	75	125	21	11	31
10:00-11:00	68	145	19	9	7
11:00-12:00	57	158	19	8	10
12:00-13:00	45	187	91	27	31
13:00-14:00	36	145	34	12	7
14:00-15:00	100	125	29	21	8
15:00-16:00	87	118	23	11	9
16:00-17:00	78	150	25	12	13
17:00-18:00	65	64	19	8	6
TOTAL	809	1459	333	146	183

Detailed Calculations

TRAFFIC COUNT RECORD

DAY / DATE: Saturday 16/08/2013

DIRECTION: BOTH

TIME	cycle	Motor Cycle	Car	Small Trolly	Pick up
06:00-07:00	75	85	17	9	9
07:00-08:00	35	73	19	9	5
08:00-09:00	81	150	21	7	40
09:00-10:00	75	152	23	11	33
10:00-11:00	61	125	27	5	6
11:00-12:00	57	135	27	13	7
12:00-13:00	42	145	62	23	30
13:00-14:00	36	85	45	11	5
14:00-15:00	85	95	26	17	9
15:00-16:00	87	136	23	11	7
16:00-17:00	65	89	27	9	11
17:00-18:00	55	86	11	7	7
TOTAL	754	1356	328	132	169

Detailed Calculations

TRAFFIC COUNT RECORD

DAY / DATE: Sunday 17/08/2013

DIRECTION: BOTH

Table No. 3

TIME	cycle	Motor Cycle	Car	Small Trolly	Pick up
06:00-07:00	65	92	23	15	6
07:00-08:00	45	81	21	6	3
08:00-09:00	51	150	19	9	39
09:00-10:00	55	125	31	11	29
10:00-11:00	58	156	35	9	8
11:00-12:00	57	135	39	5	11
12:00-13:00	35	145	55	23	29
13:00-14:00	29	125	35	12	8
14:00-15:00	88	129	29	17	9
15:00-16:00	78	113	15	18	7
16:00-17:00	89	98	25	9	11
17:00-18:00	65	75	17	5	5
TOTAL	715	1424	344	139	165

Detailed Calculations

TRAFFIC COUNT RECORD

DAY / DATE: Monday 18/08/2013

DIRECTION: BOTH

Table No. 4

TIME	cycle	Motor Cycle	Car	Small Trolly	Pick up
06:00-07:00	75	95	19	9	9
07:00-08:00	45	112	17	8	5
08:00-09:00	71	125	25	5	35
09:00-10:00	55	120	21	6	37
10:00-11:00	58	135	21	9	8
11:00-12:00	57	138	37	11	11
12:00-13:00	45	89	87	25	29
13:00-14:00	36	98	53	17	12
14:00-15:00	73	98	19	18	13
15:00-16:00	87	76	17	11	9
16:00-17:00	68	150	19	10	11
17:00-18:00	65	69	11	6	17
TOTAL	735	1305	346	135	196

Detailed Calculations

TRAFFIC COUNT RECORD

DAY / DATE: Tuesday 19/08/2013

DIRECTION: BOTH

Table No. 5

TIME	cycle	Motor Cycle	Car	Small Trolly	Pick up
06:00-07:00	82	115	23	9	7
07:00-08:00	35	135	25	15	5
08:00-09:00	81	152	31	6	9
09:00-10:00	75	155	21	12	17
10:00-11:00	68	125	19	11	6
11:00-12:00	57	135	45	10	13
12:00-13:00	45	156	69	14	16
13:00-14:00	36	125	49	12	9
14:00-15:00	85	135	21	17	10
15:00-16:00	87	145	15	11	9
16:00-17:00	58	139	18	12	10
17:00-18:00	65	64	11	9	5
TOTAL	774	1581	347	138	116

Detailed Calculations

TRAFFIC COUNT RECORD

DAY / DATE: Wednesday 20/08/2013

DIRECTION: BOTH

Table No. 6

TIME	cycle	Motor Cycle	Car	Small Trolly	Pick up
06:00-07:00	82	95	15	9	7
07:00-08:00	35	83	16	7	3
08:00-09:00	61	158	21	6	14
09:00-10:00	75	136	19	7	12
10:00-11:00	68	125	21	7	6
11:00-12:00	57	100	24	10	9
12:00-13:00	45	89	45	12	13
13:00-14:00	36	143	37	14	7
14:00-15:00	78	145	26	9	10
15:00-16:00	74	116	20	9	8
16:00-17:00	78	142	25	12	10
17:00-18:00	65	64	11	6	5
TOTAL	754	1396	280	108	104

Detailed Calculations

TRAFFIC COUNT RECORD

DAY / DATE: Thursday 21/08/2013

DIRECTION: BOTH

Table No. 7

TIME	cycle	Motor Cycle	Car	Small Trolly	Pick up
06:00-07:00	63	95	16	9	7
07:00-08:00	35	83	16	9	3
08:00-09:00	71	159	18	6	19
09:00-10:00	75	124	21	9	17
10:00-11:00	68	150	23	7	6
11:00-12:00	57	170	35	10	9
12:00-13:00	45	142	79	13	9
13:00-14:00	36	143	38	10	7
14:00-15:00	85	89	26	11	10
15:00-16:00	77	95	20	9	8
16:00-17:00	78	97	23	12	10
17:00-18:00	65	64	11	6	5
TOTAL	755	1411	326	111	110

Drawings

SHAH KALEEM DAM PROJECT
DISTRICT NOWSHERA

CLIENT:

GOVERNMENT OF KHYBER PAKHTUNKHAWA
DIRECTORATE GENERAL SMALL DAMS,
IRRIGATION DEPARTMENT PESHAWAR

CONSULTANT:

CONSULTING ASSOCIATES
NEAR DEANS COMPLEX APARTMENTS,BEHIND GUL
CNG BOARD BAZAAR, JAMRUD ROAD,PESHAWAR
PH#: 091-5701774-45 Fax - 091-5701775
E-MAIL: consultingassociates127@gmail.com

INDEX SHEET

SHAH KALEEM DAM PROJECT

LIST OF DRAWINGS

SR NO.	DRAWING NO.	DESCRIPTION
1.	GENERAL DRAWINGS	
1	SKD-GEN-01	LOCATION MAP
2	SKD-GEN-02	VICINITY MAP
3	SKD-GEN-03	GENERAL LAYOUT PLAN
2.	TOPO-GRAPHIC SURVEY	
4	SKD-TS-01	RESERVOIR MAP
5	SKD-TS-02	COMMAND MAP
3.	HYDROLOGY	
6	SKD-HYD-01	CATCHMENT AREA
7	SKD-HYD-02	ISOHYTAL MAP
8	SKD-HYD-03	RESERVOIR AREA
4.	GEOLOGY	
9	SKD-GEO-01	GEOLOGICAL MAP
10	SKD-GEO-02	CROSS SECTIONS
11	SKD-GEO-03	CROSS SECTION ALONG DAM AXIS
5.	DAM AXIS	
12	SKD-MD-01	SETTING OUT PALN
13	SKD-MD-02	EXCAVATION PALN
14	SKD-MD-03	PLAN
15	SKD-MD-04	LONG SECTION
16	SKD-MD-05	GROUTING
17	SKD-MD-06	GROUTING NOTES
18	SKD-MD-07 TO 16	X - SECTIONS
19	SKD-MD-17	GRADATION LIMITS
20	SKD-MD-18	INSTRUMNETATION

SR NO.	DRAWING NO.	DESCRIPTION
6.	SPILLWAY	
21	SKD-SP-01	PLAN
22	SKD-SP-02	SPILLWAY PLAN AND DETAIL
23	SKD-SP-03	SPILLWAY LONG SECTION AND DETAIL
24	SKD-SP-04	SPILLWAY CROSS SECTIONS
25	SKD-SP-05	SPILLWAY CROSS SECTIONS
26	SKD-SP-06	SPILLWAY L- SECTION & REINFORCEMENT DETAIL
27	SKD-SP-07	SPILLWAY PLAN DRAINAGE ARRANGEMENT & DETAIL
28	SKD-SP-08	SPILLWAY L-SECTION DRAINAGE ARRANGEMENT & DETAIL
29	SKD-SP-09	SPILLWAY X-SECTION DRAINAGE ARRANGEMENT & DETAIL
7.	INTAKE & OUTLET STRUCTURES	
30	SKD-INT-01	IRRIGATION CONDUIT LAYOUT PLAN
31	SKD-INT-02	IRRIGATION CONDUIT L - SECTION (A-A) AND DETAILS
32	SKD-INT-03	IRRIGATION CONDUIT CROSS SECTIONS
33	SKD-INT-04	INTAKE STRUCTURE PLAN, SECTIONS & DETAILS
34	SKD-INT-05	OUTLET STRUCTURE PLAN, SECTIONS & DETAILS
35	SKD-INT-06	TRASHRACK AND STOPLOG DETAILS INTAKE OPENING AT LOWER LEVEL
36	SKD-INT-07	TRASHRACK AND STOPLOG DETAILS
8.	IRRIGATION SYSTEM	
37	SKD-IS-01 TO 07	IRRIGATION CHANNEL PLAN AND PROFILE
38	SKD-IS-08	CANAL TYPICAL CROSS-SECTION
39	SKD-IS-09	ACQUEDUCT DETAIL
40	SKD-IS-10	CASCADE FALL DETAIL
41	SKD-IS-11	DROP FALL TYP.DETAIL

Client:- Directorate General Small Dams

Consultants:- Consulting Associates

Project:- Detail Design & Construction Supervision of Package - F

Job:- TENDER DRAWINGS

INDEX SHEET

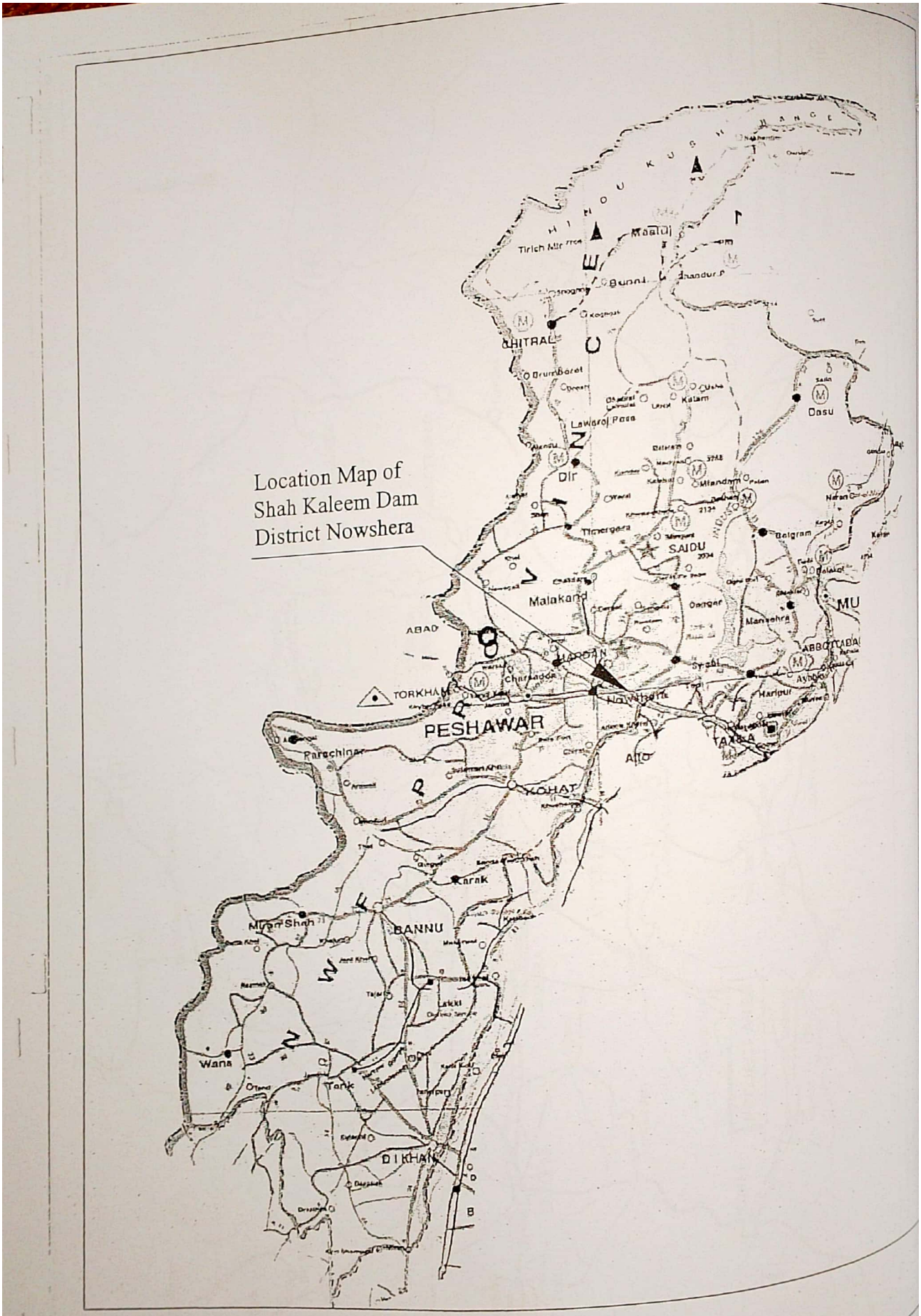
INDEX SHEET

SHAH KALEEM DAM PROJECT

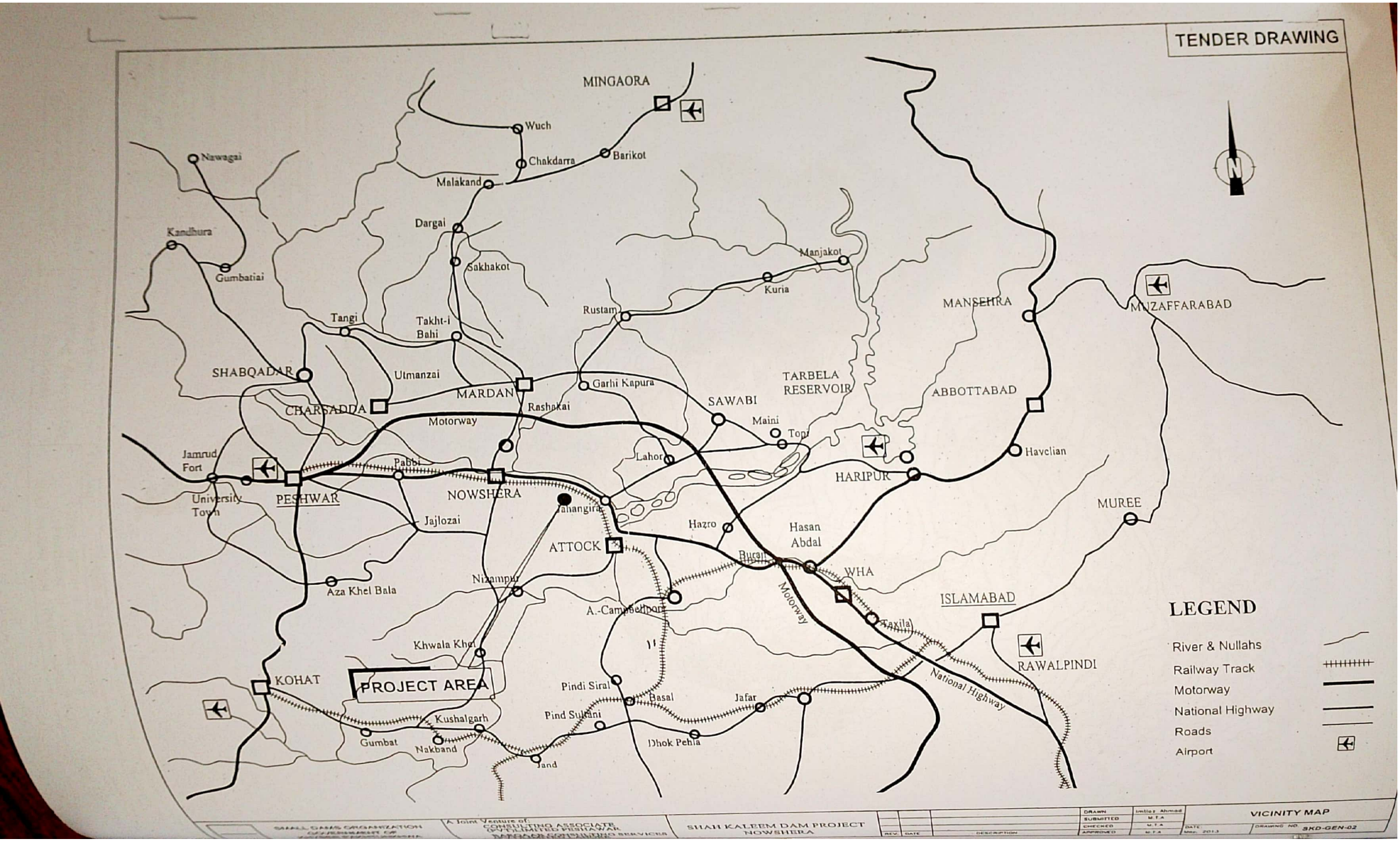
LIST OF DRAWINGS

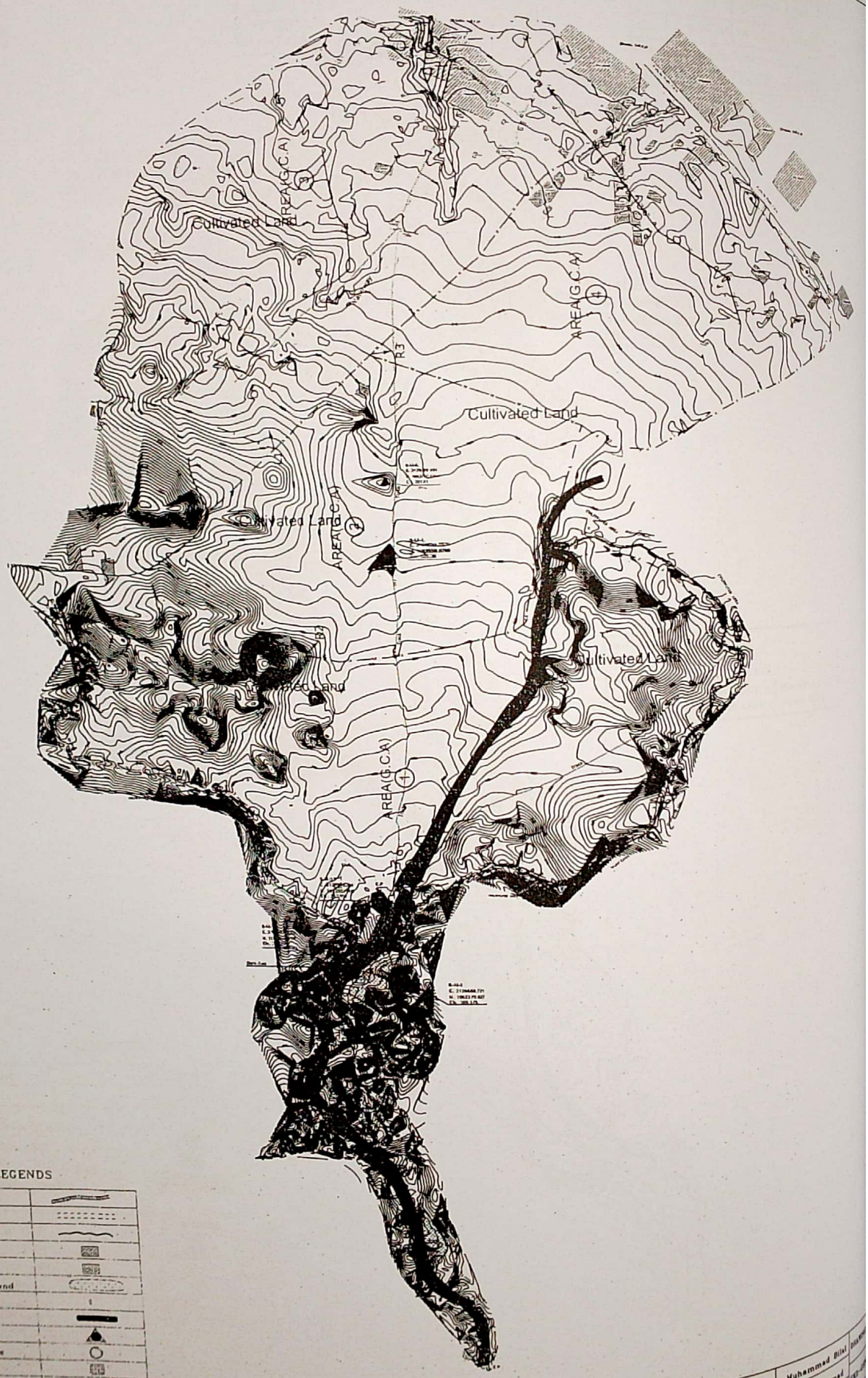
SR NO.	DRAWING NO.	DESCRIPTION
42	SKD-IS-12	SYPHON DETAILS TYPICAL
43	SKD-IS-13	TAIL CLUSTER WITH TWO
44	SKD-IS-14	TYPICAL PIPE OUTLET DETAIL
9.	ROAD	
45	SKD-R-01	TOPOGRAPHIC PLAN
46	SKD-R-02	TYPICAL SECTION AND RETAINING WALL
47	SKD-R-03 TO 04	PLAN SHEET
48	SKD-R-05 TO 07	PROFILE
10.	ROAD STRUCTURES	
49	SKD-RS-01	TYPICAL PLAN OF CULVERT
50	SKD-RS-02	TYPICAL L-SECTION OF CULVERT & REINFORCEMENT DETAIL
51	SKD-RS-03	TYPICAL X-SECTION OF CULVERT
52	SKD-RS-04	DETAIL OF CULVERT
11.	INSPECTION HUT	
53	SKD-IH-01	INSPECTION HUT

GENERAL DRAWINGS



Client:-	Consultants:-	Project:-	Job:-	LOCATION MAP
Directorate General Small Dams Irrigation Department Govt. of KPK Peshawar	Consulting Associates Peshawar	Detail Design & Construction Supervision of Package – F	Shah Kaleem Dam (Location Map)	DRAWING NO SKD-DG


TENDER DRAWING
MINGAORA
Wuch
Chakdarra
Barikot
Nawagai
Malakand
Dargai
Kandhura
Gumbatiai
Sakhakot
Manjakot
Kuria
Rustam
MANSEHRA
MUZAFFARABAD
Tangi
Takht-i Bahi
SHABQADAR
Utmanzai
MARDAN
Garhi Kapura
TARBELA RESERVOIR
ABBOTTABAD
CHARSADDA
Rashakai
SAWABI
Motorway
Maini
Topi
Jamrud Fort
Pabbi
Lahor
Havelian
HARIPUR
University Town
PESHWAR
NOWSHERA
Jahangira
MUREE
Jajlozai
Hazro
Hasan Abdal
ATTOCK
Bucal
WHA
Aza Khel Bala
Nizampur
A.-Campbellpur
Motorway
ISLAMABAD
Taxila
Khwala Khel
RAWALPINDI
KOHAT
PROJECT AREA
Pindi Siral
National Highway
Basal
Jafar
Kushalgarh
Pind Sultani
Gumbat
Nakband
Dhok Pehla
Jand
LEGEND
River & Nullahs
Railway Track
Motorway
National Highway
Roads
Airport
SMALL DAMS ORGANIZATION
A Joint Venture of:
CONSULTING ASSOCIATE (PVT) LIMITED PESHAWAR
SHAH KALEEM DAM PROJECT NOWSHERA
DRAWN
SUBMITTED
CHECKED
APPROVED
REV.
DATE
DESCRIPTION
VICINITY MAP
DRAWING NO
SKD-GEN-02



LEGENDS

Waterway	
Track	
Nullah	
House	
School	
Cultivated Land	
Well	
Gabion Wall	
Bench Mark	
Electric pole	
Tube Well	
Spill Way	

Client:-	Consultants:-	Project:- TENDER DRAWINGS	
Directorate General Small Dams Irrigation Department Govt: of KPK Peshawar	Consulting Associates Peshawar	DETAIL DESIGN & CONSTRUCTION SUPERVISION OF PACKAGE – F SHAH KALEEM DAM GENERAL LAYOUT PLAN	Muhammad Bilal Shakeel Ahmad Farid Khan Wazir

Bench Mark

	Easting	Northing	Elv
BM-1	3128464.618	1082423.618	367.789
BM-2	3128688.721	1082370.827	366.178
BM-3	3128595.311	1082597.595	342.195

Dam Top Level: (365.00)
Dam Bed Level: (343.00)
Dam Height: 22 M (72.182 ft)
Reservoir Area: 222424.891 m^2 (54.97 Acre)
Cultivated Area: 18859.1048 m^2 (4.66 Acre)

LEGENDS

Waterway	
Track	
Nullah	
House	
School	
Cultivated Land	
Well	
Gabion Wall	
Bench Mark	
Electric pole	
Tube Well	
Spill Way	

Client:- Directorate General Small Dams Irrigation Department Govt: of KPK Peshawar	Consultants:- Consulting Associates Peshawar	TENDER DRAWINGS Project:- Detail Design & Construction Supervision of Package - F Shah Kaleem Dam	Muhammad Bilal Shakeel Ahmad Fari Khan Wazir RESERVOIR MAP DRAWING NO SKD-TS-01

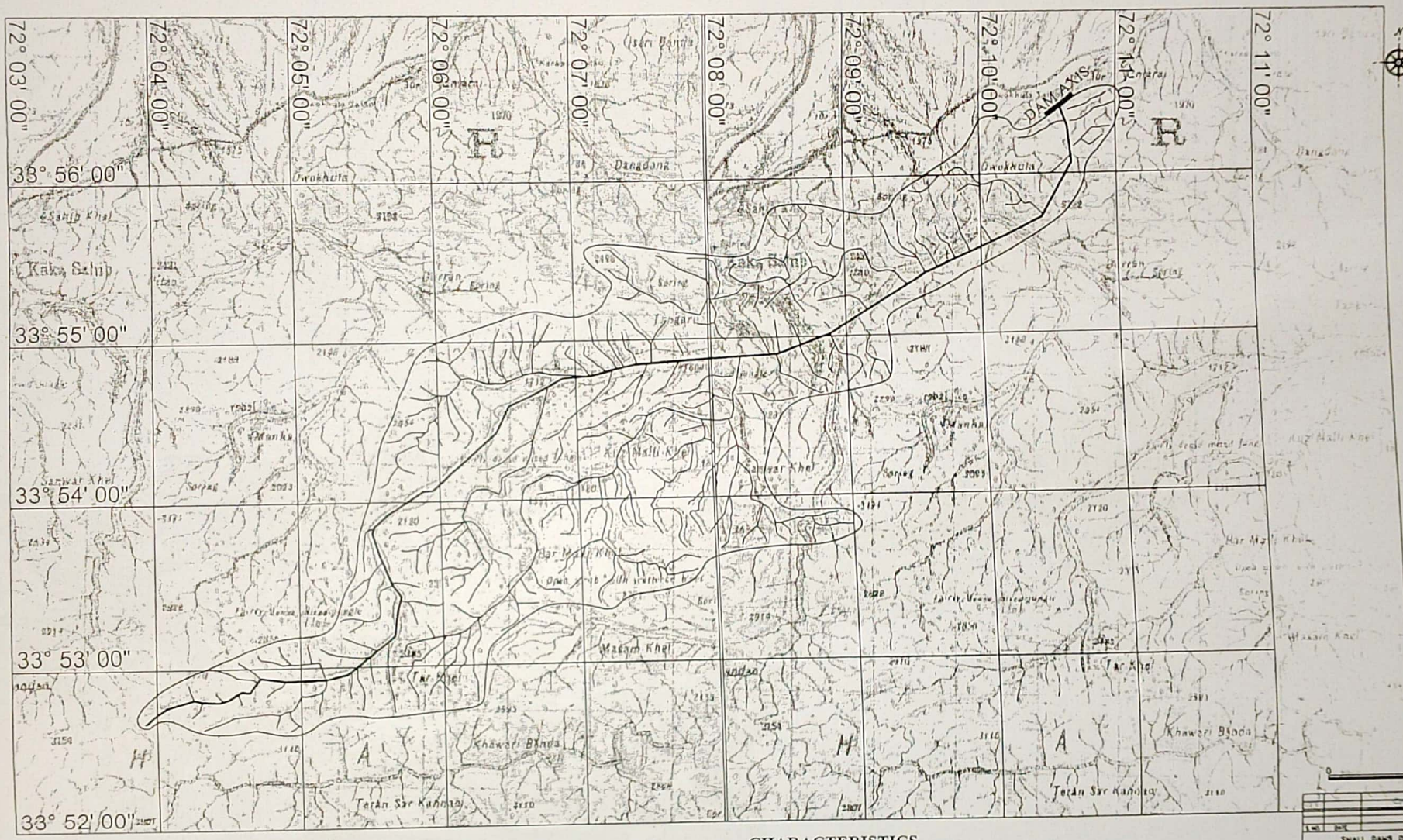
TOPO-GRAPHIC SURVEY

LEGENDS

Waterway	
Track	
Nullah	
House	
School	
Cultivated Land	
Well	
Gabion Wall	
Bench Mark	
Electric pole	
Tube Well	
Spill Way	

Client:-	Consultants:-	Project:-	Job:-	
Directorate General Small Dams Irrigation Department Govt: of KPK Peshawar	Consulting Associates Peshawar	Detail Design & Construction Supervision of Package - F (Shah Kaleem Dam)	COMMAND MAP	DRAWING SKD-PS

HYDROLOGY



LEGEND

Catchment Boundary	
Main Stream	

CHARACTERISTICS

Catchment Area	9.96 Square Miles
Main Stream Length	8.96 Miles
Inlet Level	343 m (1125.3 ft) a.m.s.l
Outlet Level	905.3 m (2970.0 ft) a.m.s.l

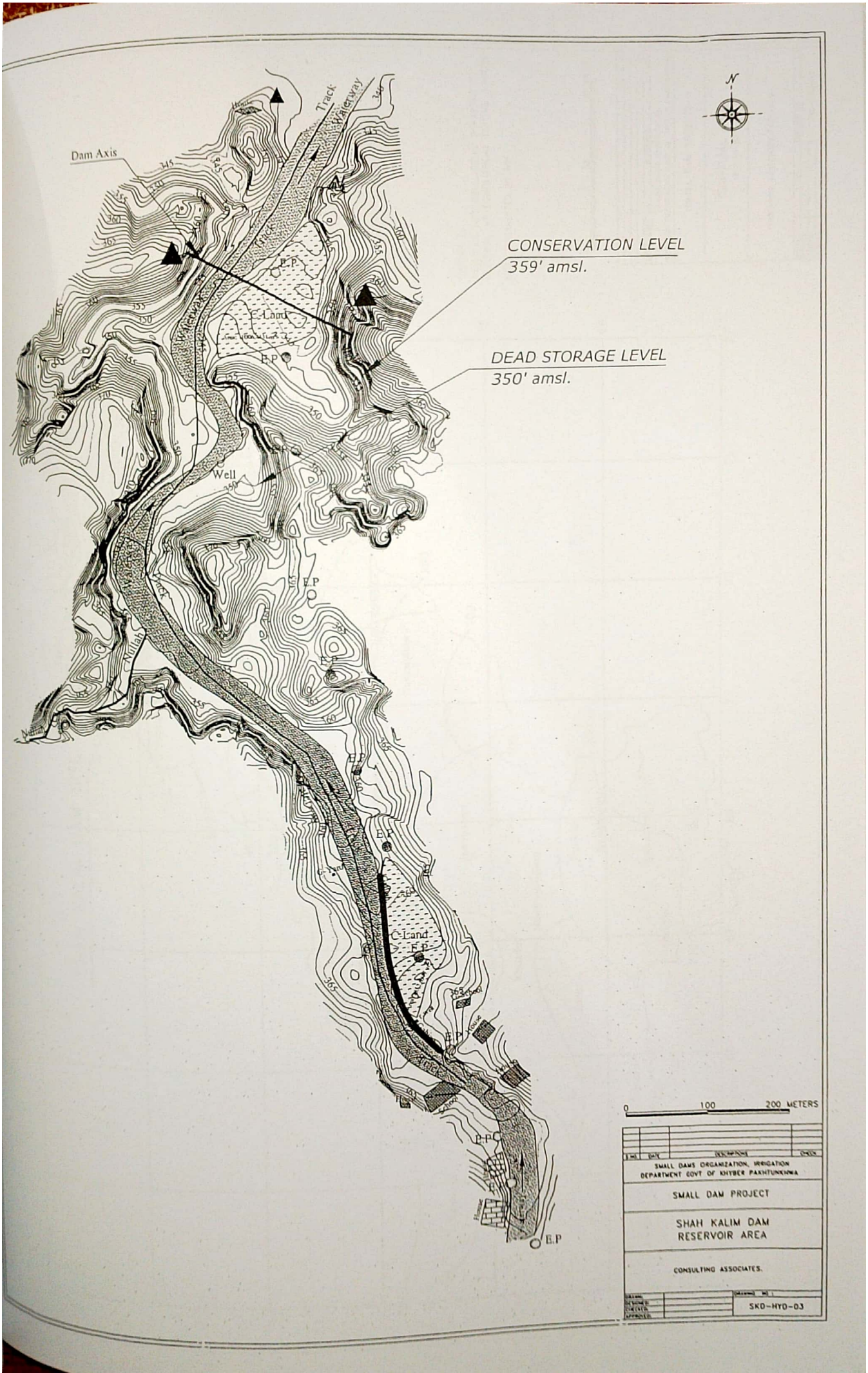
No	Date	Description	Check

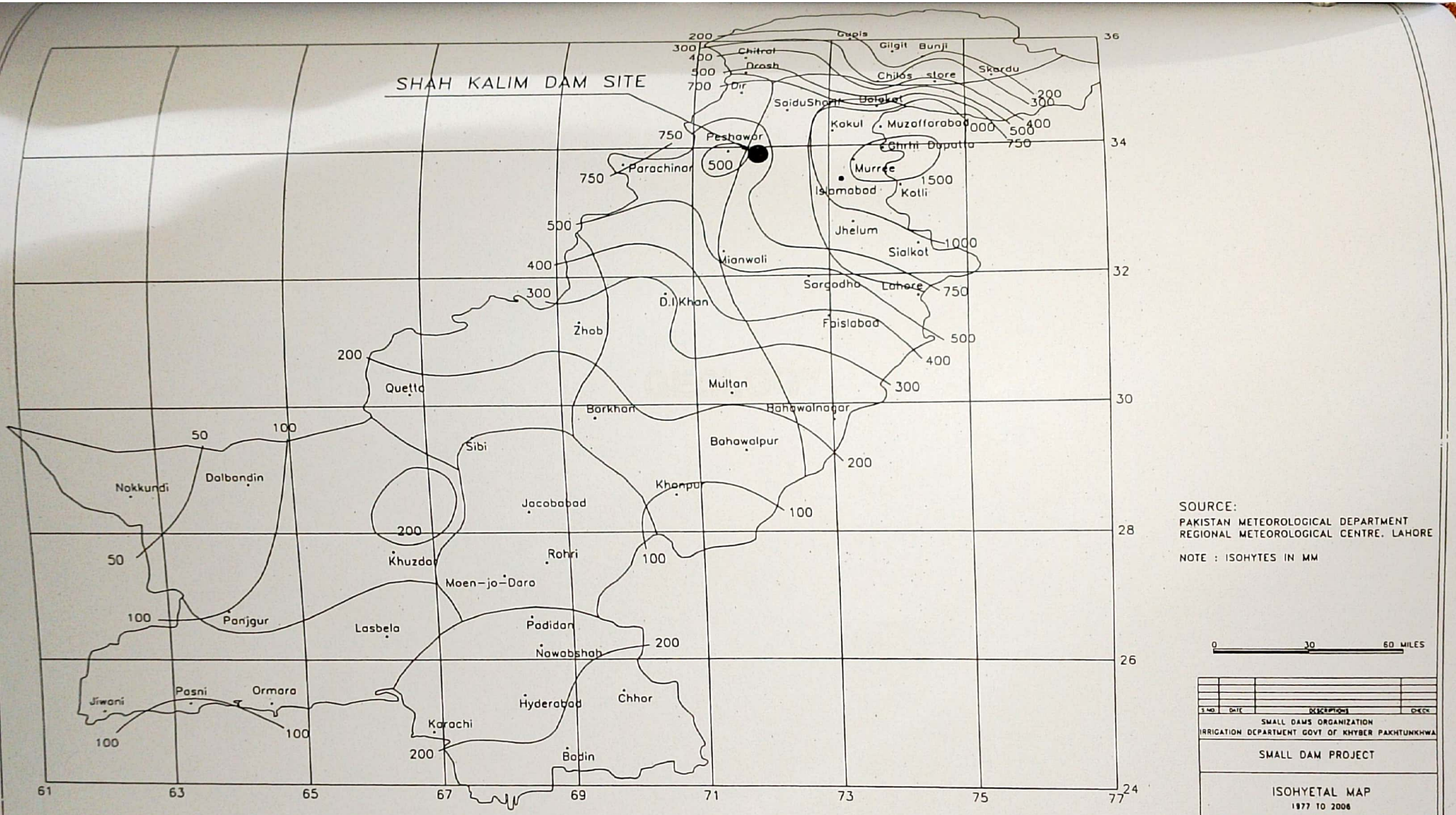
SMALL DAMS ORGANIZATION, IRRIGATION DEPARTMENT GOVT OF NWFP

SMALL DAM PROJECT

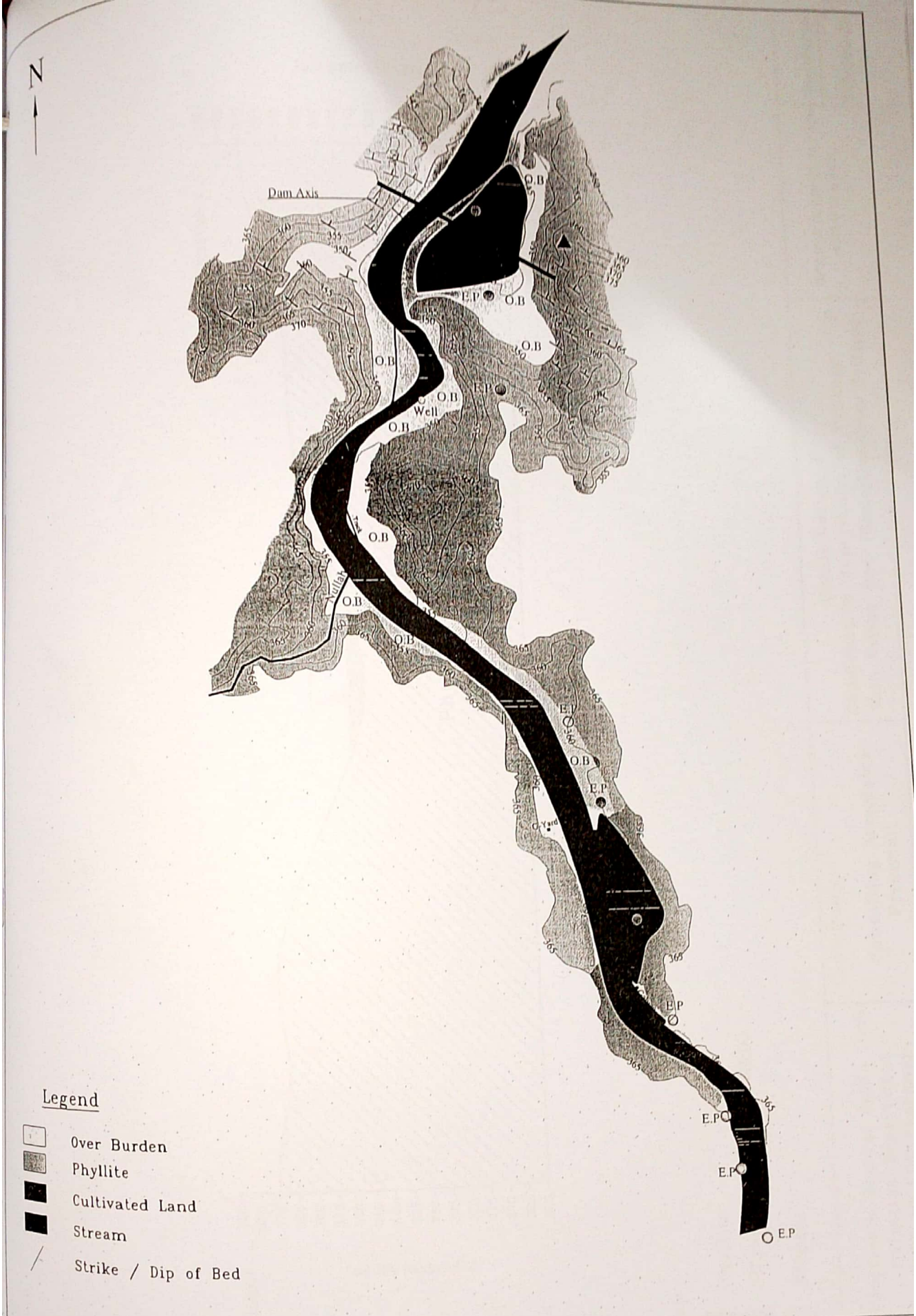
SHAH KALIM DAM
CATCHMENT AREA

CONSULTING ASSOCIATES.

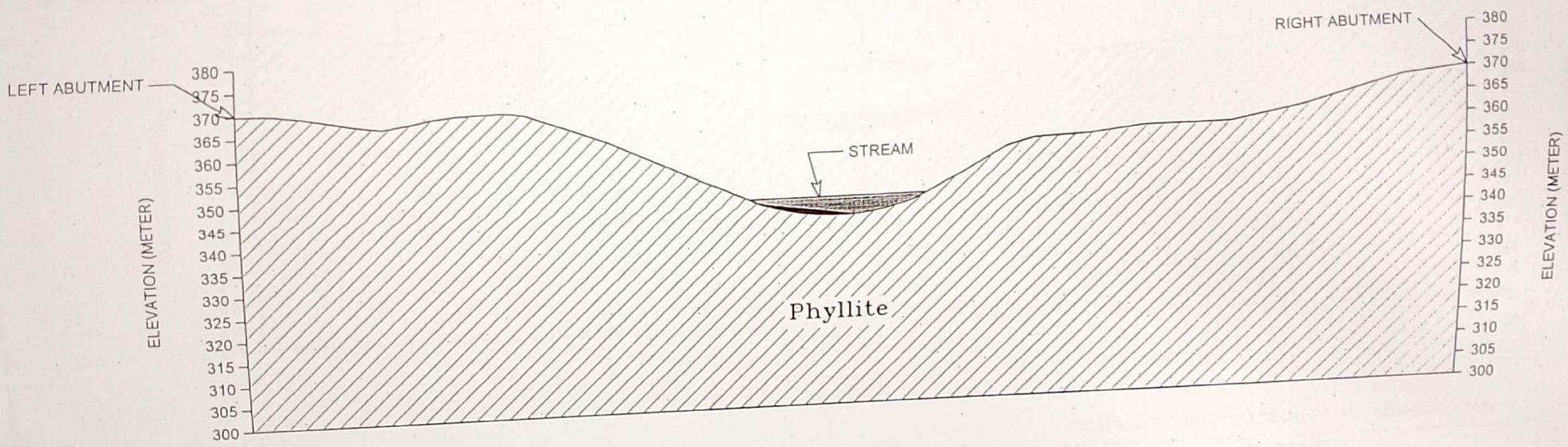

N
Dam Axis
Track
Waterway
CONSERVATION LEVEL
359' amsl.
DEAD STORAGE LEVEL
350' amsl.
E.P
C-Land
Well
Nullah
0
100
200 METERS
SMALL DAMS ORGANIZATION, IRRIGATION
DEPARTMENT GOVT OF KHYBER PAKHTUNKHWA
SMALL DAM PROJECT
SHAH KALIM DAM
RESERVOIR AREA
CONSULTING ASSOCIATES.
SKD-HYD-03


SHAH KALIM DAM SITE
Gupis
Gilgit
Bunji
Chitral
Drosh
Dir
Chilas
Skardu
Saidu Sharif
Dolakot
Kakul
Muzaffarabad
Chhhi Dopatta
Peshawar
Parachinar
Murree
Islamabad
Kotli
Jhelum
Sialkot
Mianwali
Sargodha
Lahore
D.I.Khan
Faislabad
Zhob
Quetta
Multan
Bahawalnagar
Barkhan
Bahawalpur
Sibi
Khanpur
Jacobabad
Nokkundi
Dalbandin
Khuzdar
Rohri
Moen-jo-Daro
Panjgur
Lasbela
Padidan
Nawabshah
Jiwani
Pasni
Ormara
Hyderabad
Chhor
Karachi
Badin
SOURCE:
PAKISTAN METEOROLOGICAL DEPARTMENT
REGIONAL METEOROLOGICAL CENTRE, LAHORE
NOTE : ISOHYTES IN MM
0 30 60 MILES
S.NO DATE DESCRIPTIONS CHECK
SMALL DAMS ORGANIZATION
IRRIGATION DEPARTMENT GOVT OF KHYBER PAKHTUNKHWA
SMALL DAM PROJECT
ISOHYETAL MAP
1977 TO 2006
CONSULTING ASSOCIATES PESHAWAR
DRAWN:
DESIGNED:
CHECKED:
APPROVED:
DRAWING NO.
SKD-HYD-02

GEOLOGY



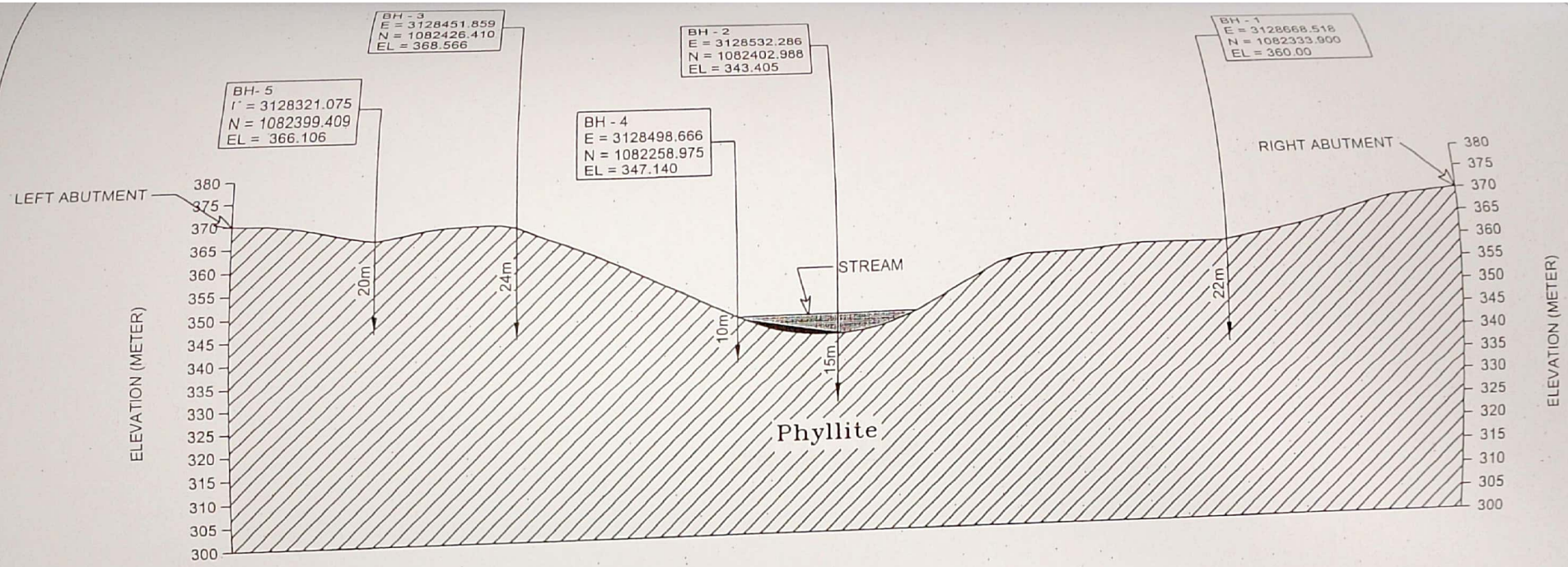
Client:-	Consultants:-	Project:-	Job:-	Designed. Muhammad Bilal	
Directorate General Small Dams Irrigation Department Govt: of KPK Peshawar	Consulting Associates Peshawar	Detail Design & Construction Supervision of Package - F	Shah Kaleem Dam (Geological Map)	Checked. NAEEM-ULLAH JAN (Geologist)	DRAW
				APPROVED: NAEEM-ULLAH JAN (Sr.Geologist)	SKD-(



LEGEND

- Phyllite
- Alluvial Deposits (RSRD)
- Stream

CLIENT:- Directorate General Small Dams Irrigation Department KPK, Peshawar	Consultants:- Consulting Associates Peshawar	Detail Design & Construction Supervision of Package - F Shah Kaleem Dam (Geological Cross Section)	GEOLOGICAL CROSS SECTION ALONG DAM AXIS	DRAWING NO SKD-GEO-02



TENTATIVE SUBSURFACE INVESTIGATION PROGRAM

LENGEND

Bore Hole

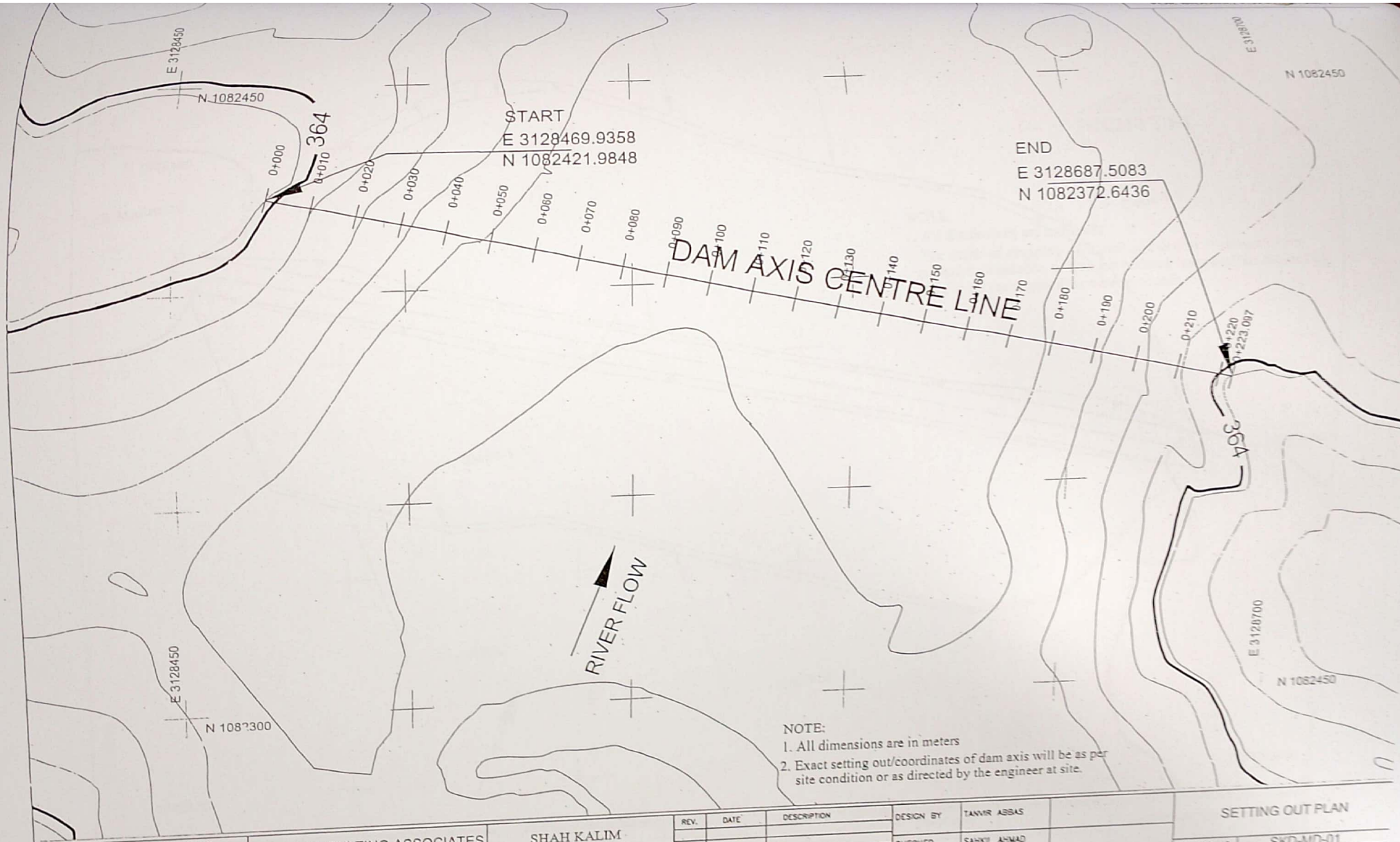
S.NO	B.H. N.O	Location	BORE LENGTH (m)	ROCK LENGTH (m)
1	SKD-1	BH-1 Right Abuttment	22	22
2	SKD-2	BH-2 Nallah Bed	3	15
3	SKD-3	BH-3 Left Abuttment	23	24
4	SKD-4	BH-4 Upstream Nallah Bed	6	10
5	SKD-5	BH-5 L.H.S Spillway	18	20

LEGEND

- Phyllite
- Alluvial Deposits (RSRD)
- Stream

Client:-	Consultants:-	Detail Design & Construction Supervision of Package – F Shah Kaleem Dam (Geological Cross Section)	GEOLOGICAL CROSS SECTION ALONG DAM AXIS	DRAWING NO
Directorate General Small Dams Irrigation Department Govt: of KPK Peshawar	Consulting Associates Peshawar			SKD-GEO-03

DAM AXIS



NOTE:
1. All dimensions are in meters
2. Exact setting out/coordinates of dam axis will be as per site condition or as directed by the engineer at site.

GOVERNMENT OF KHYBER PAKHTUNKHWA
DIRECTORATE GENERAL SMALL DAMS,IRRIGATION DEPARTMENT, PESHAWAR

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E MAIL: consultingassociates127@gmail.com

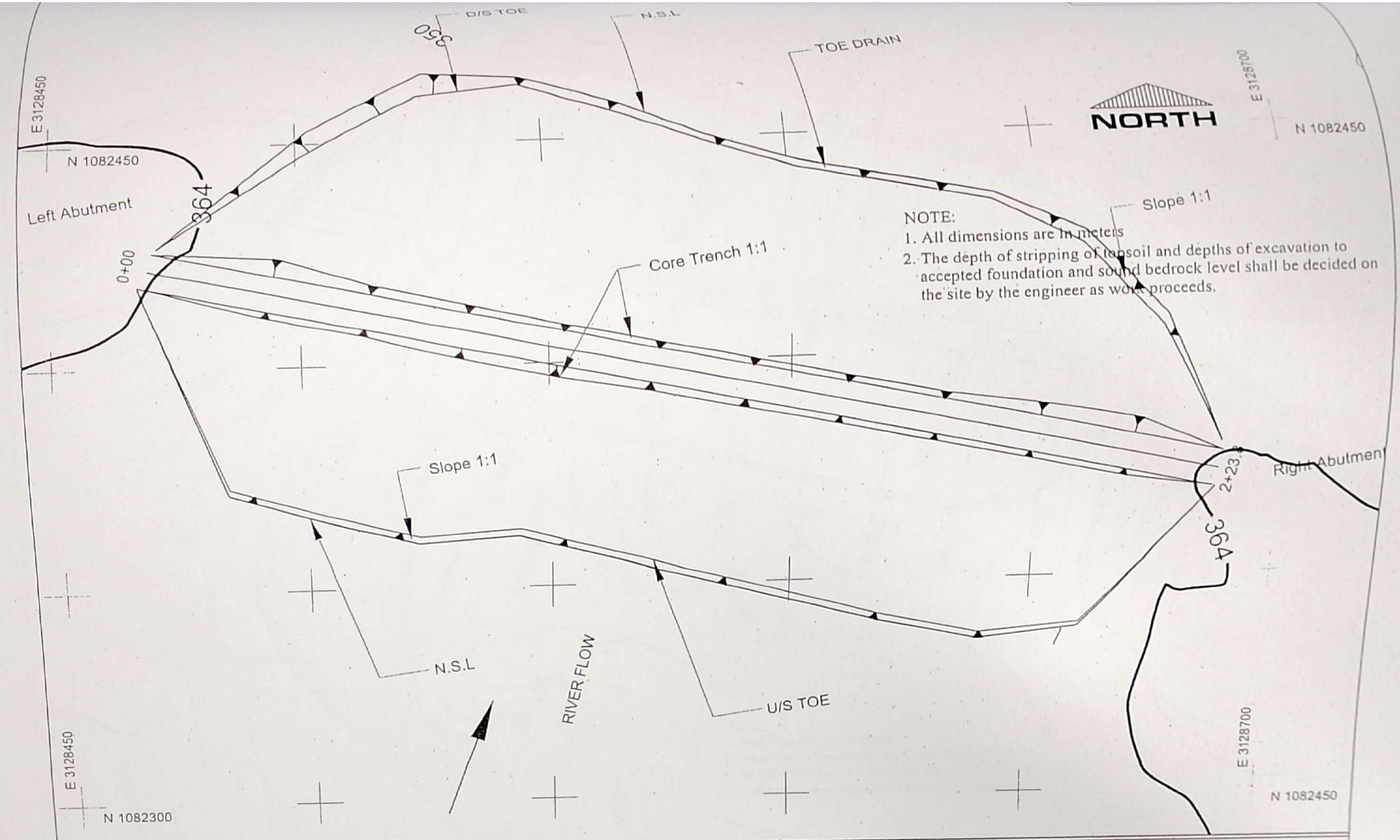
SHAH KALIM DAM PROJECT NOWSHERA

REV.	DATE	DESCRIPTION

DESIGN BY	TANVIR ABBAS
CHECKED SUBMITTED BY	SAHIL AHMAD

SETTING OUT PLAN

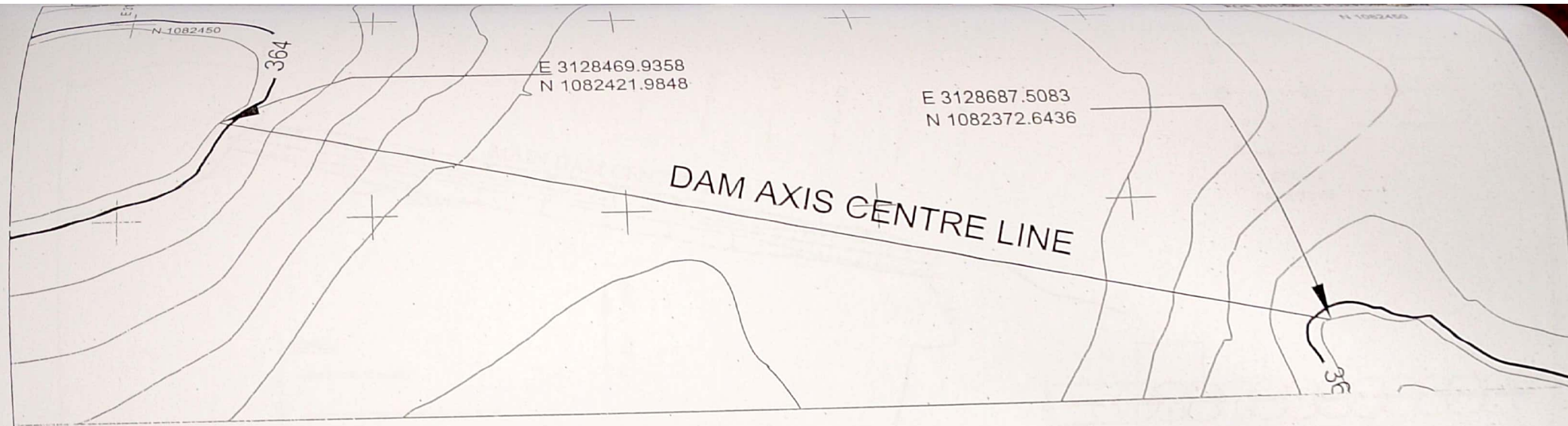
DRAWING NO. SKD-MD-01

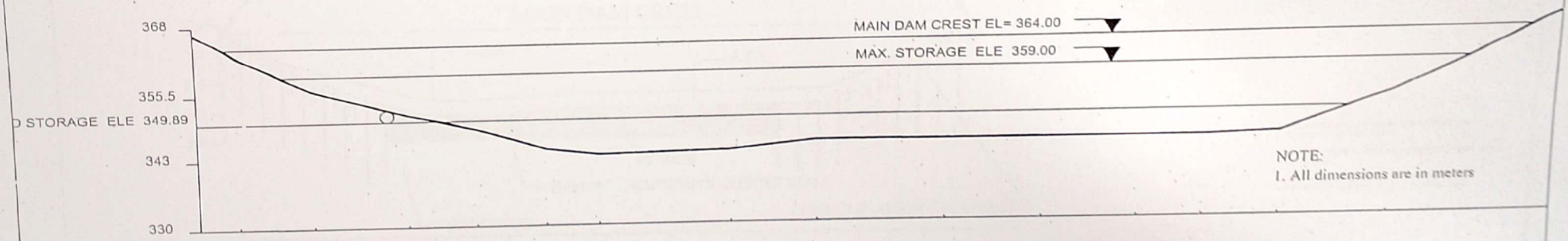


NOTE:
1. All dimensions are in meters
2. The depth of stripping of topsoil and depths of excavation to accepted foundation and sound bedrock level shall be decided on the site by the engineer as work proceeds.

GOVERNMENT OF KHYBER PAKHTUNKHWA DIRECTORATE GENERAL SMALL DAMS,IRRIGATION DEPARTMENT, PESHAWAR	CONSULTING ASSOCIATES NEAR DEANS COMPLEX APARTMENTS,BEHIND GUL CNG,BOARD BAZAAR,JAMRUD ROAD,PESHAWAR PH #: 091-5701774-45 Fax - 091-5701775 E-MAIL: consultingassociates127@gmail.com	SHAH KALIM DAM PROJECT NOWSHERA	REV. / DATE / DESCRIPTION	DESIGN BY: TANVIR ABBAS	EXCAVATION PLAN		
				CHECKED / SUBMITTED BY: SAHKIL AHMAD	DRAWING NO. SKD-MD-02		

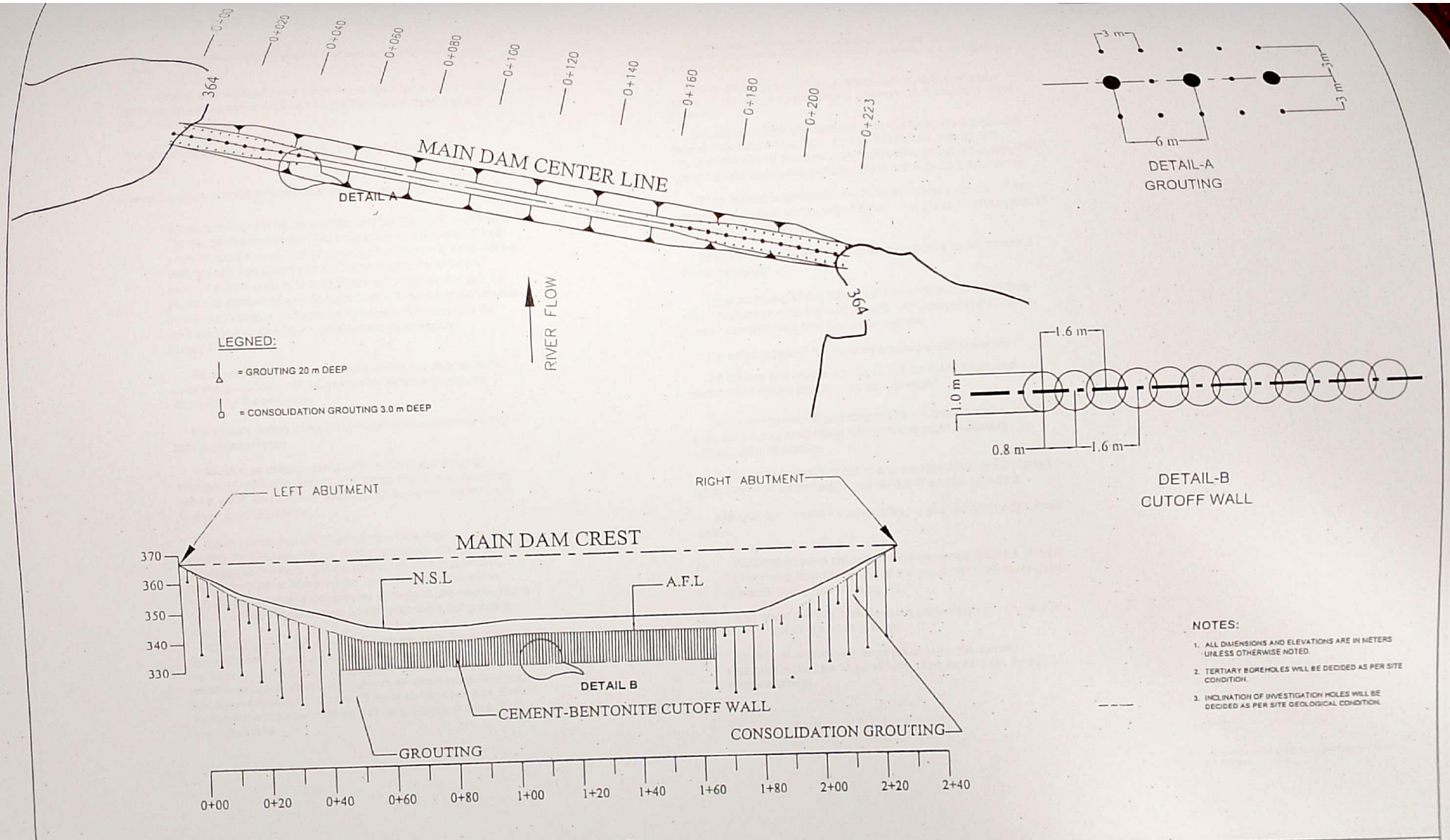
NORTH
MAIN DAM CREST EL. 364 M
SLOPE 1 : 2
SLOPE 1 : 2.25
TOE DRAIN
D/S TOE
U/S TOE
RIVER FLOW
0+00
0+25
0+45
0+65
0+85
1+05
1+25
1+45
1+65
1+85
2+05
2+228
N 1082450
E 3128450
N 1082300
E 3128700
355
360
364
350
345
NOTE:
1. All dimensions are in meters
2. For setting out detail refer Dwg. No. SKD-MD-01
3. For cross sections refer Dwg. No. SKD-MD-05 to 14
4. Drains shall be provided as directed by the engineer.
REV.
DATE
DESCRIPTION
DESIGN BY
TANVIR ABBAS
CHECKED
SUBMITTED BY
SAJJAD AHMAD
PLAN
DRAWING NO.
SKD-MD-03
SHAH KALIM
DAM PROJECT
NOWSHERA
CONSULTING ASSOCIATES
GOVERNMENT OF
KHYBER PAKHTUNKHWA
DIRECTORATE GENERAL
SMALL DAMS,IRRIGATION
DEPARTMENT, PESHAWAR





NOTE:
1. All dimensions are in meters

GOVERNMENT OF KHYBER PAKHTUNKHWA DIRECTORATE GENERAL SMALL DAMS,IRRIGATION DEPARTMENT, PESHAWAR	CONSULTING ASSOCIATES NEAR DEANS COMPLEX APARTMENTS,BEHIND GUL CNG,BOARD BAZAAR,JAMRUD ROAD,PESHAWAR PH # : 091-5701774-45 Fax - 091-5701775 E-MAIL: consultingassociates127@gmail.com	SHAH KALIM DAM PROJECT NOWSHERA	REV. / DATE / DESCRIPTION	DESIGN BY	TANVIR ABBAS		MAIN DAM L - SECTION
				CHECKED SUBMITTED BY	SAHKIL AHMAD		DRAWING NO. SKD-MD-04


0+00
0+020
0+040
0+060
0+080
0+100
0+120
0+140
0+160
0+180
0+200
0+223
364
MAIN DAM CENTER LINE
DETAIL A
RIVER FLOW
364
LEGNED:
= GROUTING 20 m DEEP
= CONSOLIDATION GROUTING 3.0 m DEEP
3 m
3m
3 m
6 m
DETAIL-A
GROUTING
1.6 m
1.0 m
0.8 m
1.6 m
DETAIL-B
CUTOFF WALL
LEFT ABUTMENT
RIGHT ABUTMENT
MAIN DAM CREST
370
360
350
340
330
N.S.L
A.F.L
DETAIL B
CEMENT-BENTONITE CUTOFF WALL
CONSOLIDATION GROUTING
GROUTING
0+00
0+20
0+40
0+60
0+80
1+00
1+20
1+40
1+60
1+80
2+00
2+20
2+40
NOTES:
1. ALL DIMENSIONS AND ELEVATIONS ARE IN METERS UNLESS OTHERWISE NOTED.
2. TERTIARY BOREHOLES WILL BE DECIDED AS PER SITE CONDITION.
3. INCLINATION OF INVESTIGATION HOLES WILL BE DECIDED AS PER SITE GEOLOGICAL CONDITION.
NOT TO SCALE
GOVERNMENT OF KHYBER PAKHTUNKHWA DIRECTORATE GENERAL SMALL DAMS,IRRIGATION DEPARTMENT, PESHAWAR
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SHAH KALIM DAM PROJECT NOWSHERA
REV.
DATE
DESCRIPTION
DESIGN BY
TANVIR ABBAS
CHECKED SUBMITTED BY
SAHKIL AHMAD
MAIN DAM GROUTING
DRAWING NO.
SKD-MD-05

INSTRUCTIONS FOR GROUTING

The grouting works consist of curtain grouting in abutment of the dam.

The spacing and depth of grout holes are subject to variation during grouting based on the results and evaluations of permeability and grout-take data.

The grout mix comprises cement suspension stabilized with bentonite.

Some important details for execution of grouting are given below.

- Slush grouting will be requird for sealing the rock surface of the structures foundation after cleaning. It will cortain 2 to 3 parts of sand to one part of portland cement. The sand will be well graded conforming to ASTM concrete. Its moisture content will be sufficient to produce a mixture which can be poured to penetrate and fill open joints, fissures and fractures in the rock surface and can be broomed over and into the rock surface to fill minor surface discontinuties and irregularities.
- All superficial joints and fissure within the rock surface near the grout hole will be sealed by slush grouting, as directed by the engineer.
- No accumulation of flushing water will be allowed within the foundation area.
- Inflatable or mechanical packers, having a sealing element of minimum length of 8 times of the hole diameter, will be used. Mechanical packers will be preferred for near surface grouting stage.
- Grout pressures will depend upon the depth of grout section. In general, the maximum pressure as measured at the collar of the hole (gauge pressure) shall not exceed 0.07kg/cm² per 0.30m(one psi per foot) of depth when measured normal to the ground surface to the middle of the grout section. Table shows typical pressures for grouting sections.
- Grouting will start with water cement ratio 3:1 with 2% bentonite which may be swiched to a thicker mix (water cement 2:1 by volume), in case of fast take or when maximum pressure is not obtained, or when grout-take does not show change even after 30 kg of cement per foot. Switch to thinner mix (water cement 5:1 by volume), in case of very low initial take.
- The bentonite slurry will be pre-activated (soaked and homogenized) over a preiod of 10 hours in a mix of 1 kg bentonite to 10 liter water.
- During grouting operation, all leaks noticed in the adjacent areas will be plugged immediately and no rock movement will be allowed.
- Grouting of a hole will continue until the hole takes grout at a rate of less than one cubic foot (0.0283 cubic meter) of the grout mixture in 10 minutes at the allowable gauge pressure. The grouting rate during the end phase will not exceed 2 liter per m.
- Once refusal is achieved, the in-let and return valves will be closed and packer will be kept inflated or in-place till dissipation of the gauge pressure.
- Wait for 12 hours before next stage grouting to let the grout stone hardened.
- Take sounding of the hole after completion of waiting time after final stage grouting and backfill with neat cement slurry (water cement ratio 1:1) by tremie method.
- No adjacent grout hole will be grouted simultaneously.
- All testing and grouting recored will be maintained and summaries will be prepared or as directed.
- Upon completion of grouting works a comprehensive grouting plan will be prepared along with cross section indicating cement-take quantities.
- Embankment construction in any section will only be started after thorough examination and review of all relevant data.
- Material requirment for all grouting works are briefly descibed below.

a) Water absorption potential of the bentonite shall be at least 500 percent. flow properties of the grout mix shall correspond to marsh flow time >30 seconds.

b) The water cement ratio shall not preferably vary beyond the limits of 1:1 to 4:1 or as directed.

c) In case of excessively large grout-take, the cement suspension may be blended with clay, stone dust, fly ash or similar material.

NOTES:

1. ALL WORKS TO BE DONE IN ACCORDANCE WITH THE THE ENGINEER AT SITE.

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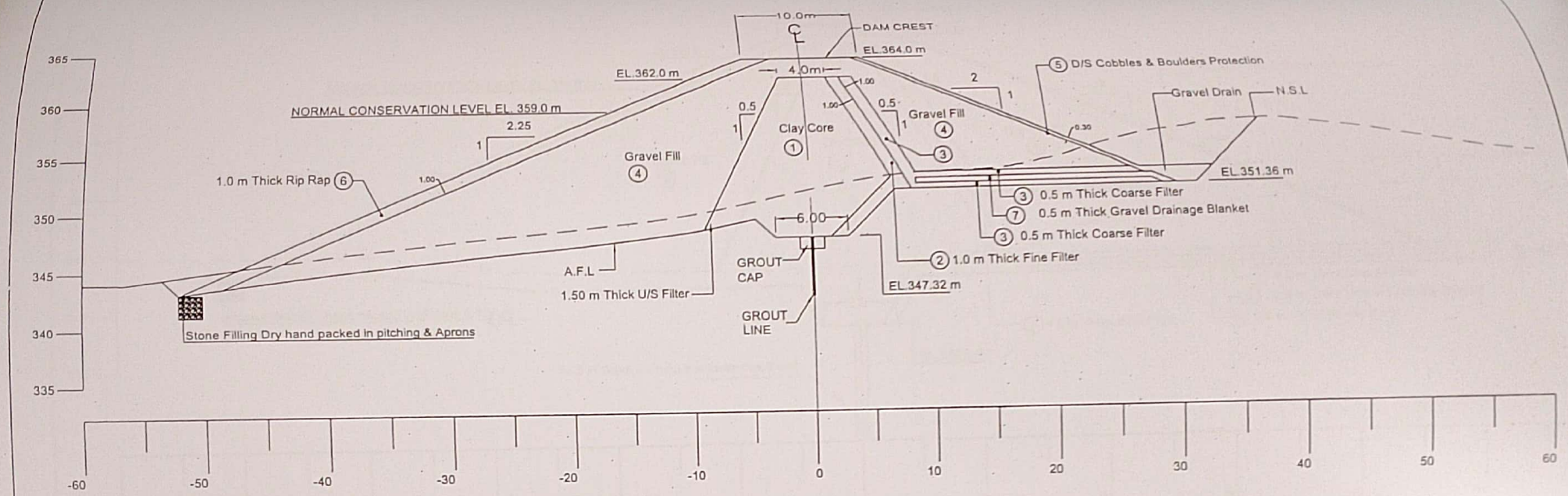
				CHECKED SUBMITTED BY	SAHKIL AHMAD	DRAWING NO.	SKD-MD-06



EMBANKMENT MATERIALS

ZONE	MATERIAL
1	CLAYEY SILT
2	FINE FILTER
3	COARSE FILTER
4	SANDY GRAVEL
5	COBBLES & BOULDER PROTECTION BEDDING
6	RIP RAP
7	GRAVEL DRAINAGE BLANKET

NOTE:

1. All dimensions are in meters
2. For location of section refer Dwg. No. SKD-MD-03
3. Drains shall be provided as directed by the engineer.
4. For gradation limits of fill zones refer to Dwg. No.SKD-MD-17
5. The depth of stripping of topsoil and depths of excavation to accepted foundation and sound bedrock level shall be decided on the site by the engineer as work proceeds.

GOVERNMENT OF KHYBER PAKHTUNKHWA
DIRECTORATE GENERAL SMALL DAMS, IRRIGATION DEPARTMENT, PESHAWAR

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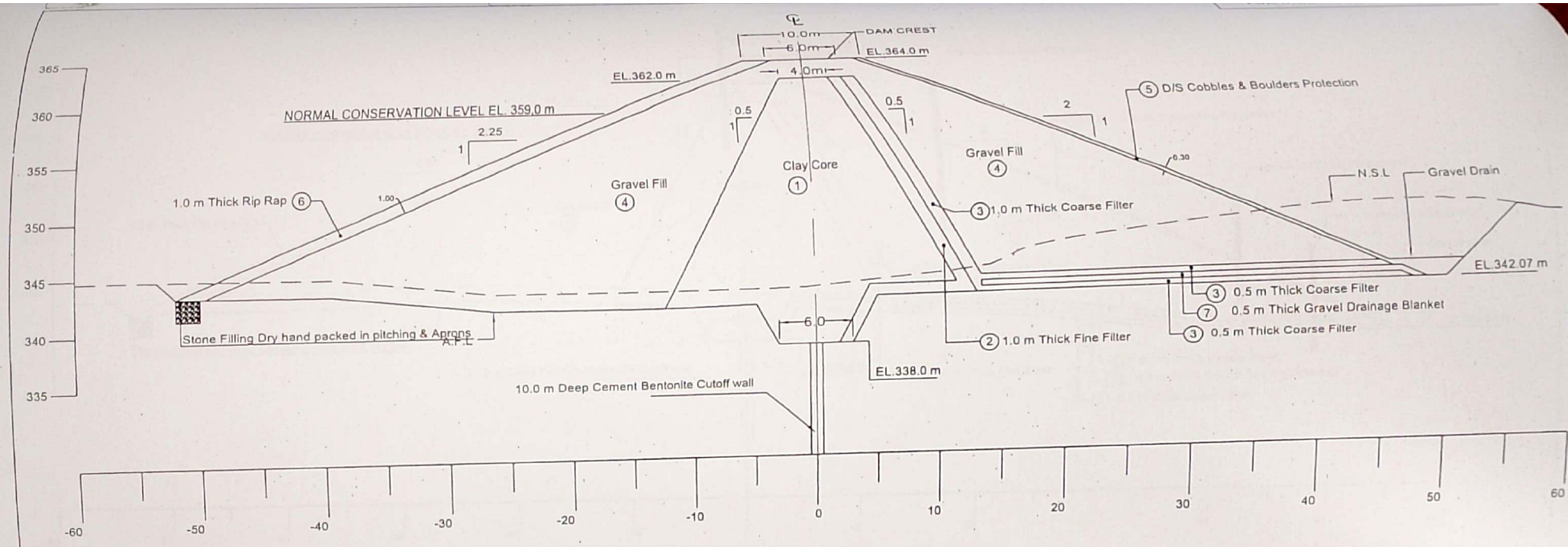
SHAH KALIM DAM PROJECT NOWSHERA

REV.	DATE	DESCRIPTION

DESIGN BY	TANVIR ABBAS	
CHECKED SUBMITTED BY	SAHIL AHMAD	

CROSS SECTION
RD 0+25

DRAWING NO. SKD-MD-07



EMBANKMENT MATERIALS

ZONE	MATERIAL
1	CLAYEY SILT
2	FINE FILTER
3	COARSE FILTER
4	SANDY GRAVEL
5	COBBLES & BOULDER PROTECTION BEDDING
6	RIP RAP
7	GRAVEL DRAINAGE BLANKET

NOTE:
1. All dimensions are in meters
2. For notes refer Dwg. No. SKD-MD-07

GOVERNMENT OF KHYBER PAKHTUNKHWA
DIRECTORATE GENERAL SMALL DAMS, IRRIGATION DEPARTMENT, PESHAWAR

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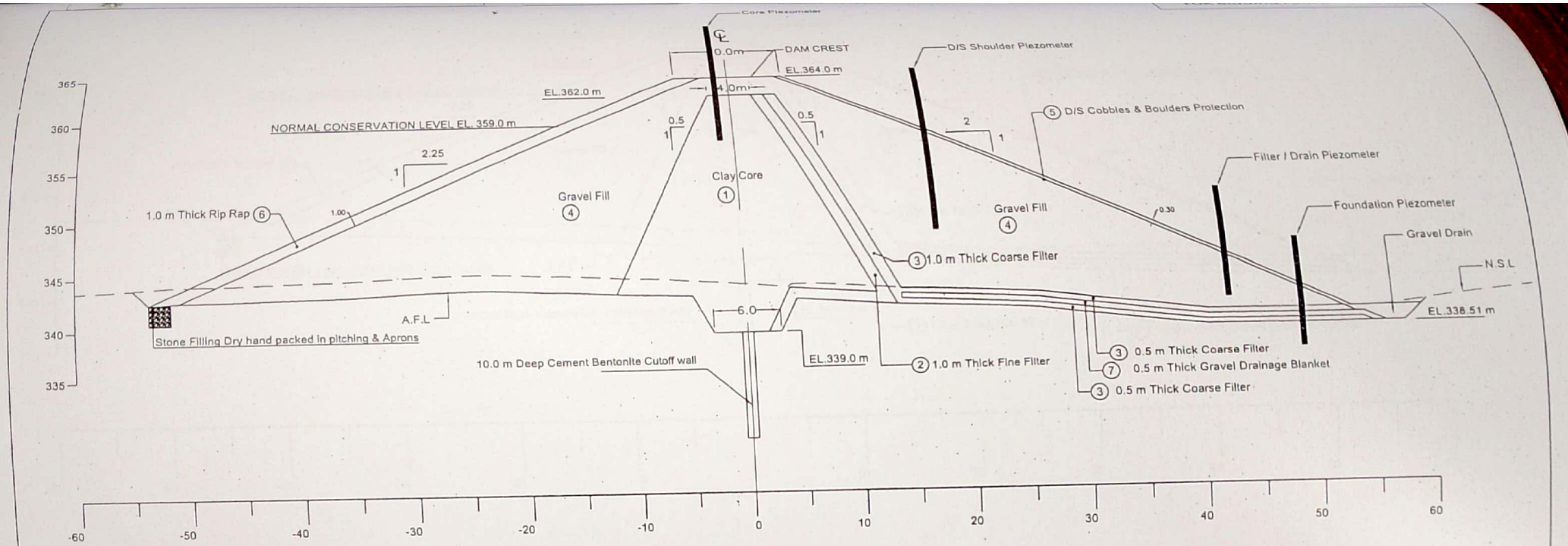
SHAH KALIM DAM PROJECT NOWSHERA

REV.	DATE	DESCRIPTION

DESIGN BY	TANVIR ABBAS
CHECKED SUBMITTED BY	SAHKIL AHMAD

CROSS SECTION
RD 0+45

DRAWING NO. SKD-MD-08



EMBANKMENT MATERIALS

ZONE	MATERIAL
1	CLAYEY SILT
2	FINE FILTER
3	COARSE FILTER
4	SANDY GRAVEL
5	COBBLES & BOULDER PROTECTION BEDDING
6	RIP RAP
7	GRAVEL DRAINAGE BLANKET

LEGEND

Symbol	Description	Purpose
▲	Marker	To observe horizontal & vertical movements
I	Piezometer	To observe pore water pressure
●	Slope Indicator	To observe lateral movement in fill
T	Settlement Gauge	To observe settlemnt of foundation & consolidation of fill

NOTE:
1. All dimensions are in meters
2. For notes refer Dwg. No. SKD-MD-07

GOVERNMENT OF KHYBER PAKHTUNKHWA
DIRECTORATE GENERAL SMALL DAMS, IRRIGATION DEPARTMENT, PESHAWAR

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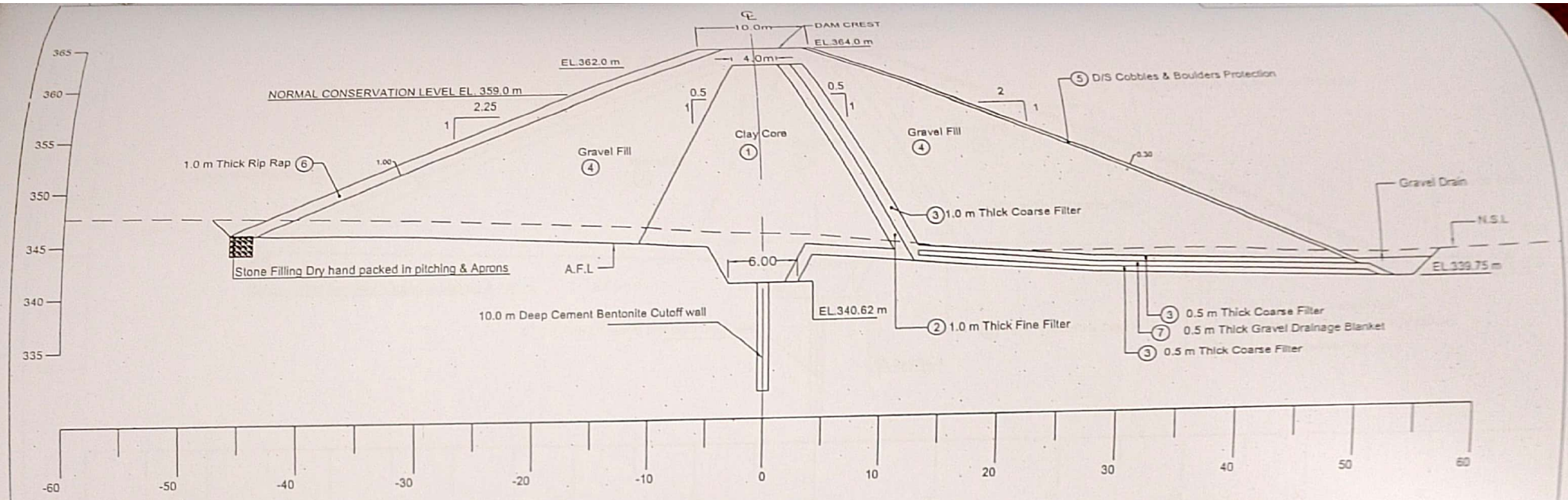
SHAH KALIM DAM PROJECT NOWSHERA

REV.	DATE	DESCRIPTION

DESIGN BY	TANVIR ABBAS	
CHECKED SUBMITTED BY	SAHKIL AHMAD	

CROSS SECTION RD 0+65

DRAWING NO. SKD-MD-09



EMBANKMENT MATERIALS

ZONE	MATERIAL
1	CLAYEY SILT
2	FINE FILTER
3	COARSE FILTER
4	SANDY GRAVEL
5	COBBLES & BOULDER PROTECTION BEDDING
6	RIP RAP
7	GRAVEL DRAINAGE BLANKET

NOTE:
1. All dimensions are in meters
2. For notes refer Dwg. No. SKD-MD-07

GOVERNMENT OF KHYBER PAKHTUNKHWA
DIRECTORATE GENERAL SMALL DAMS,IRRIGATION DEPARTMENT, PESHAWAR

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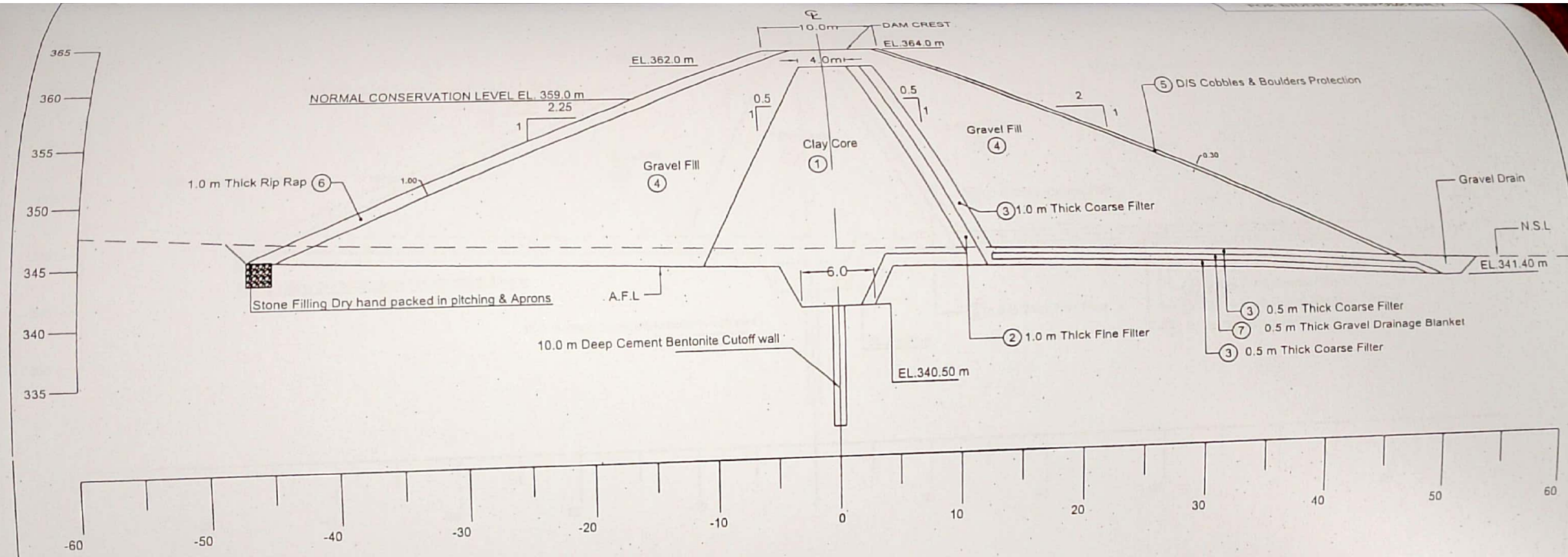
SHAH KALIM DAM PROJECT NOWSHERA

REV.	DATE	DESCRIPTION

DESIGN BY	TANVIR ABBAS	
CHECKED SUBMITTED BY	SAHKIL AHMAD	

CROSS SECTION RD 0+85

DRAWING NO. SKD-MD-10



EMBANKMENT MATERIALS

ZONE	MATERIAL
1	CLAYEY SILT
2	FINE FILTER
3	COARSE FILTER
4	SANDY GRAVEL
5	COBBLES & BOULDER PROTECTION BEDDING
6	RIP RAP
7	GRAVEL DRAINAGE BLANKET

NOTE:
1. All dimensions are in meters
2. For notes refer Dwg. No. SKD-MD-07

GOVERNMENT OF KHYBER PAKHTUNKHWA
DIRECTORATE GENERAL SMALL DAMS, IRRIGATION DEPARTMENT, PESHAWAR

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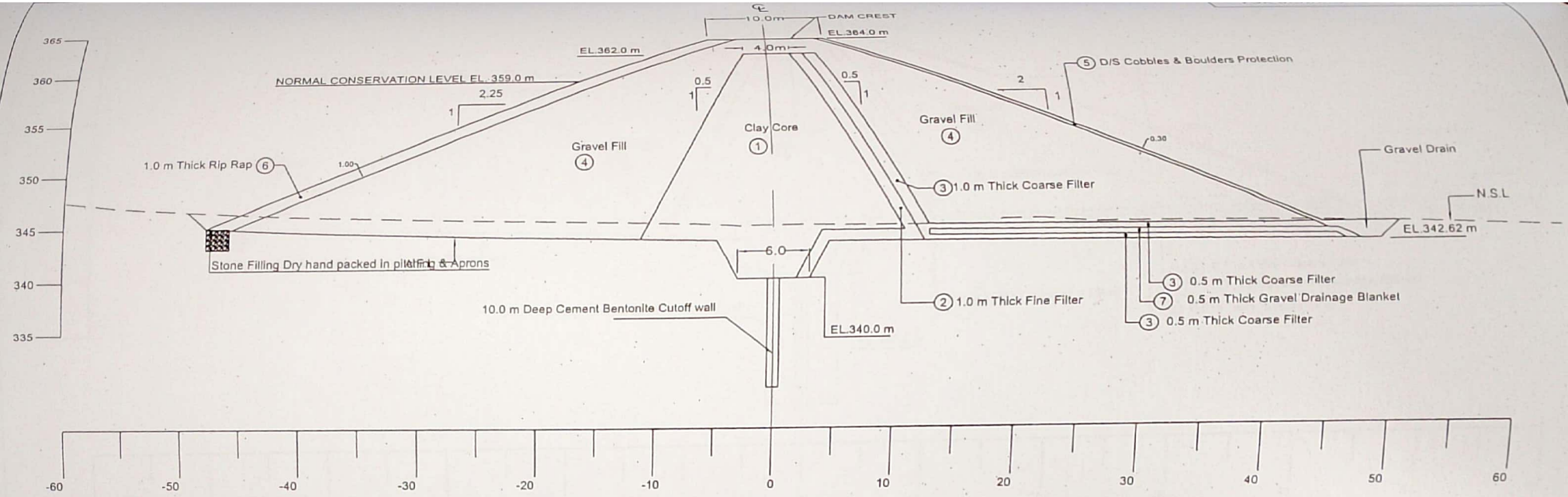
SHAH KALIM DAM PROJECT NOWSHERA

REV.	DATE	DESCRIPTION

DESIGN BY	TANVIR ABBAS
CHECKED SUBMITTED BY	SAHKIL AHMAD

CROSS SECTION
RD 1+05

DRAWING NO. SKD-MD-11



EMBANKMENT MATERIALS

ZONE	MATERIAL
1	CLAYEY SILT
2	FINE FILTER
3	COARSE FILTER
4	SANDY GRAVEL
5	COBBLES & BOULDER PROTECTION BEDDING
6	RIP RAP
7	GRAVEL DRAINAGE BLANKET

NOTE:
1. All dimensions are in meters
2. For notes refer Dwg. No. SKD-MD-07

GOVERNMENT OF KHYBER PAKHTUNKHWA
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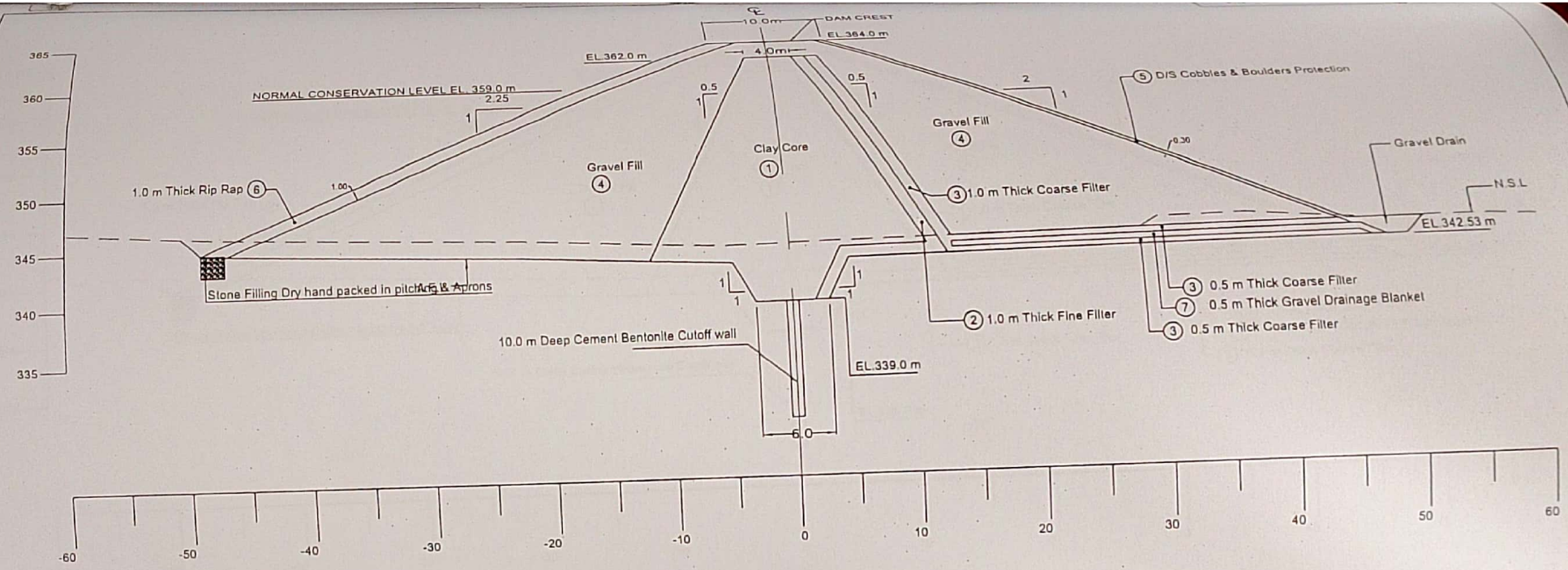
SHAH KALIM DAM PROJECT NOWSHERA

REV.	DATE	DESCRIPTION

DESIGN BY	TANVIR ABBAS	
CHECKED SUBMITTED BY	SAHKIL AHMAD	

CROSS SECTION
RD 1+25

DRAWING NO. SKD-MD-12



EMBANKMENT MATERIALS

ZONE	MATERIAL
1	CLAYEY SILT
2	FINE FILTER
3	COARSE FILTER
4	SANDY GRAVEL
5	COBBLES & BOULDER PROTECTION BEDDING
6	RIP RAP
7	GRAVEL DRAINAGE BLANKET

NOTE:
1. All dimensions are in meters
2. For notes refer Dwg. No. SKD-MD-07

1+45

GOVERNMENT OF KHYBER PAKHTUNKHWA
DIRECTORATE GENERAL SMALL DAMS, IRRIGATION DEPARTMENT, PESHAWAR

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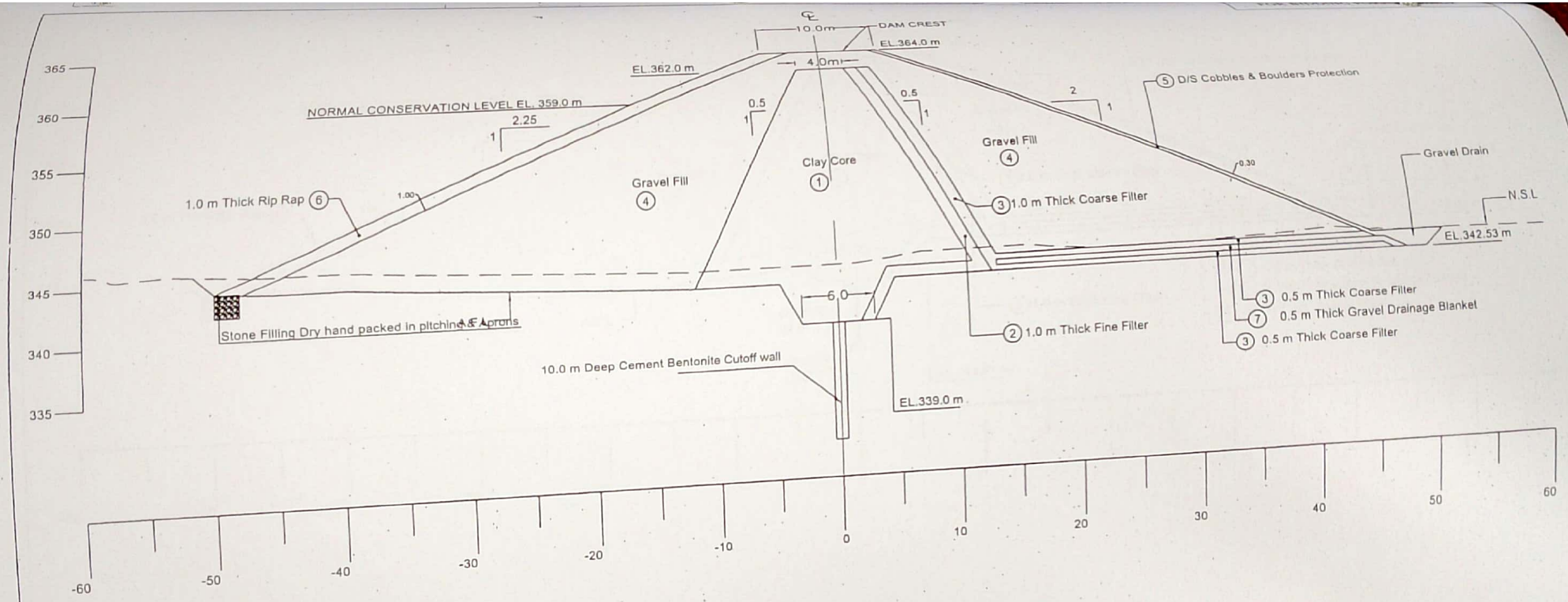
SHAH KALIM DAM PROJECT NOWSHERA

REV.	DATE	DESCRIPTION

DESIGN BY	TANVIR ABBAS
CHECKED SUBMITTED BY	SAHKIL AHMAD

CROSS SECTION
RD 1+45

DRAWING NO. SKD-MD-13



EMBANKMENT MATERIALS

ZONE	MATERIAL
1	CLAYEY SILT
2	FINE FILTER
3	COARSE FILTER
4	SANDY GRAVEL
5	COBBLES & BOULDER PROTECTION BEDDING
6	RIP RAP
7	GRAVEL DRAINAGE BLANKET

NOTE:
1. All dimensions are in meters
2. For notes refer Dwg. No. SKD-MD-07

GOVERNMENT OF KHYBER PAKHTUNKHWA
DIRECTORATE GENERAL SMALL DAMS, IRRIGATION DEPARTMENT, PESHAWAR

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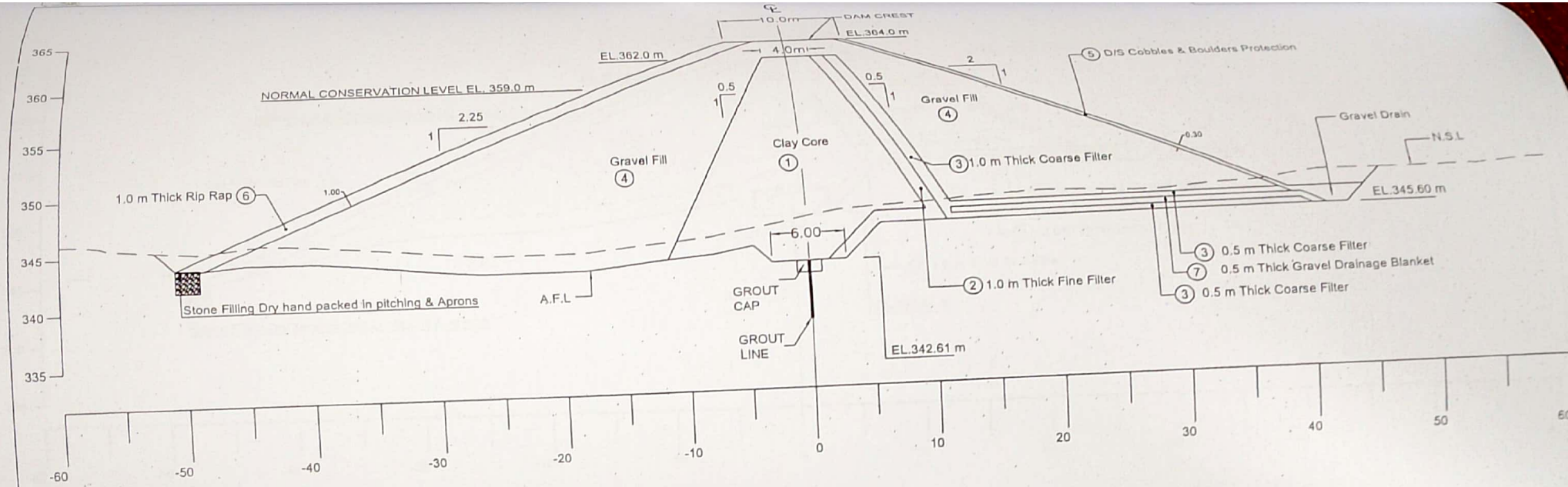
SHAH KALIM DAM PROJECT NOWSHERA

REV.	DATE	DESCRIPTION

DESIGN BY	TANVIR ABBAS
CHECKED SUBMITTED BY	SAHKIL AHMAD

CROSS SECTION
RD 1+65

DRAWING NO. SKD-MD-14



EMBANKMENT MATERIALS

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1	CLAYEY SILT
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5	COBBLES & BOULDER PROTECTION BEDDING
6	RIP RAP
7	GRAVEL DRAINAGE BLANKET

NOTE:
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2. For notes refer Dwg. No. SKD-MD-07

GOVERNMENT OF KHYBER PAKHTUNKHWA
DIRECTORATE GENERAL SMALL DAMS,IRRIGATION DEPARTMENT, PESHAWAR

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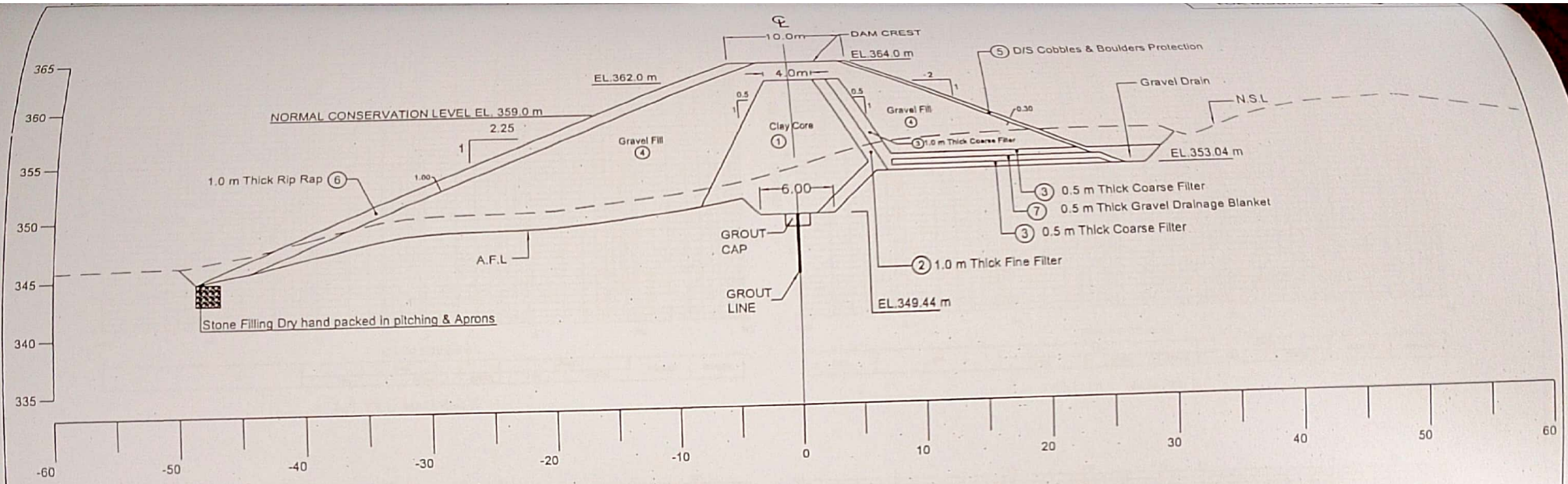
SHAH KALIM DAM PROJECT NOWSHERA

REV.	DATE	DESCRIPTION

DESIGN BY	TANVIR ABBAS
CHECKED SUBMITTED BY	SAHKIL AHMAD

CROSS SECTION RD 1+85

DRAWING NO. SKD-MD-15



EMBANKMENT MATERIALS

ZONE	MATERIAL
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2	FINE FILTER
3	COARSE FILTER
4	SANDY GRAVEL
5	COBBLES & BOULDER PROTECTION BEDDING
6	RIP RAP
7	GRAVEL DRAINAGE BLANKET

NOTE:
1. All dimensions are in meters
2. For notes refer Dwg. No. SKD-MD-07

GOVERNMENT OF KHYBER PAKHTUNKHWA
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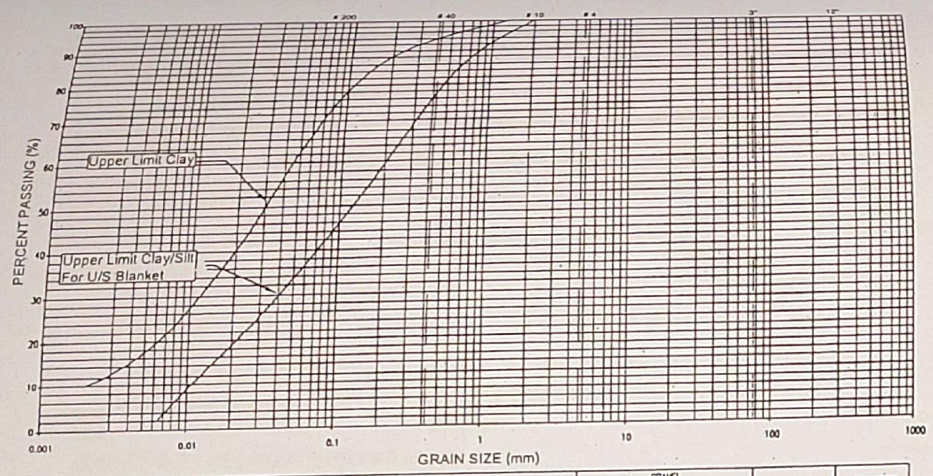
SHAH KALIM DAM PROJECT NOWSHERA

REV.	DATE	DESCRIPTION

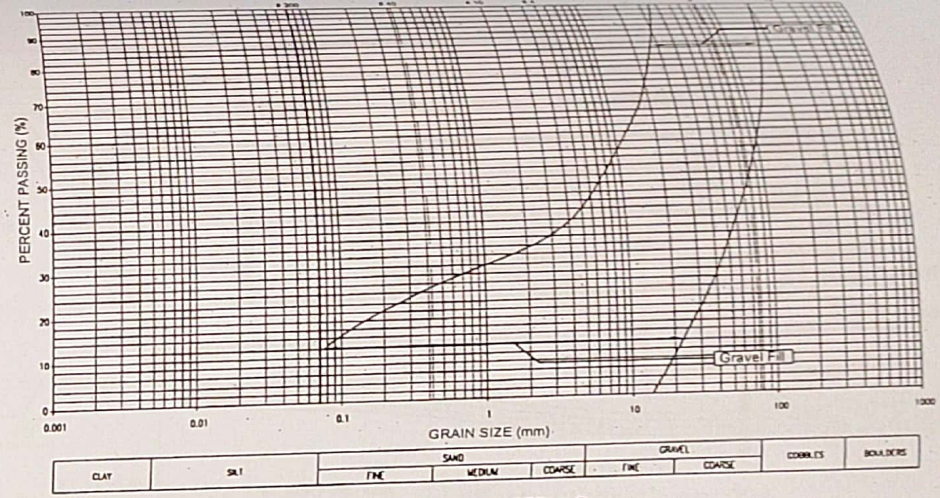
DESIGN BY	TANVIR ABBAS
CHECKED SUBMITTED BY	SAHKIL AHMAD

CROSS SECTION
RD 2+05

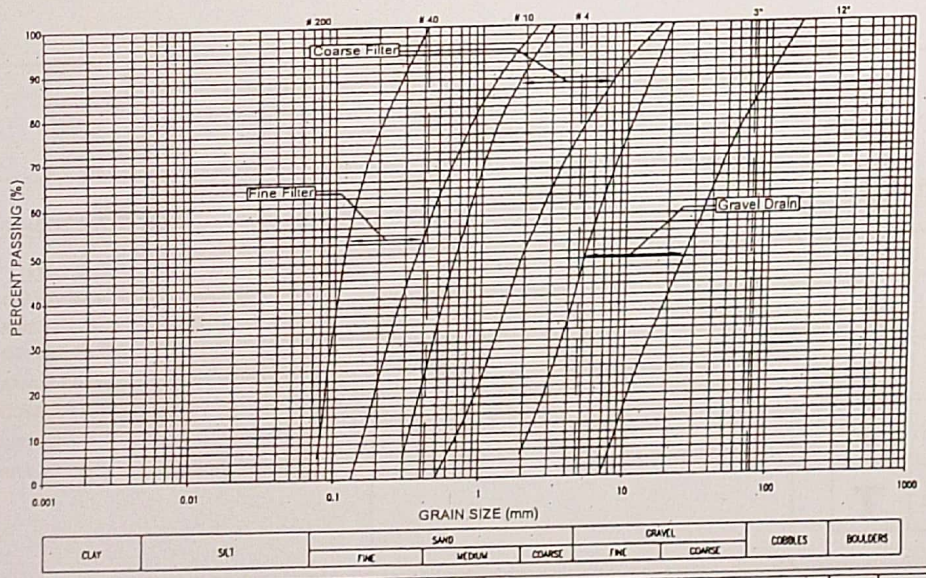
DRAWING NO. SKD-MD-16

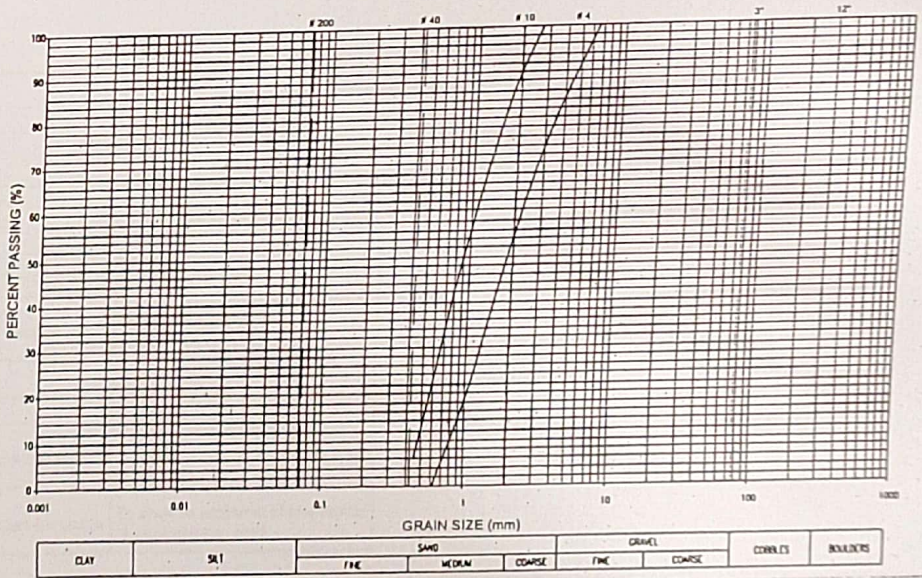


(a) FILL MATERIALS



(b) FILL MATERIALS





GOVERNMENT OF KHYBER PAKHTUNKHWA
DIRECTORATE GENERAL SMALL DAMS, IRRIGATION DEPARTMENT, PESHAWAR

CONSULTING ASSOCIATES
NEAR DEANS COMPLEX APARTMENTS, BEHIND GUL CNG, BOARD BAZAAR, JAMRUD ROAD, PESHAWAR
PH #: 091-5701774-45 Fax - 091-5701775
E-MAIL: consultingassociates127@gmail.com

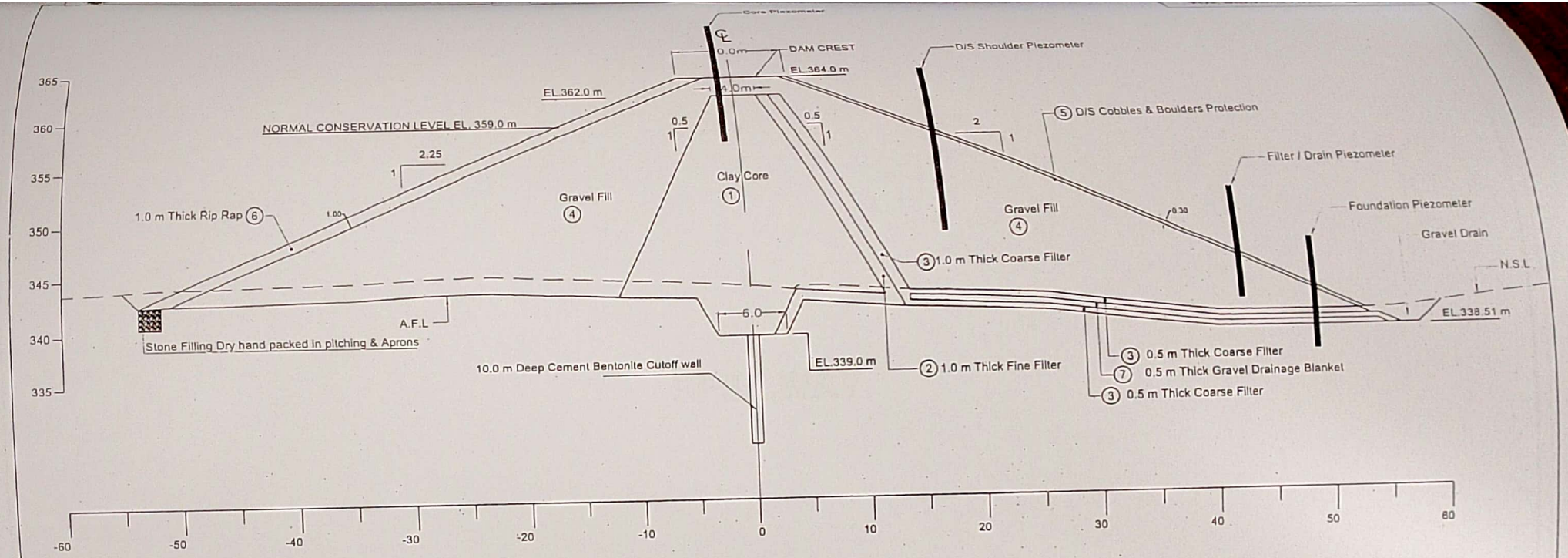
SHAH KALIM DAM PROJECT NOWSHERA

REV.	DATE	DESCRIPTION

DESIGN BY	TANVIR ABBAS	
CHECKED SUBMITTED BY	SAHKIL AHMAD	

FILL MATERIAL GRADATION LIMITS

DRAWING NO. SKD-MD-17



EMBANKMENT MATERIALS

ZONE	MATERIAL
1	CLAYEY SILT
2	FINE FILTER
3	COARSE FILTER
4	SANDY GRAVEL
5	COBBLES & BOULDER PROTECTION BEDDING
6	RIP RAP
7	GRAVEL DRAINAGE BLANKET

LEGEND

Symbol	Description	Purpose
▲	Marker	To observe horizontal & vertical movements
I	Piezometer	To observe pore water pressure
●	Slope Indicator	To observe lateral movement in fill
T	Settlement Gauge	To observe settlemnt of foundation & consolidation of fill

GOVERNMENT OF KHYBER PAKHTUNKHWA
DIRECTORATE GENERAL SMALL DAMS,IRRIGATION DEPARTMENT, PESHAWAR

CONSULTING ASSOCIATES
NEAR DEANS COMPLEX APARTMENTS,BEHIND GUL CNG,BOARD BAZAAR,JAMRUD ROAD,PESHAWAR
PH #: 091-5701774-45 Fax - 091-5701775
E-MAIL: consultingassociates127@gmail.com

SHAH KALIM DAM PROJECT NOWSHERA

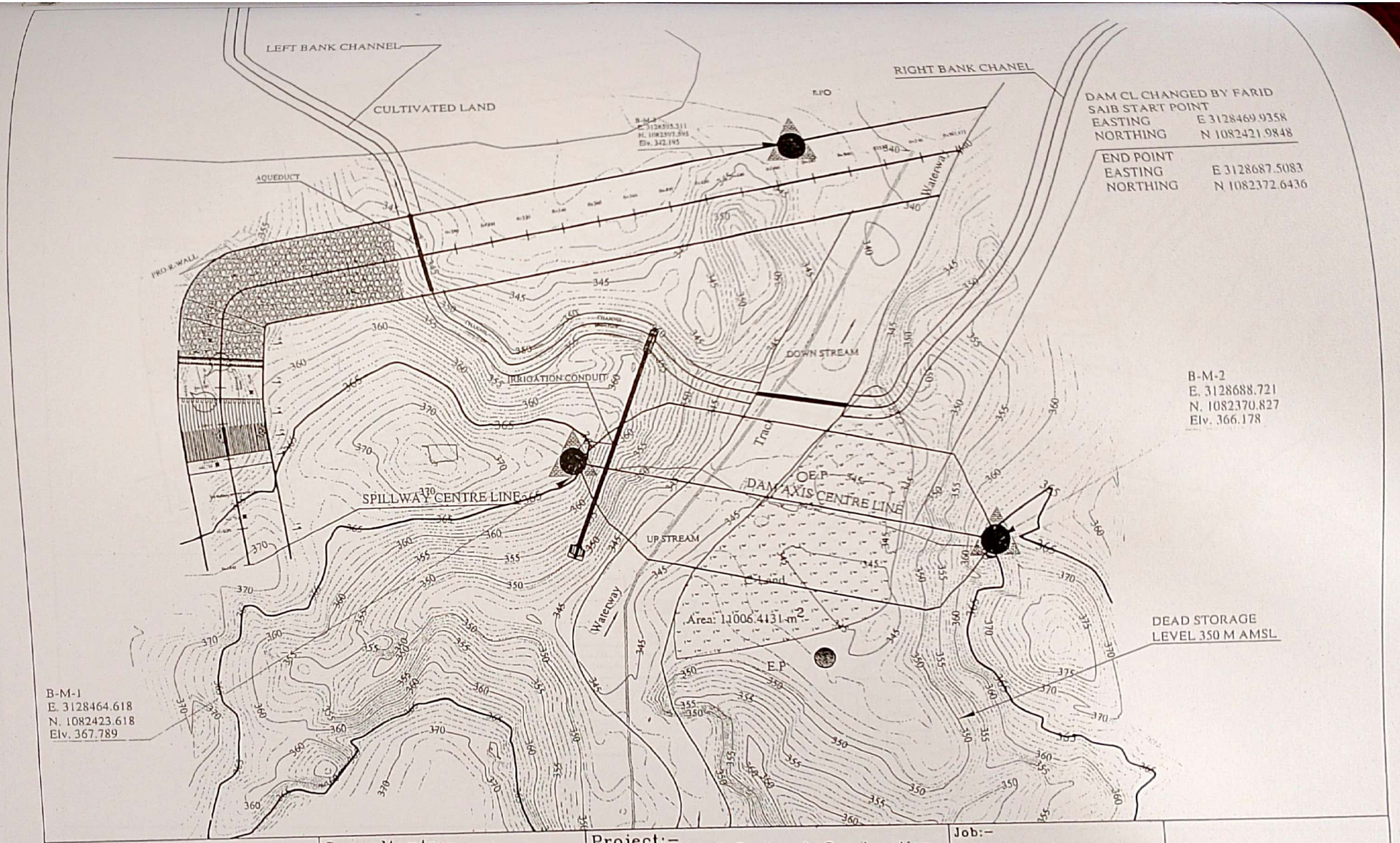
REV.	DATE	DESCRIPTION

DESIGN BY	TANVIR ABBAS	
CHECKED SUBMITTED BY	SAHKIL AHMAD	

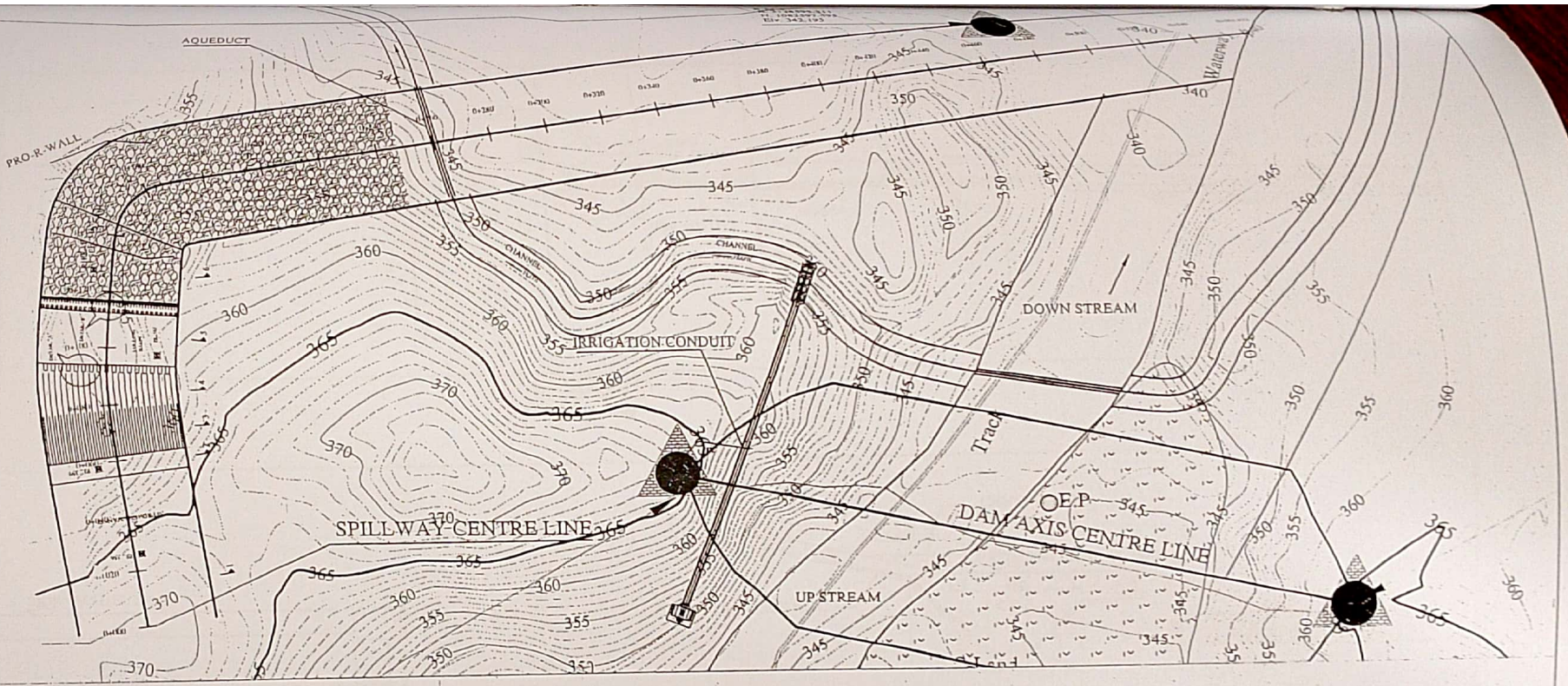
INSTRUMENTATION CROSS SECTION AT RD 0+65

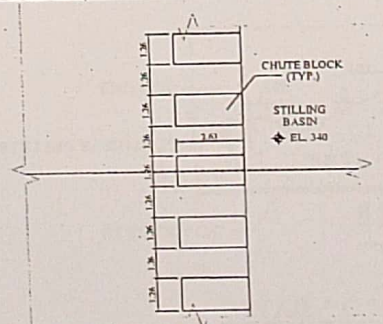
DRAWING NO. SKD-MD-18

SPILLWAY

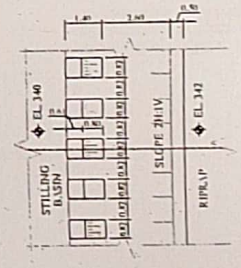


Client:-	Consultants:-	Project:-	Job:-	
Directorate General Small Dams Irrigation Department Govt: of KPK Peshawar	Consulting Associates Peshawar	Detail Design & Construction Supervision of Package - F (Shah Kaleem Dam)	PLAN	DRAWING NO SKD-SP-01



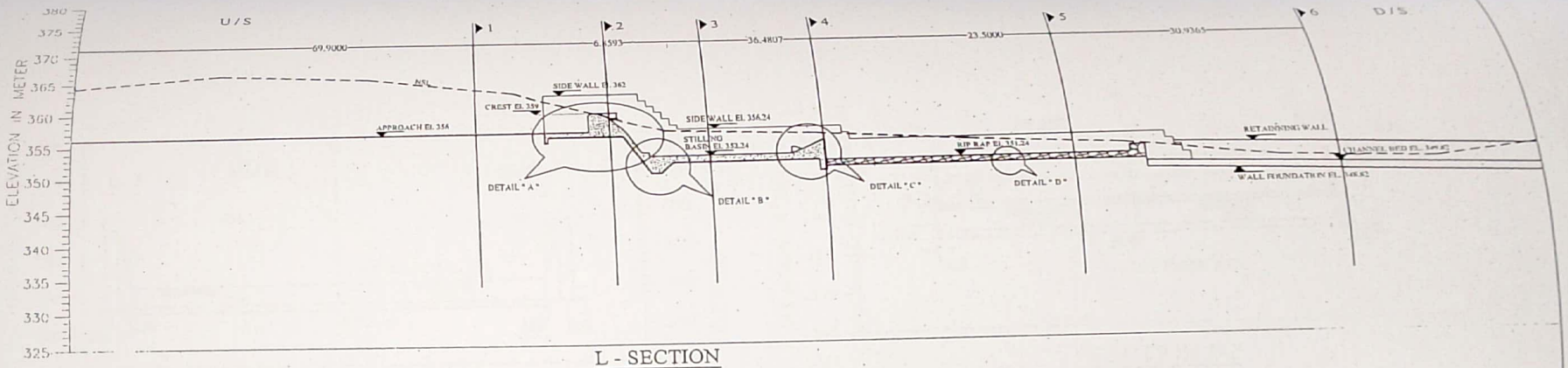


DETAIL " A "
SCALE " 1:125 "



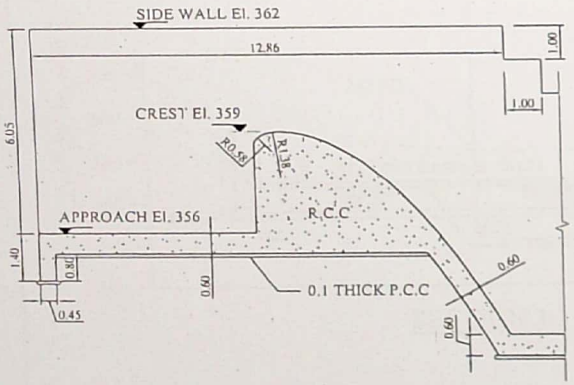
DETAIL " B "
SCALE " 1:125 "

Client:–	Consultants:–	Project:–	Job:–	
Directorate General Small Dams Irrigation Department Govt: of KPK Peshawar	Consulting Associates Peshawar	Detail Design & Construction Supervision of Package – F (Shah Kaleem Dam)	SPILLWAY PLAN AND DETAILS	DRAWING NO SKD-SP-02



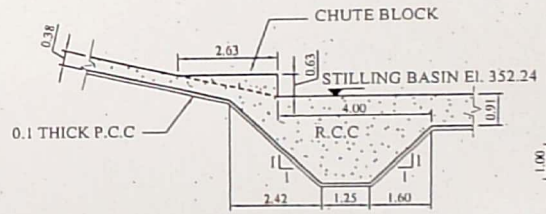
L - SECTION

SCALE " 1:500 "



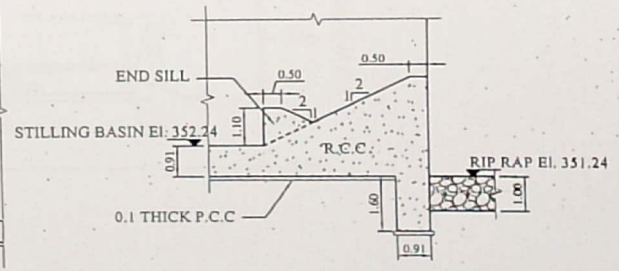
DETAIL " A "

SCALE " 1:125 "



DETAIL " B "

SCALE " 1:125 "



DETAIL " C "

SCALE " 1:125 "

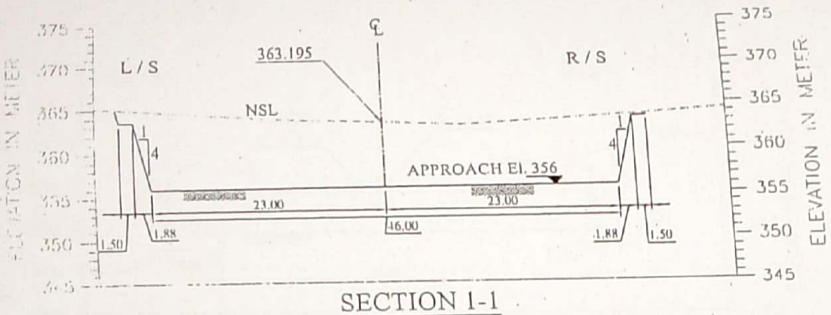
DETAIL " D "

SCALE " 1:125 "

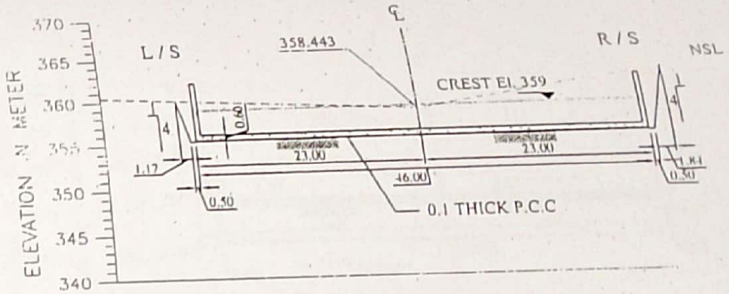
NOTE :-

ALL DIMENSIONS ARE IN METERS.

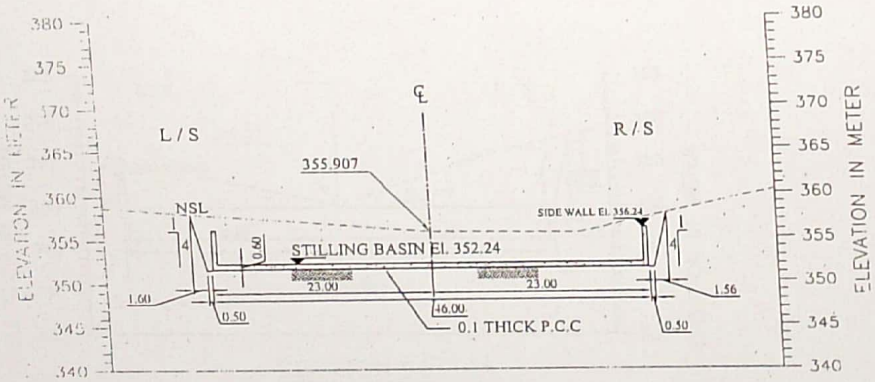
Client:-	Consultants:-	Project:-	Job:-	
Directorate General Small Dams Irrigation Department Govt: of KPK Peshawar	Consulting Associates Peshawar	Detail Design & Construction Supervision of Package - F (Shah Kaleem Dam)	SPILLWAY L-SECTION AND DETAILS	DRAWING NO SKD-SP-03



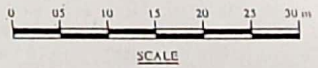
SECTION 1-1



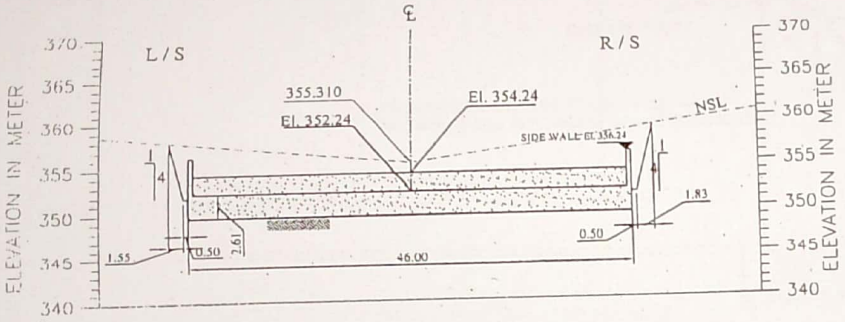
SECTION 2-2



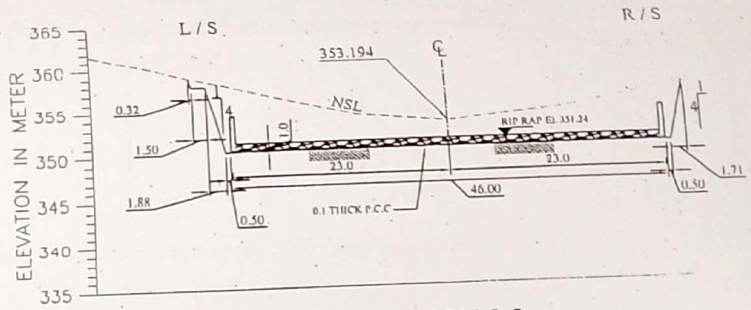
SECTION 3-3



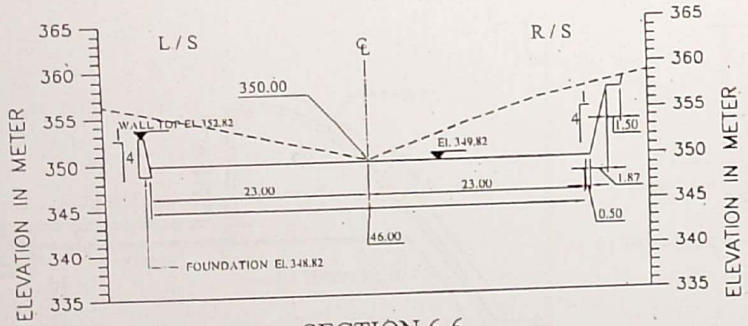
Client:-	Consultants:-	Project:-	Job:-	
Directorate General Small Dams Irrigation Department Govt: of KPK Peshawar	Consulting Associates Peshawar	Detail Design & Construction Supervision of Package - F (Shah Kaleem Dam)	SPILLWAY CROSS SECTIONS	DRAWING NO SKD-SP-04



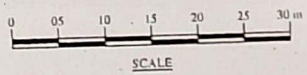
SECTION 4-4



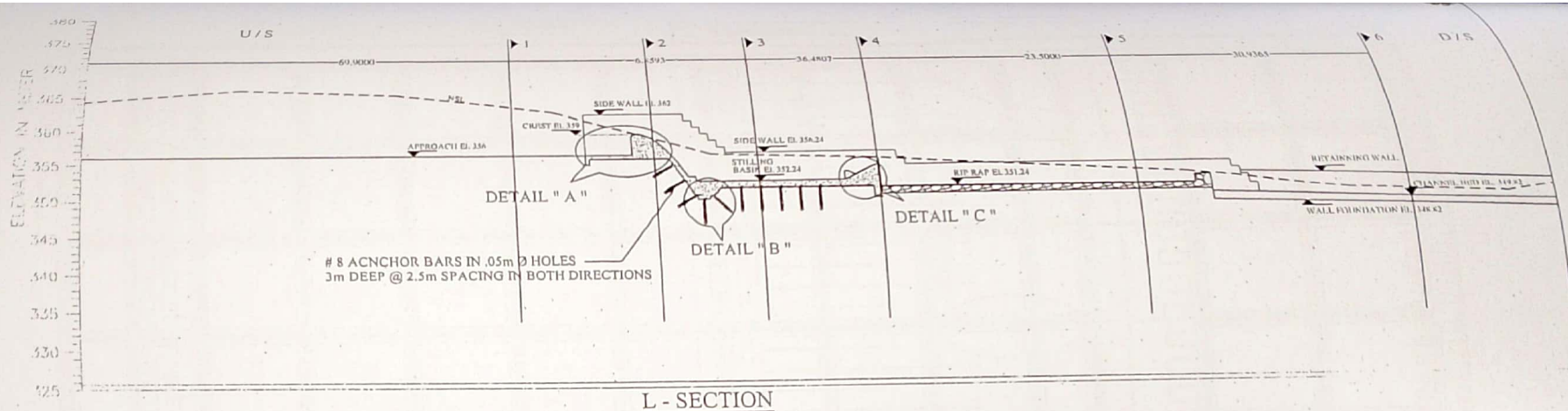
SECTION 5-5



SECTION 6-6

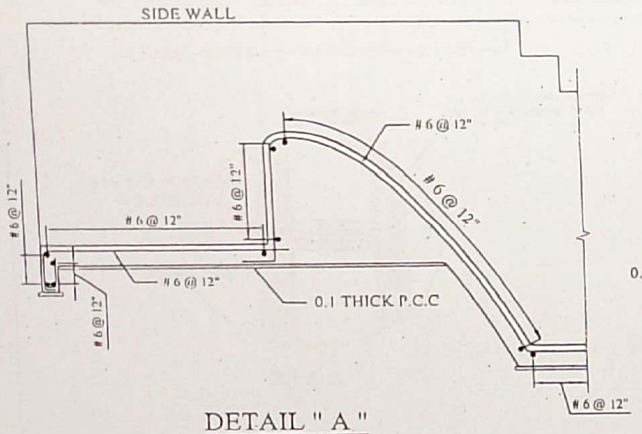


Client:-	Consultants:-	Project:-	Job:-	
Directorate General Small Dams Irrigation Department Govt: of KPK Peshawar	Consulting Associates Peshawar	Detail Design & Construction Supervision of Package - F (Shah Kaleem Dam)	SPILLWAY CROSS SECTIONS	DRAWING NO SKD-SP-05



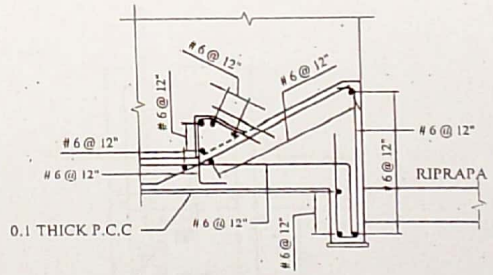
L - SECTION

SCALE " 1:500 "



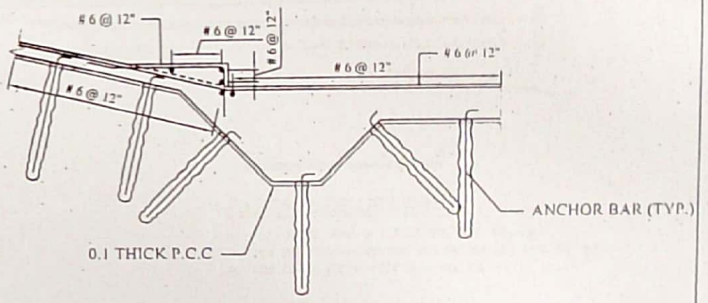
DETAIL " A "

SCALE " 1:125 "



DETAIL " C "

SCALE " 1:125 "



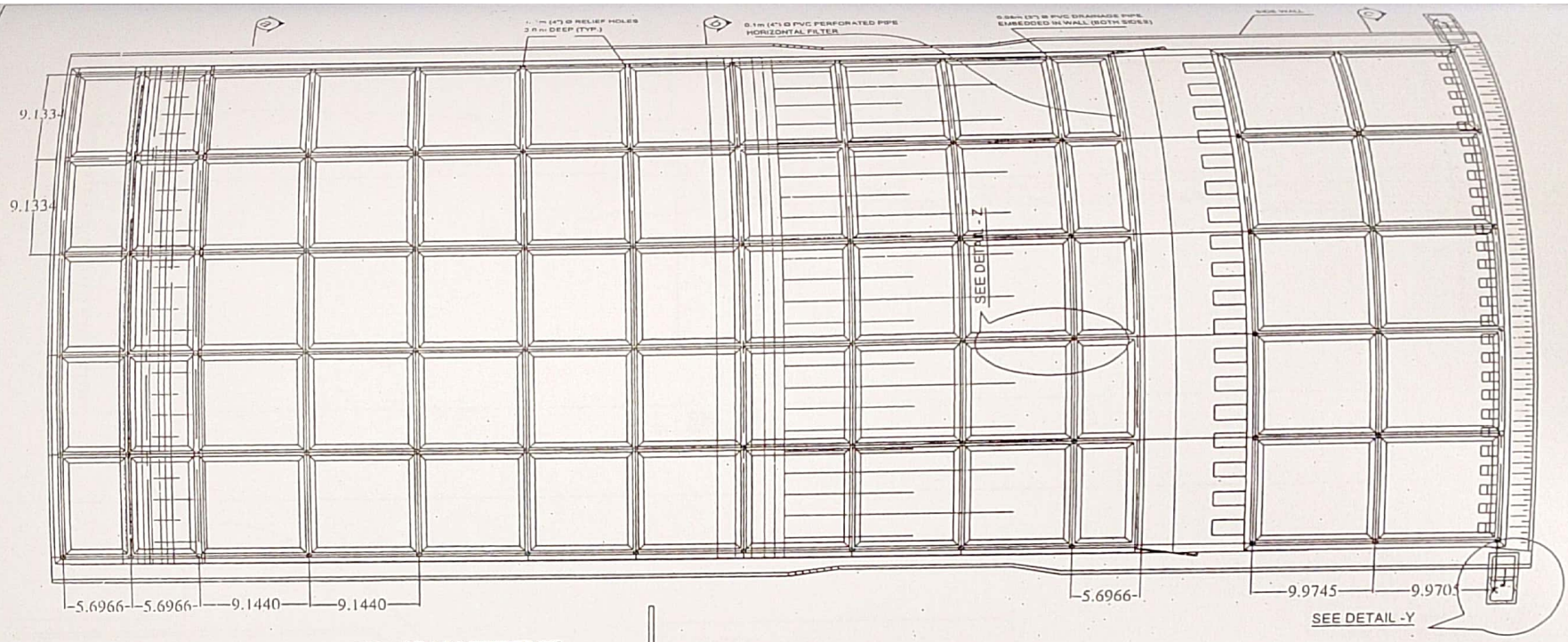
DETAIL " B "

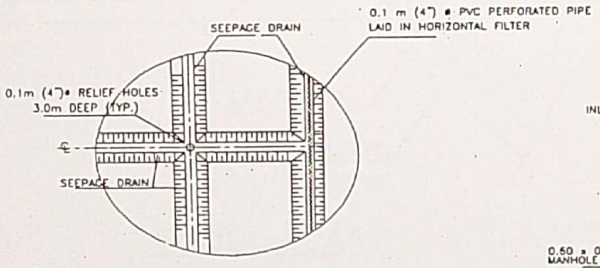
SCALE " 1:125 "

NOTE :-

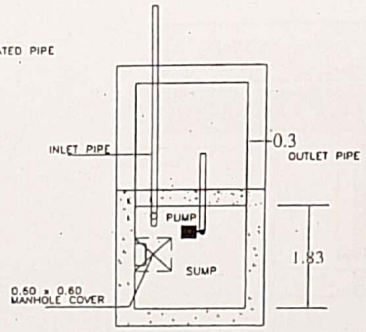
ALL DIMENSIONS ARE IN METERS.

Client:-	Consultants:-	Project:-	Job:-	
Directorate General Small Dams Irrigation Department Govt: of KPK Peshawar	Consulting Associates Peshawar	Detail Design & Construction Supervision of Package - F (Shah Kaleem Dam)	SPILLWAY L-SECTION REINFORCEMENT DETAILS	DRAWING NO SKD-SP-06





DETAIL -Z
N.T.S



DETAIL -Y
N.T.S

0 7.5 15 m

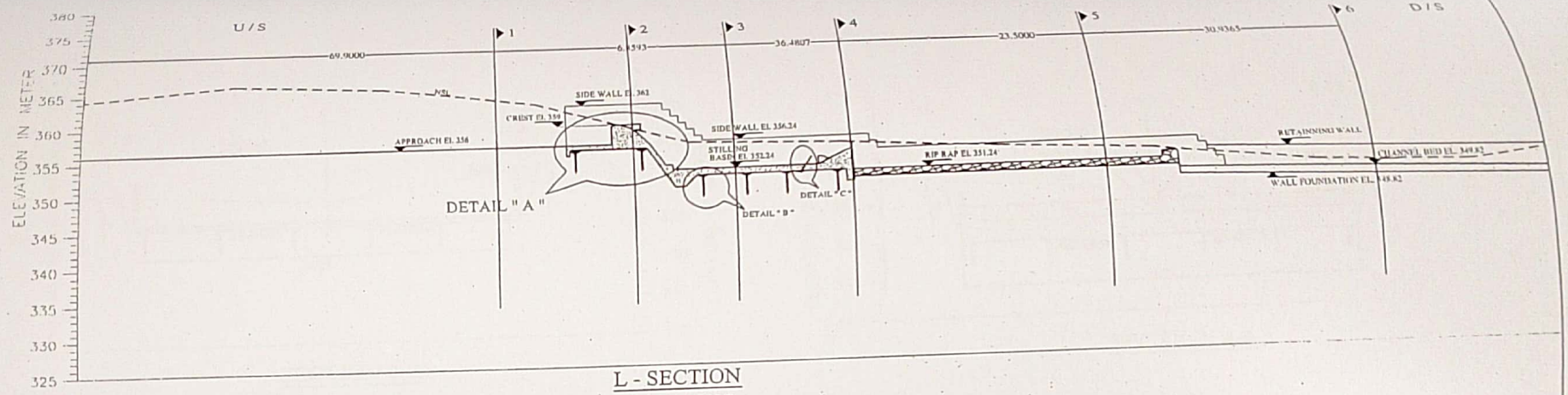
REFERENCE DRAWINGS

1. FOR LAYOUT PLAN & DETAILS SEE DWG. NO. 6.6
2. FOR LONGITUDINAL SECTION AND DETAILS SEE DWG. NO. 6.7
3. FOR CROSS SECTION SEE DWG. NO. 6.8

NOTE

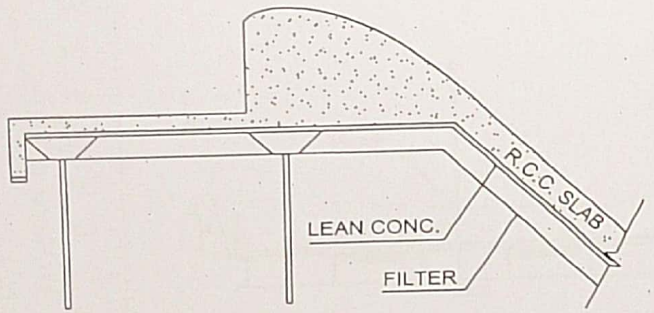
1. ALL DIMENSIONS AND LEVELS ARE IN METER.

Client:-	Consultants:-	Project:-	Job:-	
Directorate General Small Dams Irrigation Department Govt: of KPK Peshawar	Consulting Associates Peshawar	Detail Design & Construction Supervision of Package - F (Shah Kaleem Dam)	SPILLWAY PLAN DRAINAGE ARRANGEMENT & DETAIL	DRAWING NO SKD-SP-07



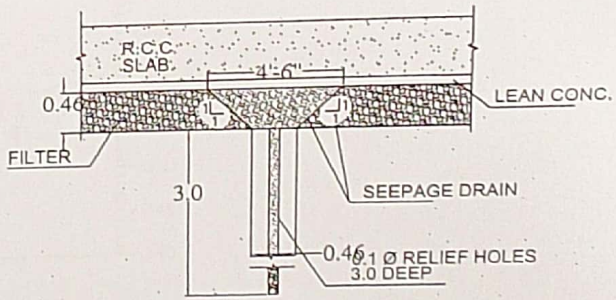
L - SECTION

SCALE " 1:500 "



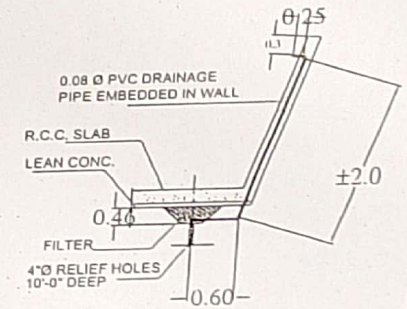
DETAIL – AA

N.T.S



DETAIL – BB

N.T.S

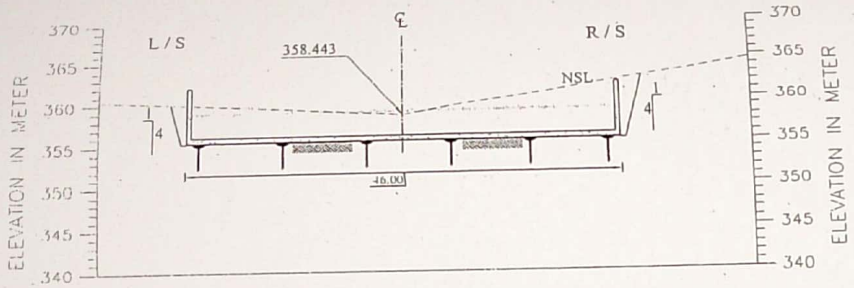


DRAIN PIPE DETAIL CC

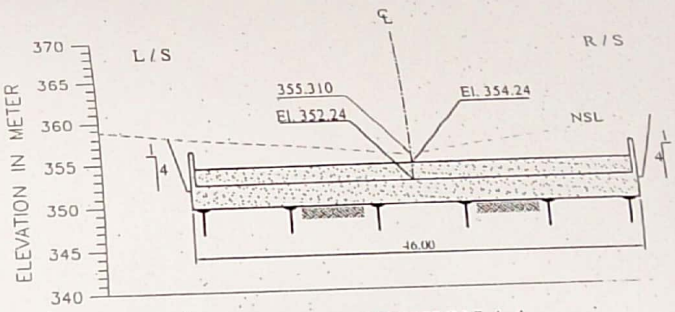
N.T.S

0 7.5 15 m

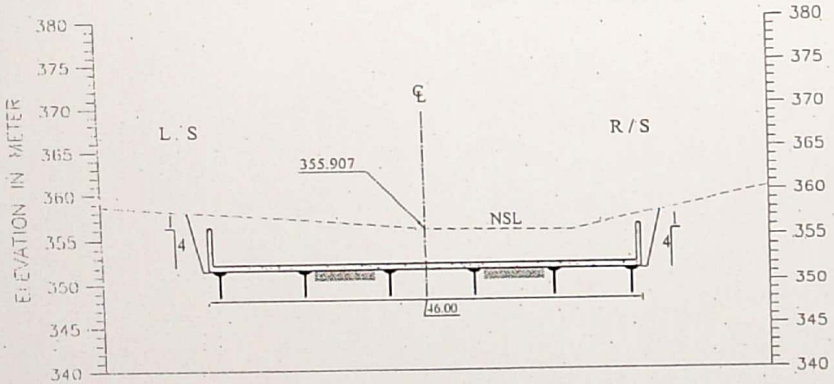
Client:–	Consultants:–	Project:–	Job:–	
Directorate General Small Dams Irrigation Department Govt: of KPK Peshawar	Consulting Associates Peshawar	Detail Design & Construction Supervision of Package – F (Shah Kaleem Dam)	SPILLWAY L-SECTION DRAINAGE ARRANGEMENT & DETAIL	DRAWING NO SKD-SP-08



SECTION 2-2



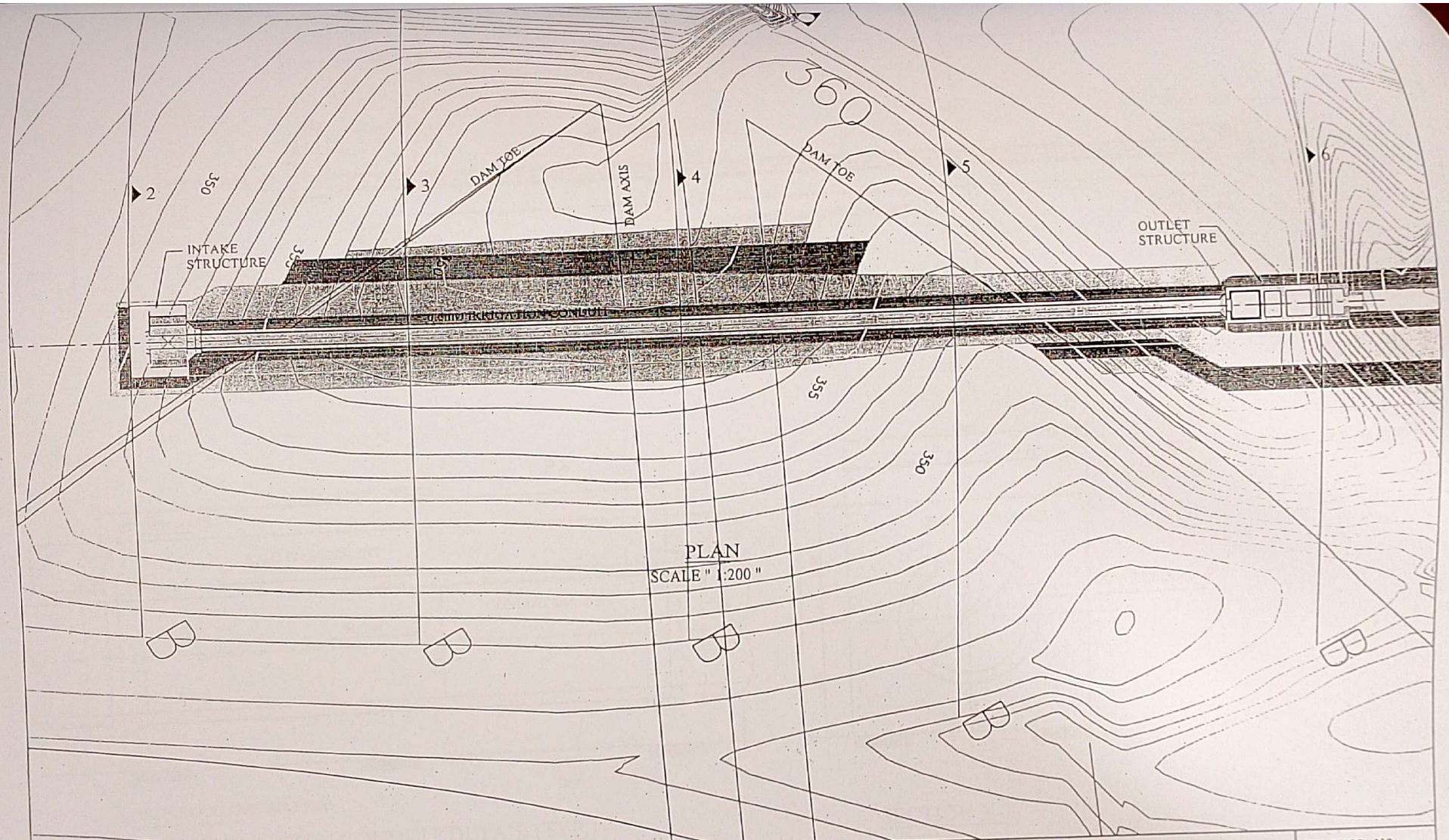
SECTION 4-4



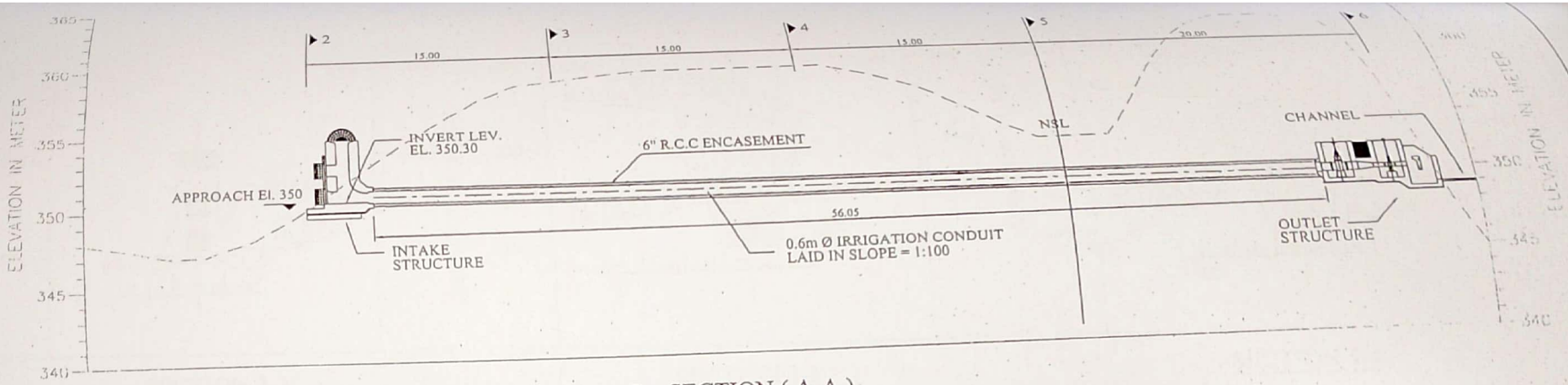
SECTION 3-3

Client:-	Consultants:-	Project:-	Job:-	
Directorate General Small Dams Irrigation Department Govt: of KPK Peshawar	Consulting Associates Peshawar	Detail Design & Construction Supervision of Package - F (Shah Kaleem Dam)	SPILLWAY X-SECTION DRAINAGE ARRANGEMENT & DETAIL	DRAWING NO SKD-SP-09

INTAKE & OUT LET STRUCTURES



Client:-	Consultants:-	Project:-	Job:-	DRAWING NO :-
Directorate General Small Dams Irrigation Department Govt: of KPK Peshawar	Consulting Associates Peshawar	Detail Design & Construction Supervision of Package - F (Shah Kaleem Dam)	CONDUIT LAYOUT PLAN	SKD-INT-01

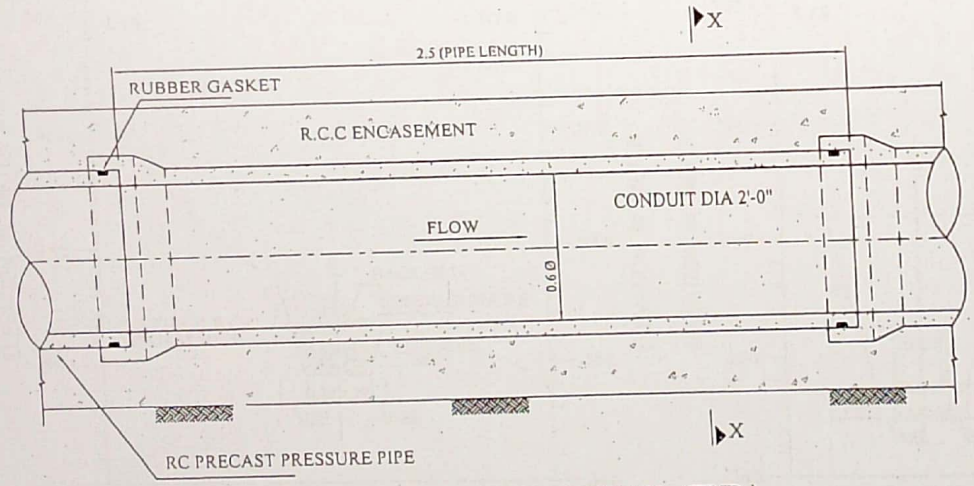


L - SECTION (A-A)

SCALE " 1:250 "

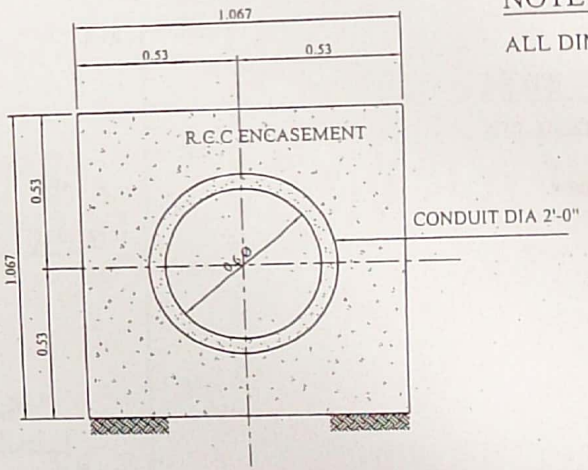
NOTE :-

ALL DIMENSIONS ARE IN METERS.



IRRIGATION CONDUIT DETAIL (TYP.)

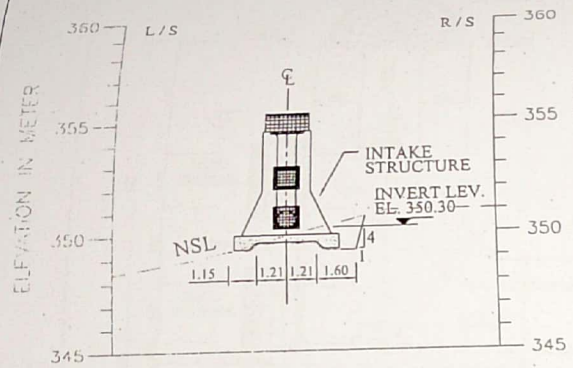
SCALE " 1:50 "



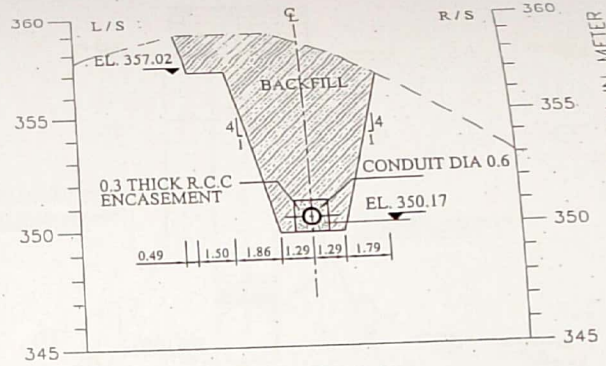
SECTION X-X

SCALE " 1:50 "

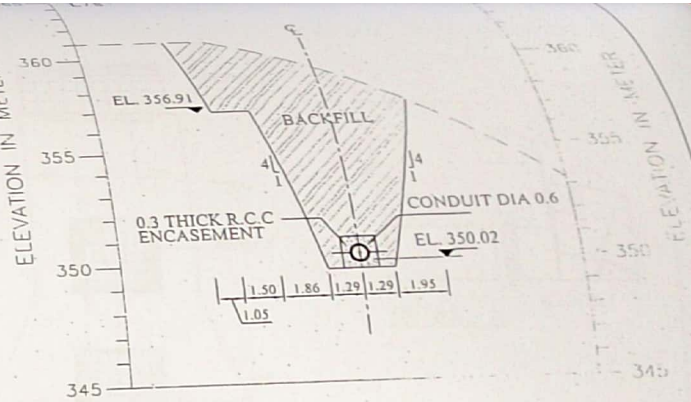
Client:-	Consultants:-	Project:-	Job:-	DRAWING NO :-
Directorate General Small Dams Irrigation Department Govt: of KPK Peshawar	Consulting Associates Peshawar	Detail Design & Construction Supervision of Package - F (Shah Kaleem Dam)	IRRIGATION CONDUIT L - SECTION (A-A) AND DETAILS	SKD-INT-02



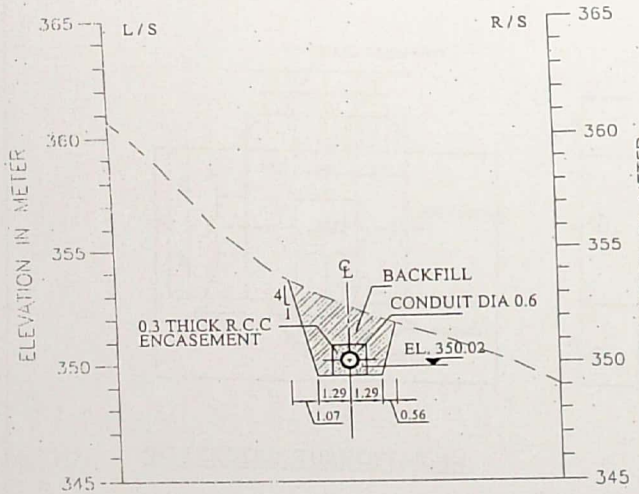
SECTION 2-2



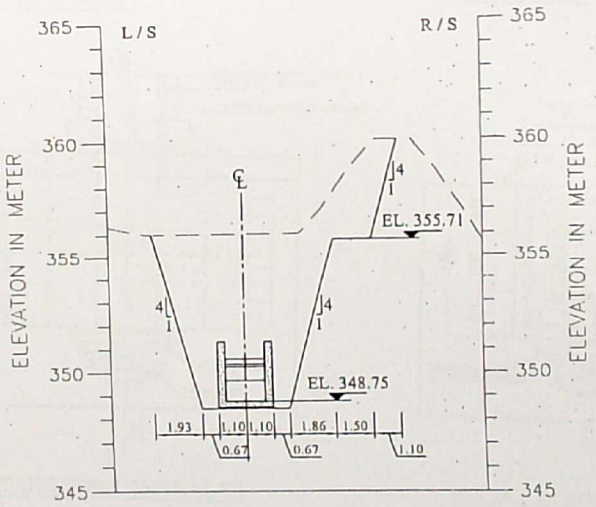
SECTION 3-3



SECTION 4-4



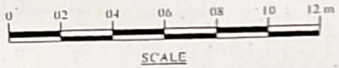
SECTION 5-5



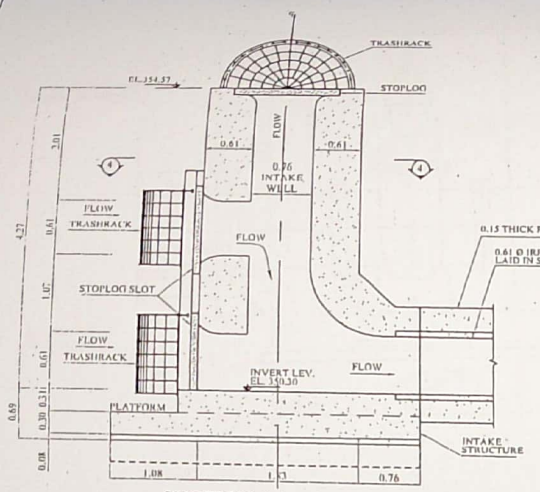
SECTION 6-6

NOTE :-

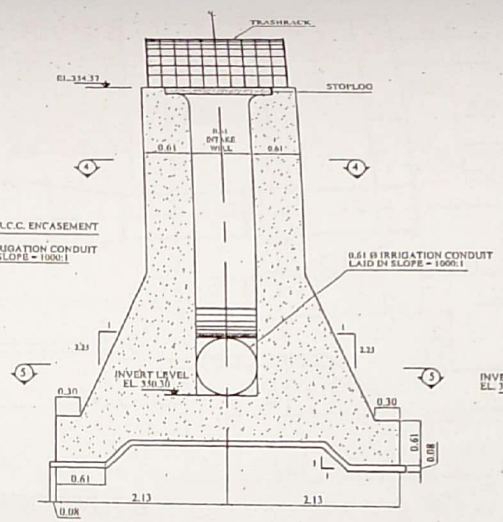
ALL DIMENSIONS ARE IN METERS.



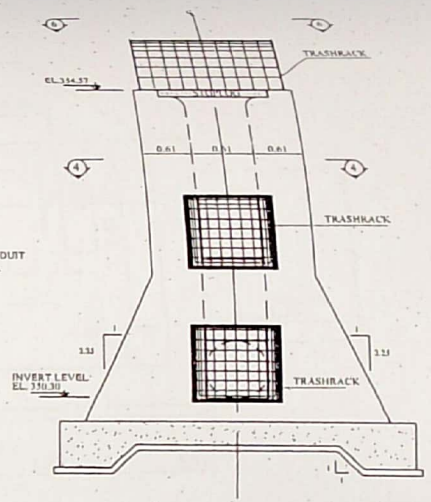
Client:-	Consultants:-	Project:-	Job:-	DRAWING NO :-
Directorate General Small Dams Irrigation Department Govt: of KPK Peshawar	Consulting Associates Peshawar	Detail Design & Construction Supervision of Package - F (Shah Kaleem Dam)	IRRIGATION CONDUIT CROSS SECTIONS	SKD-INT-03



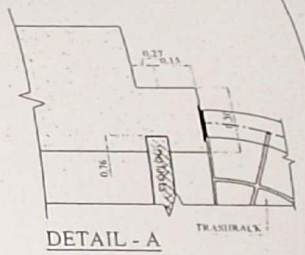
SECTION 1-1



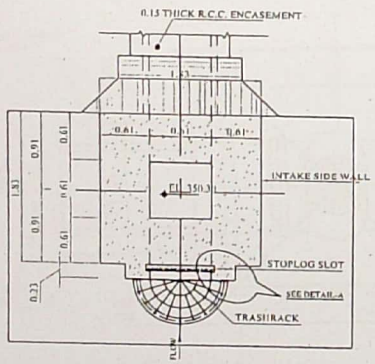
SECTION 2-2



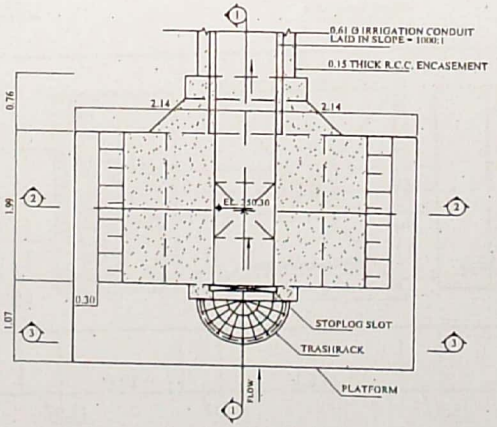
SECTION 3-3



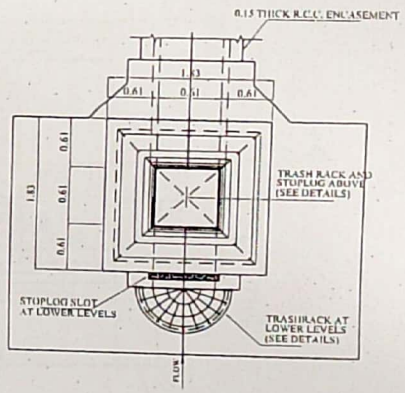
DETAIL - A



INTAKE STRUCTURE DETAIL 4-4



INTAKE STRUCTURE PLAN

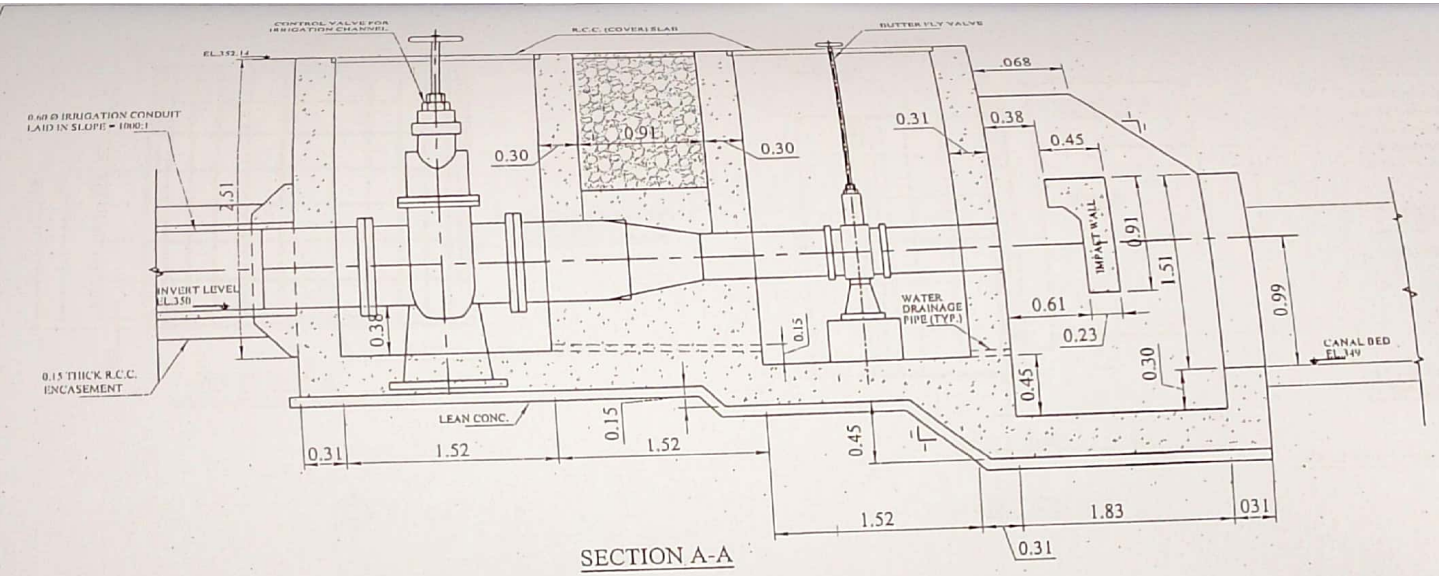


INTAKE STRUCTURE PLAN)

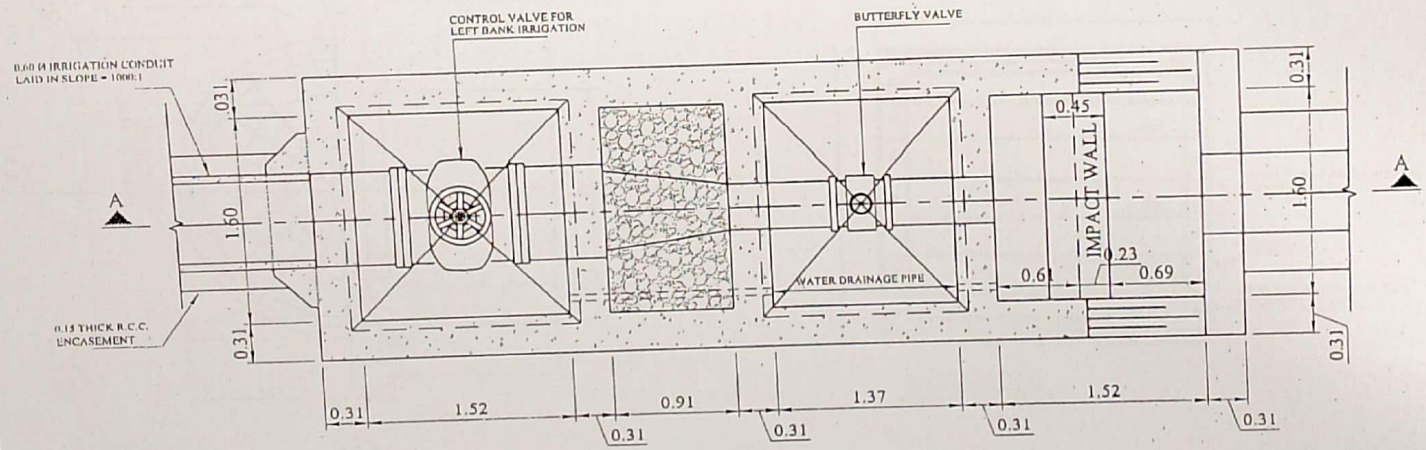
NOTE

1. ALL DIMENSIONS AND LEVELS ARE IN METER.

Client:-	Consultants:-	Project:-	Job:-	
Directorate General Small Dams Irrigation Department Govt: of KPK Peshawar	Consulting Associates Peshawar	Detail Design & Construction Supervision of Package - F (Shah Kaleem Dam)	INTAKE STRUCTURE PLAN, SECTIONS & DETAILS	DRAWING NO :- SKD-INT-04



SECTION A-A

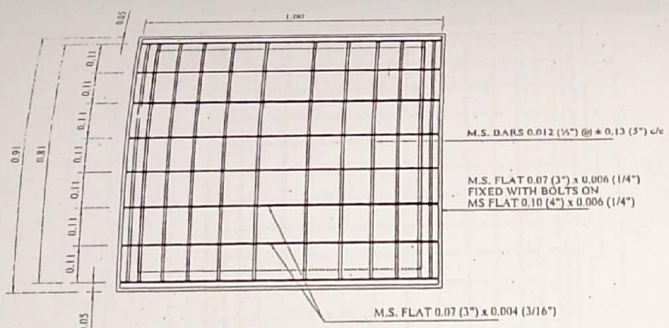


PLAN

NOTE

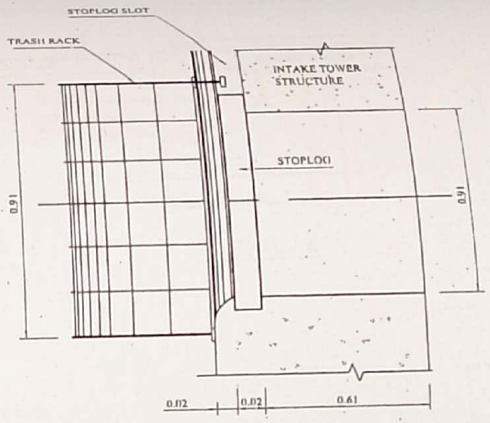
1. ALL DIMENSIONS AND LEVELS ARE IN METER.

Client:-	Consultants:-	Project:-	Job:-	DRAWING NO :-
Directorate General Small Dams Irrigation Department Govt: of KPK Peshawar	Consulting Associates Peshawar	Detail Design & Construction Supervision of Package - F (Shah Kaleem Dam)	OUTLET STRUCTURE PLAN & SECTION	SKD-INT-05



SECTION A-A

LOWER TASHRACK ELEVATION



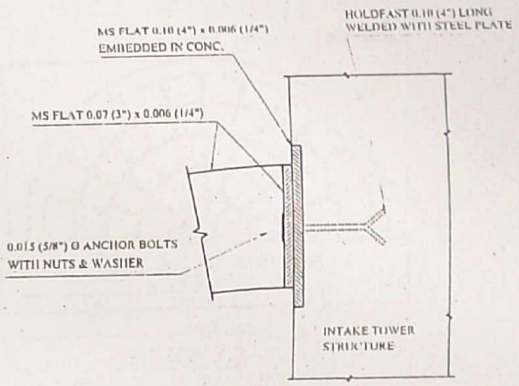
SECTION B-B

REFERENCE DRAWINGS

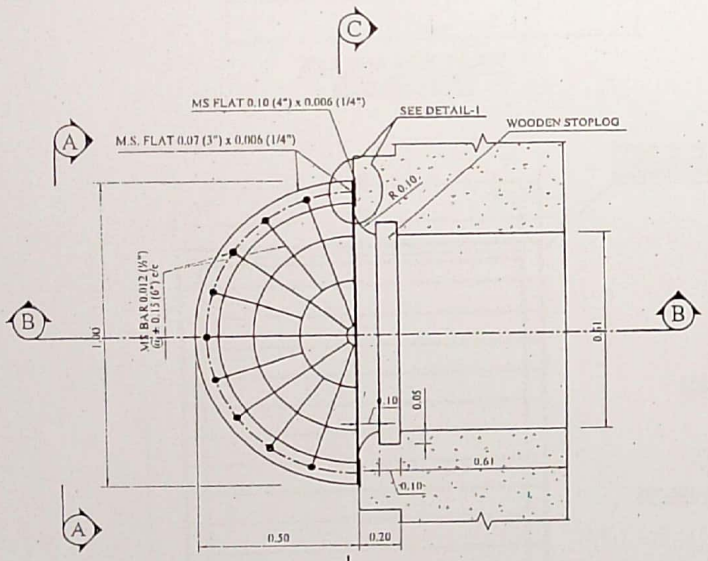
1. FOR CONDUIT LAYOUT PLAN SEE DWG. NO. 7.1
2. FOR L-SECTION & DETAILS SEE DWG. NO. 7.2
3. FOR X-SECTIONS SEE DWG. NO. 7.3, 7.4
4. FOR INTAKE STRUCTURE SEE DWG. NO. 7.5
5. FOR TRASHRACK SETAIL SEE DWG. NO. 7.8

NOTE

1. ALL DIMENSIONS AND LEVELS ARE IN FEET.

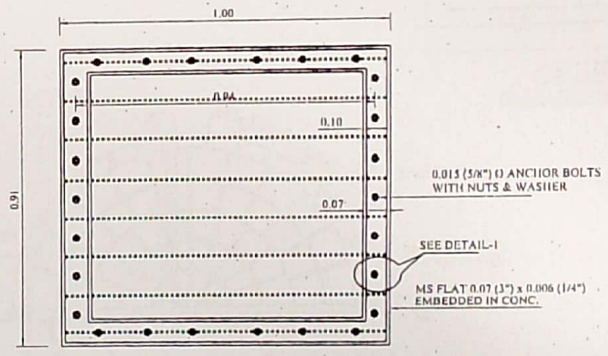


DETAIL - I



LOWER TASHRACK

PLAN



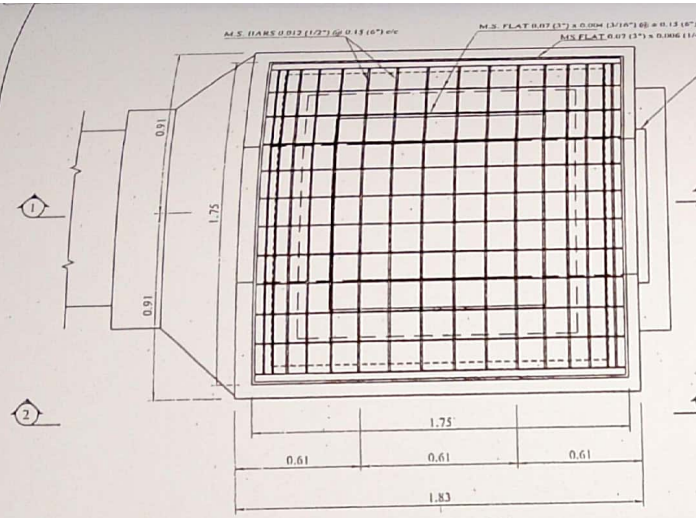
SECTION C-C

LOWER TASHRACK FRAME

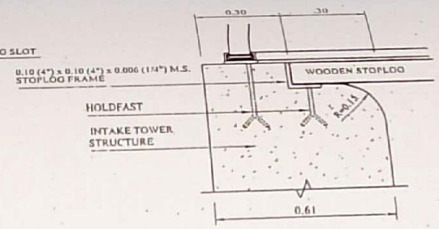
NOTE

1. ALL DIMENSIONS AND LEVELS ARE IN METER.

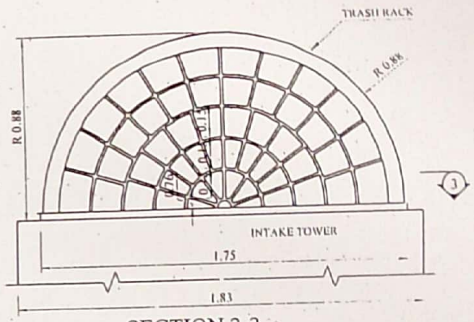
Client:-	Consultants:-	Project:-	Job:-	DRAWING NO :-
Directorate General Small Dams Irrigation Department Govt: of KPK Peshawar	Consulting Associates Peshawar	Detail Design & Construction Supervision of Package - F (Shah Kaleem Dam)	TRASHRACK AND STOPLOG DETAILS INTAKE OPENING AT LOWER LEVEL	SKD-INT-06



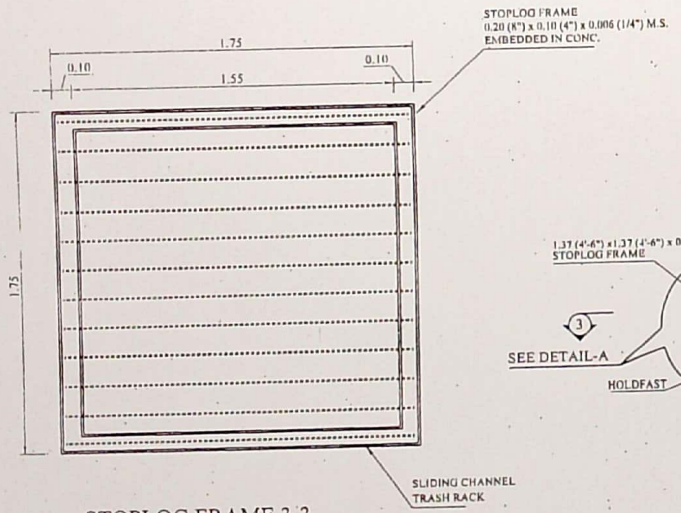
TRASHRACK PLAN
INLET STRUCTURE



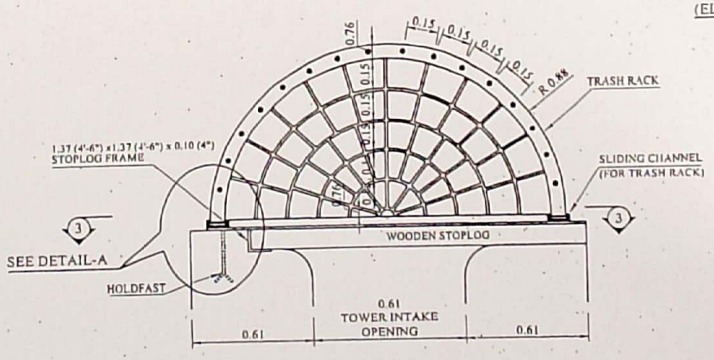
DETAIL - A



SECTION 2-2
(ELEVATION OF TRASHRACK)



STOPLOG FRAME 3-3
PLAN



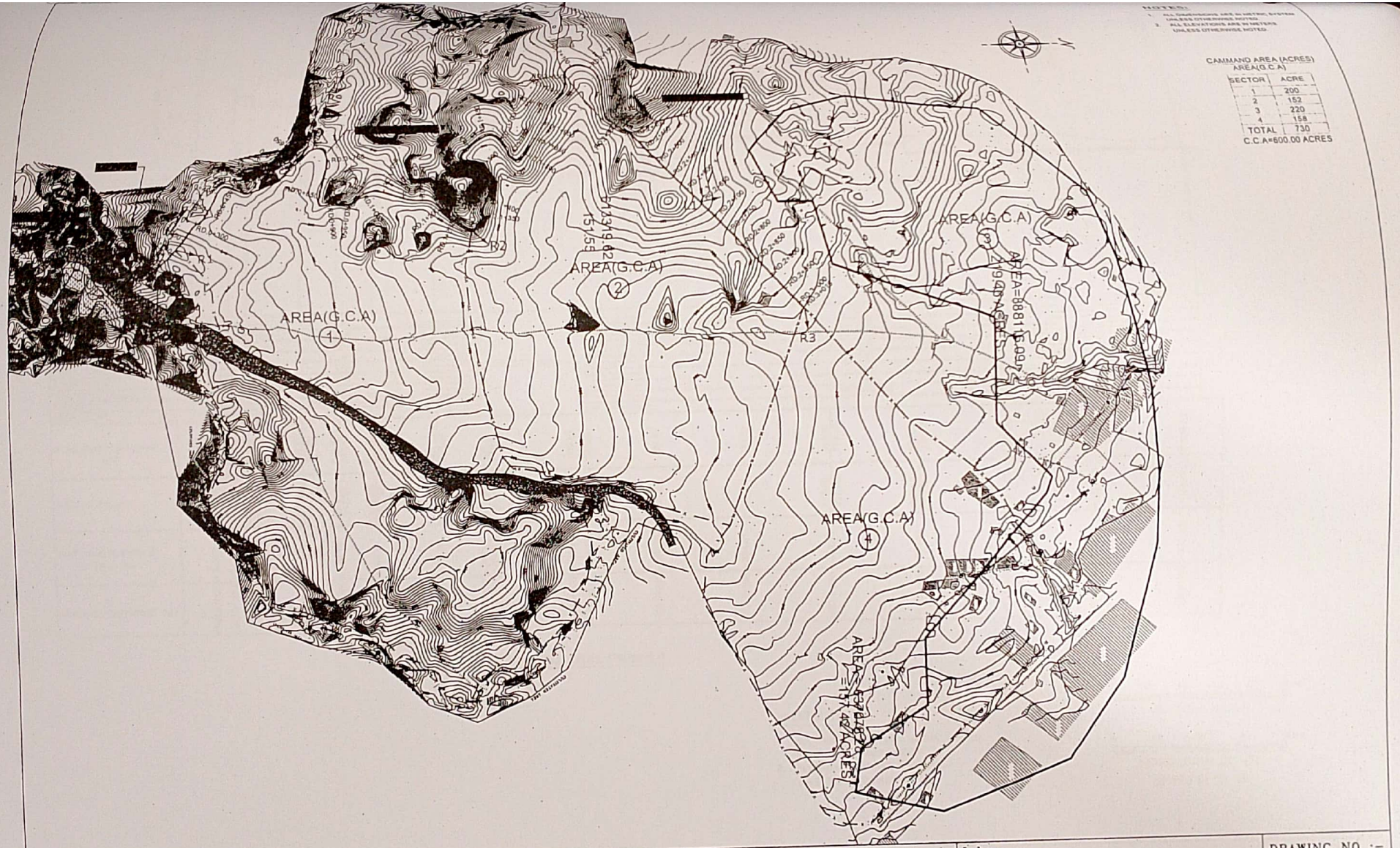
SECTION 1-1

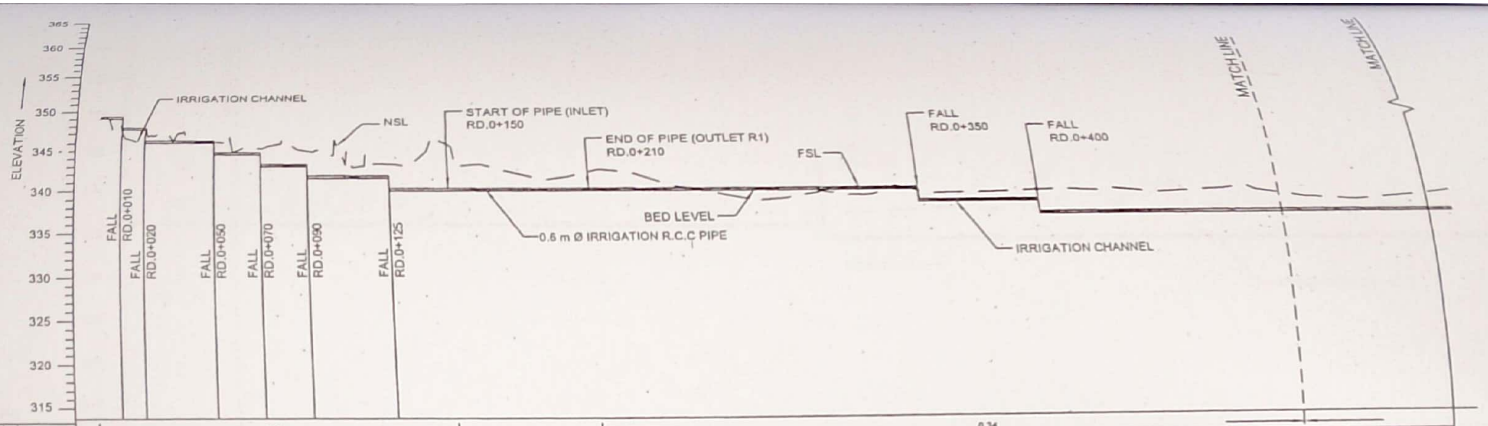
NOTE

1. ALL DIMENSIONS AND LEVELS ARE IN METER.

Client:-	Consultants:-	Project:-	Job:-	DRAWING NO :-
Directorate General Small Dams Irrigation Department Govt: of KPK Peshawar	Consulting Associates Peshawar	Detail Design & Construction Supervision of Package - F (Shah Kaleem Dam)	TRASHRACK AND STOPLOG DETAILS	SKD-INT-07

IRRIGATION SYSTEM


NOTES:
1. ALL DIMENSIONS ARE IN METRIC SYSTEM UNLESS OTHERWISE NOTED.
2. ALL ELEVATIONS ARE IN METRES UNLESS OTHERWISE NOTED.
COMMAND AREA (ACRES)
AREA(G.C.A)
SECTOR | ACRE
1 | 200
2 | 152
3 | 220
4 | 158
TOTAL | 730
C.C.A=600.00 ACRES
AREA(G.C.A)
1
AREA(G.C.A)
2
AREA(G.C.A)
3
AREA(G.C.A)
4
R3
R2
R1
AREA=88811.09 ACRES
AREA=81.47 ACRES
Client:-
Directorate General Small Dams
Irrigation Department
Govt: of KPK Peshawar
Consultants:-
Consulting Associates
Peshawar
Project:-
Detail Design & Construction
Supervision of Package - F
(Shah Kaleem Dam)
Job:-
IRRIGATION CHANNEL LAYOUT PLAN
DRAWING NO :-
SKD-IS-01



DATUM LINE

BED WIDTH / DIA (m)	0.34	R.C.C PIPE	0.34
FULL SUPPLY DEPTH (m)	0.29		0.29
BED SLOPE	0.002		0.002
DISCHARGE (cumecs)	0.061		0.061
FREE BOARD (m)	0.15		0.15
MANNINGS 'n'	0.016		0.016
VELOCITY (m/sec)	0.63		0.63
CHANNEL TYPE	RECTANGULAR		RECTANGULAR
SIDE SLOPE	-		-

REDUCE DISTANCE (m)	FULL SUPPLAY LEVEL (m)	BED LEVEL (m)	NATURAL SURFACE LEVEL (m)
RD.0+000	349.29	349.00	349.00
RD.0+010	349.27 347.77	348.98 347.48	347.09
RD.0+020	347.75 346.25	347.46 345.96	347.09
RD.0+050	346.19 344.69	345.90 344.40	348.98
RD.0+070	344.65 343.15	344.36 342.86	345.14
RD.0+090	343.11 341.61	342.82 341.32	344.71
RD.0+100	341.59	341.30	344.38
RD.0+125	341.54 340.04	341.25 339.75	343.02
RD.0+150	339.99	339.70	345.47
RD.0+155	339.98	339.69	342.71
RD.0+200	339.89	339.60	341.21
RD.0+210	339.87	339.58	341.80
RD.0+250	339.79	339.50	339.89
RD.0+300	339.69	339.40	338.81
RD.0+350	339.69 338.19	339.40 337.90	339.13
RD.0+400	338.09 336.59	337.80 336.30	339.01
RD.0+450	336.49	336.20	338.56
RD.0+500	336.39	336.10	338.22
RD.0+550	336.29	336.00	337.69

LONGITUDINAL PROFILE

NOTES:

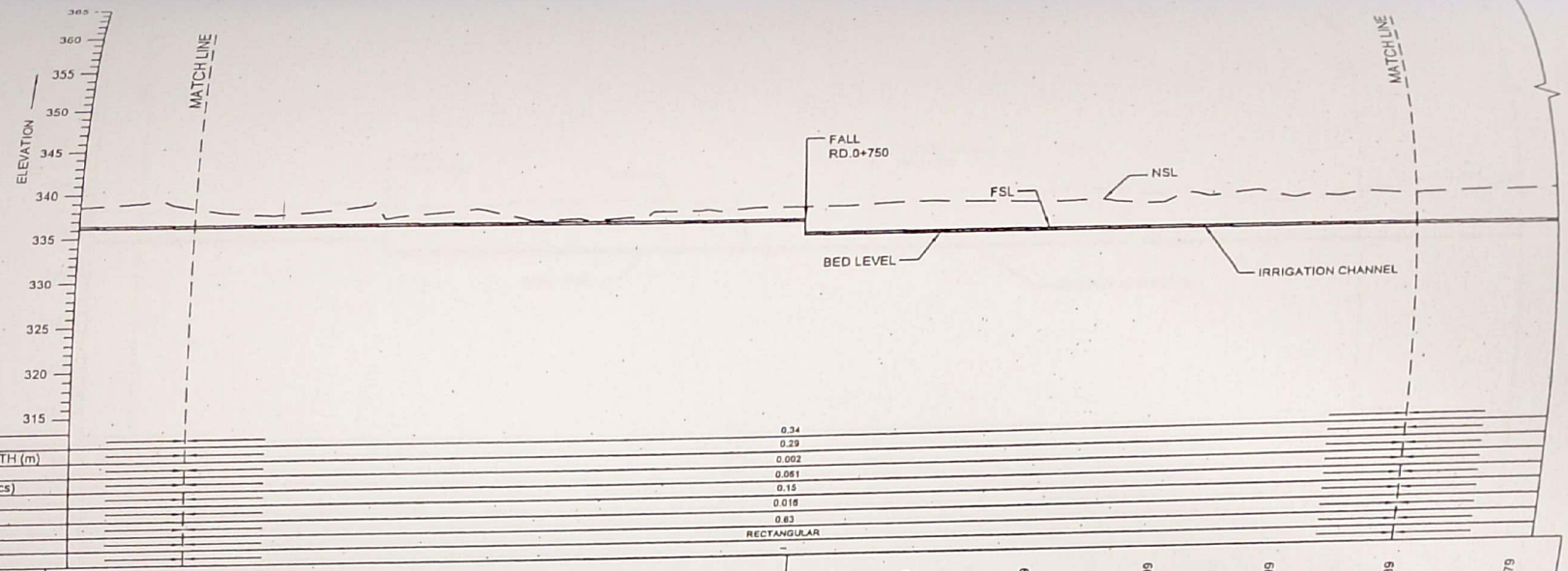
1. ALL DIMENSIONS ARE IN METRIC SYSTEM UNLESS OTHERWISE NOTED.
2. ALL ELEVATIONS ARE IN METERS UNLESS OTHERWISE NOTED.

0 5 10 15 20 25 m
VERTICAL SCALE

0 25 50 75 100 m
HORIZONTAL SCALE

SHEET 01 OF 06

Client:-	Consultants:-	Project:-	Job:-	DRAWING NO :-
Directorate General Small Dams Irrigation Department Govt: of KPK Peshawar	Consulting Associates Peshawar	Detail Design & Construction Supervision of Package - F (Shah Kaleem Dam)	IRRIGATION CHANNEL PROFILE RD. 0+000 TO RD.0+500	SKD-IS-02



DATUM LINE	
BED WIDTH	0.34
FULL SUPPLY DEPTH (m)	0.29
BED SLOPE	0.002
DISCHARGE (cumecs)	0.061
FREE BOARD (m)	0.15
MANNINGS 'n'	0.018
VELOCITY (m/sec)	0.83
CHANNEL TYPE	RECTANGULAR
SIDE SLOPE	-

REDUCE DISTANCE (m)	NATURAL SURFACE LEVEL (m)	BED LEVEL (m)	FULL SUPPLAY LEVEL (m)
RD.0+500	338.22	336.10	336.39
RD.0+550	337.69	336.00	336.29
RD.0+600	337.32	335.90	336.19
RD.0+650	336.28	335.80	336.09
RD.0+700	336.93	335.70	335.99
RD.0+750	337.16	335.60	335.89
		334.10	334.39
RD.0+800	337.47	334.00	334.29
RD.0+850	337.01	333.90	334.19
RD.0+900	336.91	333.80	334.09
RD.0+950	336.80	333.70	333.99
RD.1+000	336.91	333.60	333.89
RD.1+050	337.20	333.50	333.79

LONGITUDINAL PROFILE

0 5 10 15 20 25 m
VERTICAL SCALE

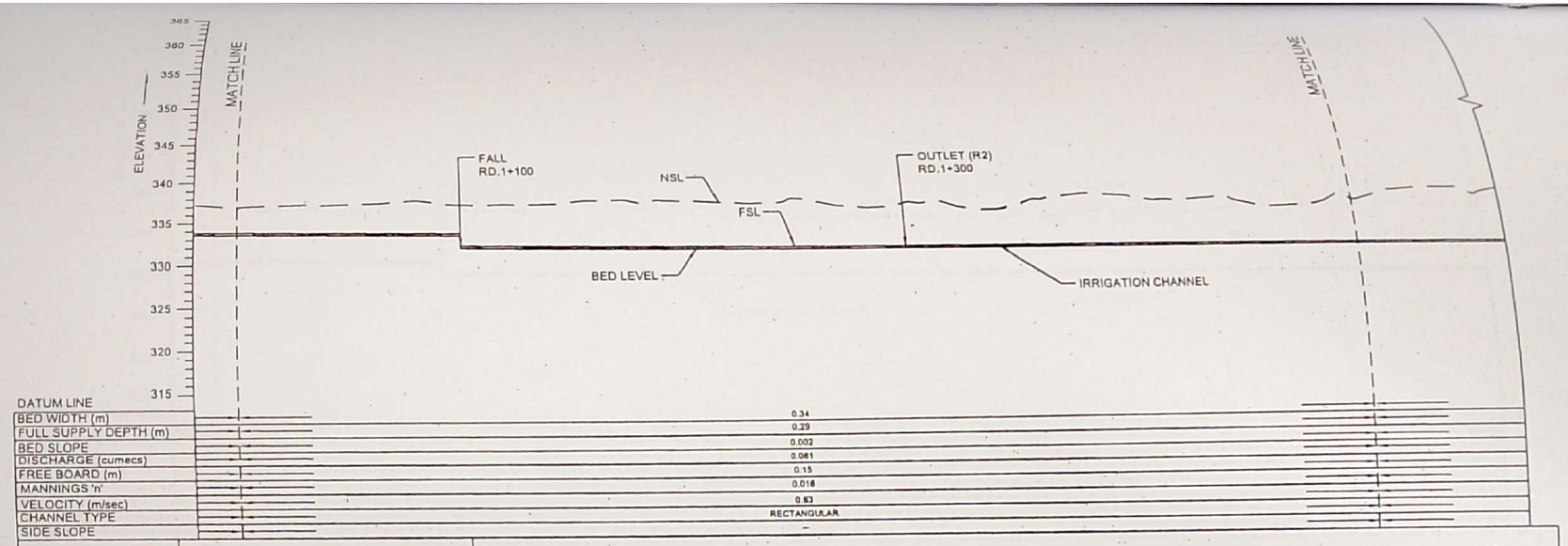
0 25 50 75 100 m
HORIZONTAL SCALE

SHEET 02 OF 06

NOTES:

1. ALL DIMENSIONS ARE IN METRIC SYSTEM UNLESS OTHERWISE NOTED.
2. ALL ELEVATIONS ARE IN METERS UNLESS OTHERWISE NOTED.

Client:-	Consultants:-	Project:-	Job:-	DRAWING NO :-
Directorate General Small Dams Irrigation Department Govt: of KPK Peshawar	Consulting Associates Peshawar	Detail Design & Construction Supervision of Package - F (Shah Kaleem Dam)	IRRIGATION CHANNEL PROFILE RD.0+500 TO RD.1+000	SKD-IS-03



FULL SUPPLAY LEVEL (m)	333.89	333.79	332.19 332.09	332.09	331.99	331.89	331.79	331.69	331.59	331.49	331.39	331.29
BED LEVEL (m)	333.60	333.50	333.40 331.90	331.80	331.70	331.60	331.50	331.40	331.30	331.20	331.10	331.00
NATURAL SURFACE LEVEL (m)	336.91	337.20	337.06	337.30	337.32	337.50	336.68	336.14	337.18	336.28	336.30	337.30
REDUCE DISTANCE (m)	RD.1+000	RD.1+050	RD.1+100	RD.1+150	RD.1+200	RD.1+250	RD.1+300	RD.1+350	RD.1+400	RD.1+450	RD.1+500	RD.1+550

LONGITUDINAL PROFILE

NOTES:

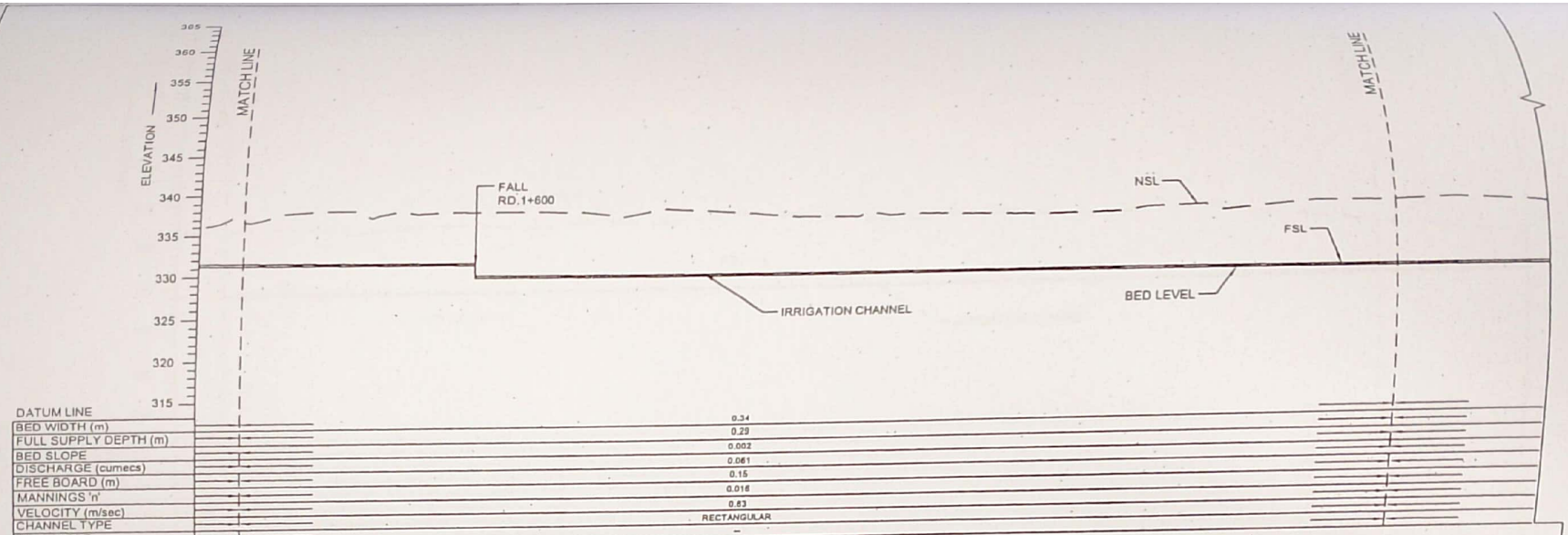
1. ALL DIMENSIONS ARE IN METRIC SYSTEM UNLESS OTHERWISE NOTED.
2. ALL ELEVATIONS ARE IN METERS UNLESS OTHERWISE NOTED.

0 5 10 15 20 25 m
VERTICAL SCALE

0 25 50 75 100 m
HORIZONTAL SCALE

SHEET 03 OF 06

Client:–	Consultants:–	Project:–	Job:–	DRAWING NO :–
Directorate General Small Dams Irrigation Department Govt: of KPK Peshawar	Consulting Associates Peshawar	Detail Design & Construction Supervision of Package – F (Shah Kaleem Dam)	IRRIGATION CHANNEL PROFILE RD.1+000 TO RD.1+500	SKD–IS–04



REDUCE DISTANCE (m)	FULL SUPPLAY LEVEL (m)	BED LEVEL (m)	NATURAL SURFACE LEVEL (m)
RD.1+500	331.39	331.10	336.30
RD.1+550	331.29	331.00	337.30
RD.1+600	331.19 / 329.69	330.90 / 329.40	337.31
RD.1+650	329.59	329.30	337.01
RD.1+700	329.49	329.20	337.09
RD.1+750	329.39	329.10	335.91
RD.1+800	329.29	329.00	335.97
RD.1+850	329.19	328.90	335.63
RD.1+900	329.09	328.80	336.22
RD.1+950	328.99	328.70	336.18
RD.2+000	328.89	328.60	336.37
RD.2+050	328.79	328.50	336.17

LONGITUDINAL PROFILE

NOTES:

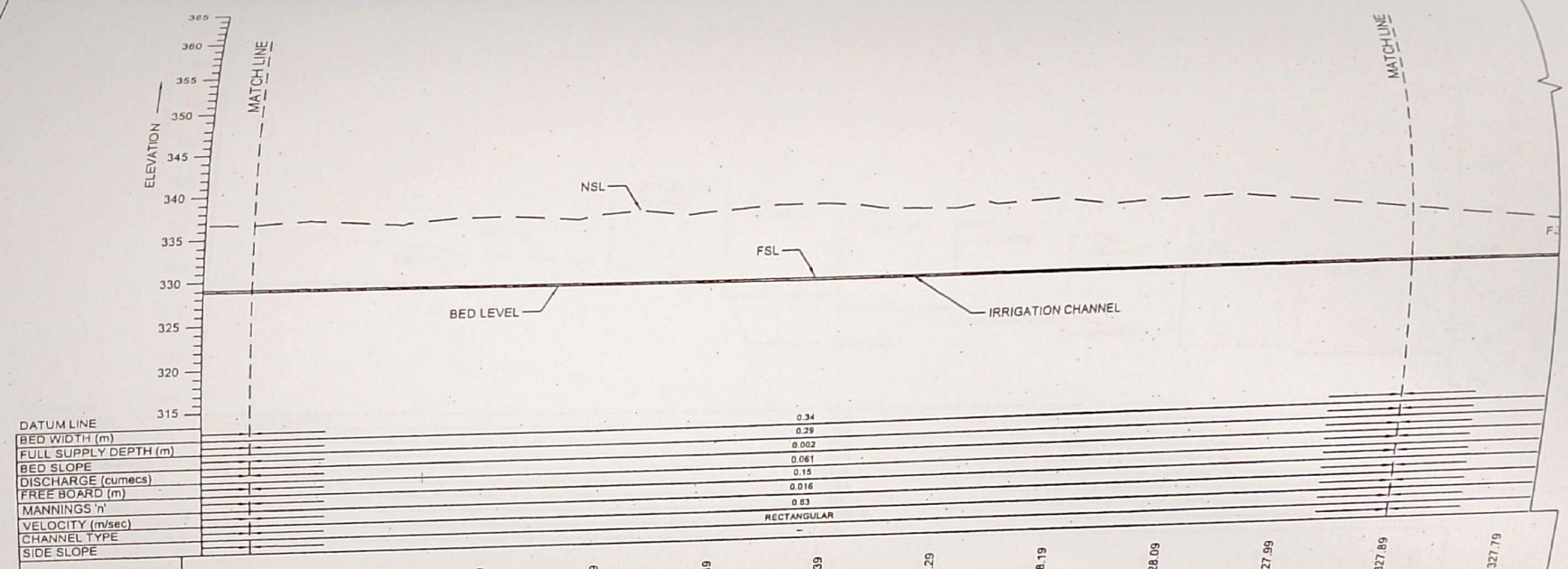
1. ALL DIMENSIONS ARE IN METRIC SYSTEM UNLESS OTHERWISE NOTED.
2. ALL ELEVATIONS ARE IN METERS UNLESS OTHERWISE NOTED.

0 5 10 15 20 25 m
VERTICAL SCALE

0 25 50 75 100 m
HORIZONTAL SCALE

SHEET 04 OF 06

Client:–	Consultants:–	Project:–	Job:–	DRAWING NO :–
Directorate General Small Dams Irrigation Department Govt: of KPK Peshawar	Consulting Associates Peshawar	Detail Design & Construction Supervision of Package – F (Shah Kaleem Dam)	IRRIGATION CHANNEL PROFILE RD.1+500 TO RD.2+000	SKD–IS–05



DATUM LINE	
BED WIDTH (m)	0.34
FULL SUPPLY DEPTH (m)	0.29
BED SLOPE	0.002
DISCHARGE (cumecs)	0.061
FREE BOARD (m)	0.15
MANNINGS 'n'	0.016
VELOCITY (m/sec)	0.83
CHANNEL TYPE	RECTANGULAR
SIDE SLOPE	–

REDUCE DISTANCE (m)	NATURAL SURFACE LEVEL (m)	BED LEVEL (m)	FULL SUPPLAY LEVEL (m)
RD.2+000	336.37	328.60	328.89
RD.2+050	336.17	328.50	328.79
RD.2+100	336.53	328.40	328.69
RD.2+150	336.50	328.30	328.59
RD.2+200	336.50	328.20	328.49
RD.2+250	336.88	328.10	328.39
RD.2+300	335.88	328.00	328.29
RD.2+350	336.44	327.90	328.19
RD.2+400	336.03	327.80	328.09
RD.2+450	335.49	327.70	327.99
RD.2+500	333.97	327.60	327.89
RD.2+550	332.46	327.50	327.79

LONGITUDINAL PROFILE

NOTES:

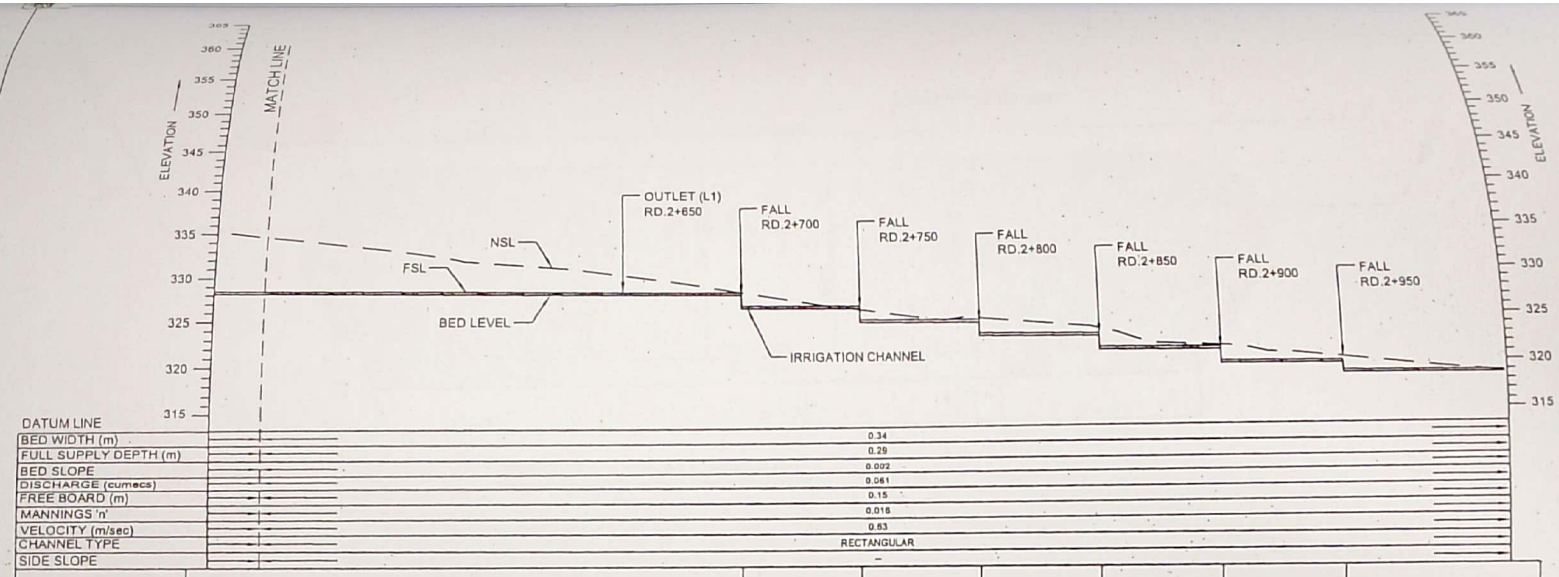
1. ALL DIMENSIONS ARE IN METRIC SYSTEM UNLESS OTHERWISE NOTED.
2. ALL ELEVATIONS ARE IN METERS UNLESS OTHERWISE NOTED.

0 5 10 15 20 25 m
VERTICAL SCALE

0 25 50 75 100 m
HORIZONTAL SCALE

SHEET 05 OF 06

Client:–	Consultants:–	Project:–	Job:–	DRAWING NO :–
Directorate General Small Dams Irrigation Department Govt: of KPK Peshawar	Consulting Associates Peshawar	Detail Design & Construction Supervision of Package – F (Shah Kaleem Dam)	IRRIGATION CHANNEL PROFILE RD.2+000 TO RD.2+500	SKD–IS–06



FULL SUPPLAY LEVEL (m)	327.89	327.79	327.69	327.59	327.49	325.99	325.89	324.39	324.29	322.79	322.69	321.19	321.09	319.19	319.49	318.49	318.39	318.36
BED LEVEL (m)	327.60	327.50	327.40	327.30	327.20	325.70	325.60	324.10	324.00	322.50	322.40	320.90	320.80	319.30	319.20	318.20	318.10	318.07
NATURAL SURFACE LEVEL (m)	333.97	332.46	330.74	329.40	327.41		325.41		324.36		323.10		321.14		319.77		318.50	318.13
REDUCE DISTANCE (m)	RD.2+500	RD.2+550	RD.2+600	RD.2+650	RD.2+700		RD.2+750		RD.2+800		RD.2+850		RD.2+900		RD.2+950		RD.3+000	RD.3+016

LONGITUDINAL PROFILE

NOTES:

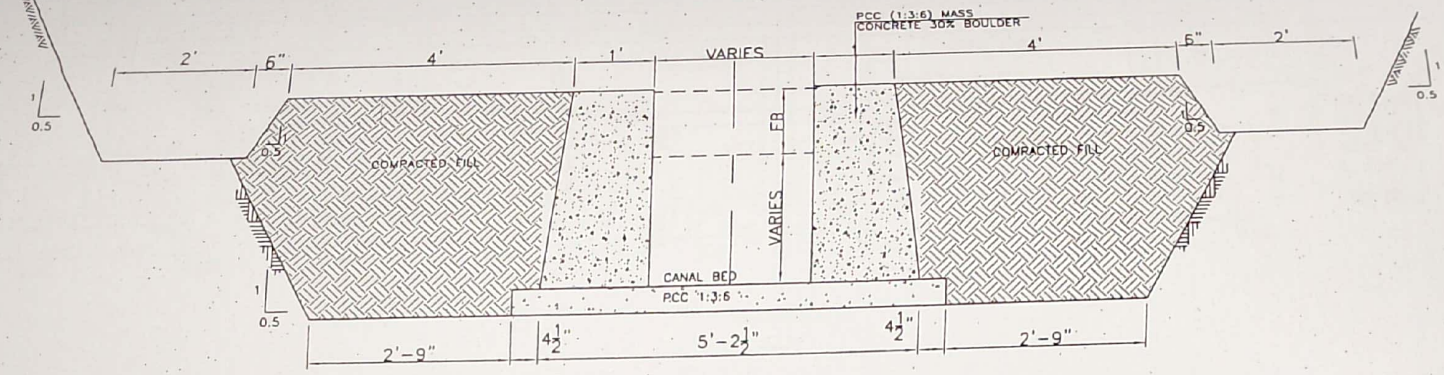
1. ALL DIMENSIONS ARE IN METRIC SYSTEM UNLESS OTHERWISE NOTED.
2. ALL ELEVATIONS ARE IN METERS UNLESS OTHERWISE NOTED.

0 5 10 15 20 25 m
VERTICAL SCALE

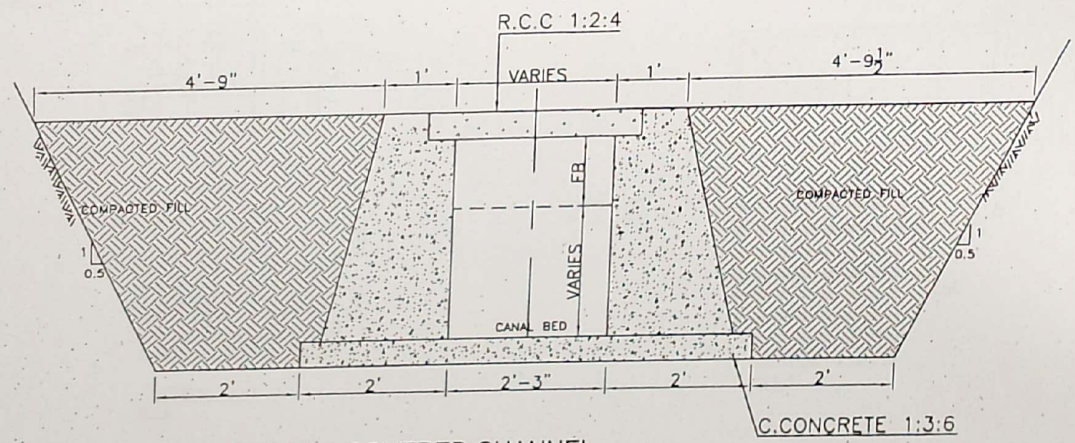
0 25 50 75 100 m
HORIZONTAL SCALE

SHEET 06 OF 06

Client:-	Consultants:-	Project:-	Job:-	DRAWING NO :-
Directorate General Small Dams Irrigation Department Govt: of KPK Peshawar	Consulting Associates Peshawar	Detail Design & Construction Supervision of Package - F (Shah Kaleem Dam)	IRRIGATION CHANNEL PROFILE RD.2+500 TO RD.3+016	SKD-IS-07



TYPICAL OPEN CHANNEL

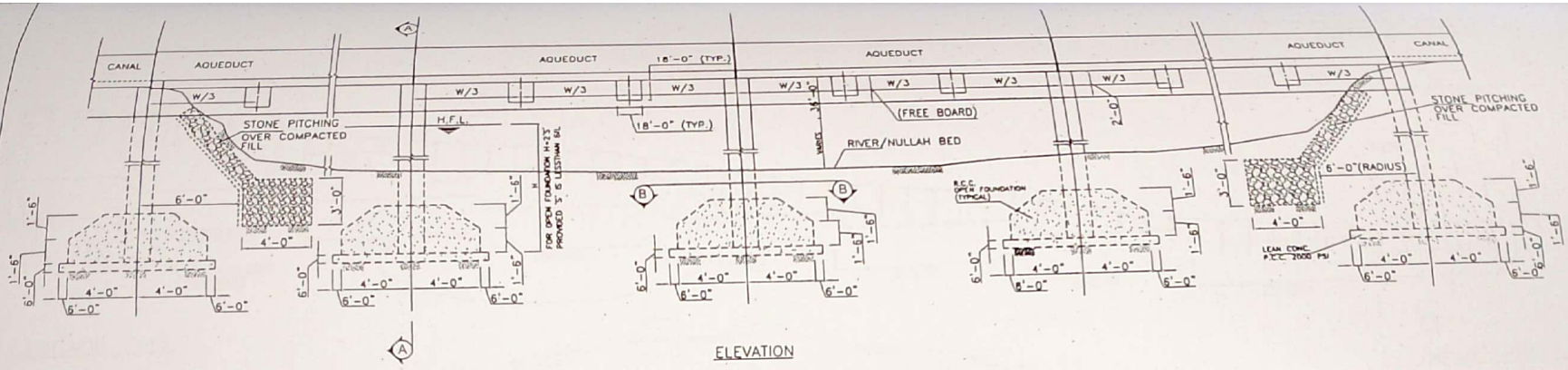


TYPICAL COVERED CHANNEL

NOTE:

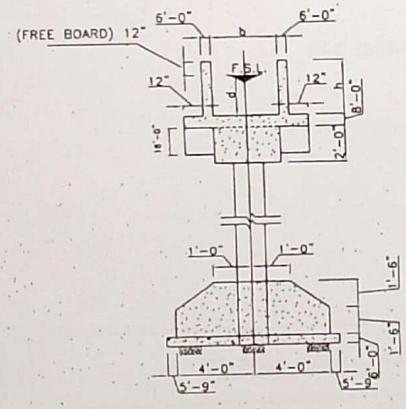
1. ALL DIMENSIONS AND LEVELS ARE IN FEET.

Client:-	Consultants:-	Project:-	Job:-	DRAWING NO :-
Directorate General Small Dams Irrigation Department Govt: of KPK Peshawar	Consulting Associates Peshawar	Detail Design & Construction Supervision of Package - F (Shah Kaleem Dam)	SHAH KALEEM DAM TYP. X-SECTIONS DETAILS	SKD-IS-08



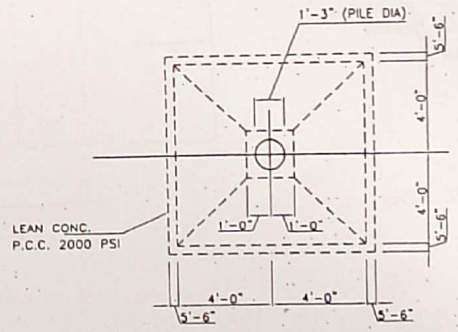
ELEVATION

N.T.S



SECTION A-A

N.T.S



SECTION B-B

N.T.S

NOTES

1:- THIS DRAWING IS NOT FOR CONSTRUCTION.

2:- THIS DRAWING COMBINES TWO TYPES OF FOUNDATIONS. OPEN OR PILE. USE OF ONE OF THE TWO WILL DEPEND ON THE SITE CONDITIONS e.g. RIVER / NULLAH DISCHARGE, SUB-SOIL STRATA, NO. OF FLOW CREEKS UNDER HIGH FLOOD AND "SCOUR" FOR EACH CREEK.

3:- EXCEPT PILES WHOLE STRUCTURE WILL CONSIST OF R.C.C HAVING CONCRETE OF 3,000 psi STRENGTH (CYLINDRICAL).FOR PILES THE CONCRETE STRENGTH WILL BE 4000 P.S.I

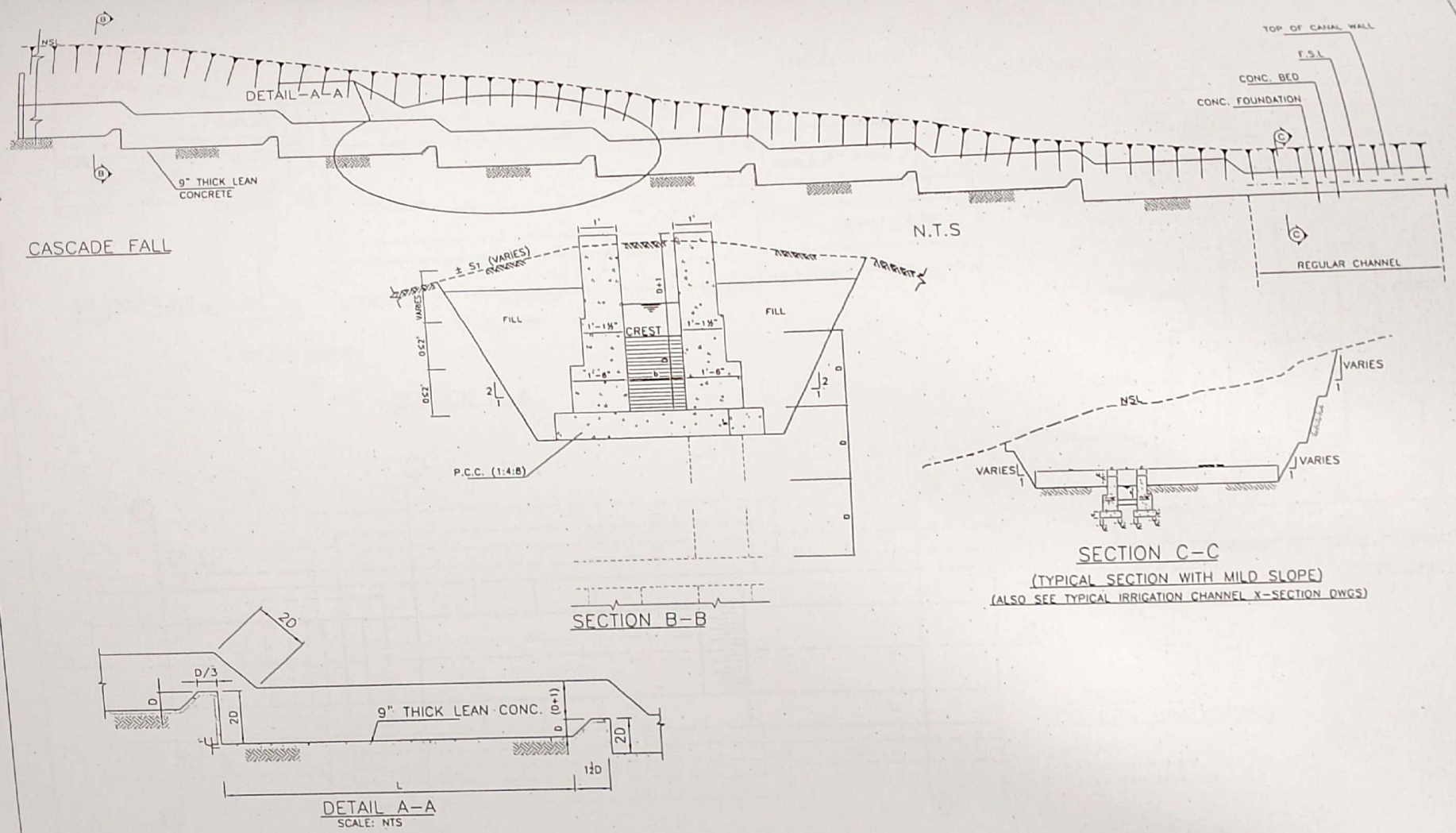
4:- AQUEDUCT LONGITUDINAL SLOPE WILL BE THE SAME AS FOR THE CANAL.

5:- MORE DETAILS WILL BE PROVIDED AT DETAILED DESIGN STAGE.

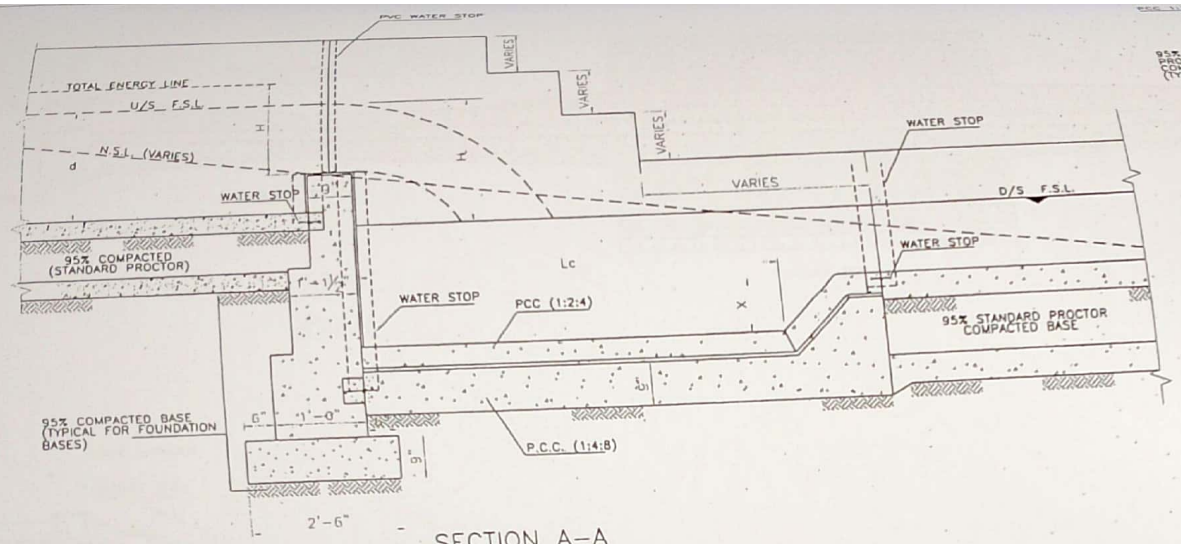
6:- ALL EARTH FILL SHALL BE COMPACTED TO 95% OF STANDARD PROCTOR DRY DENSITY.

Client:-	Consultants:-	Project:-	Job:-	DRAWING NO :-
Directorate General Small Dams Irrigation Department Govt: of KPK Peshawar	Consulting Associates Peshawar	Detail Design & Construction Supervision of Package - F (Shah Kaleem Dam)	SHAH KALEEM DAM TYPICAL AQUEDUCT DETAIL	SKD-IS-09

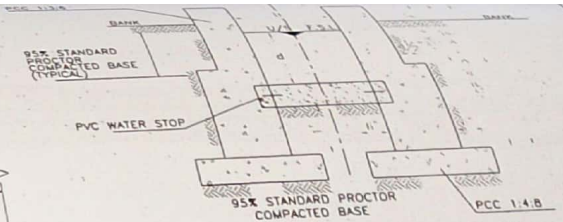
NOTES:
1. THIS DRAWING IS FOR DESIGN AND CLEARANCE
2. ALL DIMENSIONS ARE IN FEET AND INCHES
3. THIS DRAWING IS NOT TO SCALE
4. S = TRANSVERSE SLOPE OF TERRAIN



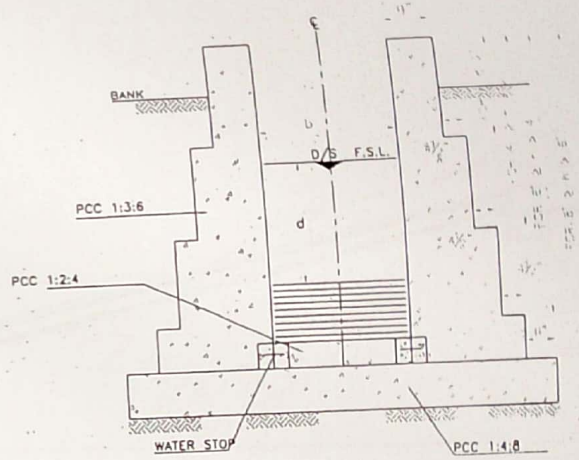
Client:-	Consultants:-	Project:-	Job:-	DRAWING NO :-
Directorate General Small Dams Irrigation Department Govt: of KPK Peshawar	Consulting Associates Peshawar	Detail Design & Construction Supervision of Package - F (Shah Kaleem Dam)	SHAH KALEEM DAM CASCADE FALL	SKD-IS-10



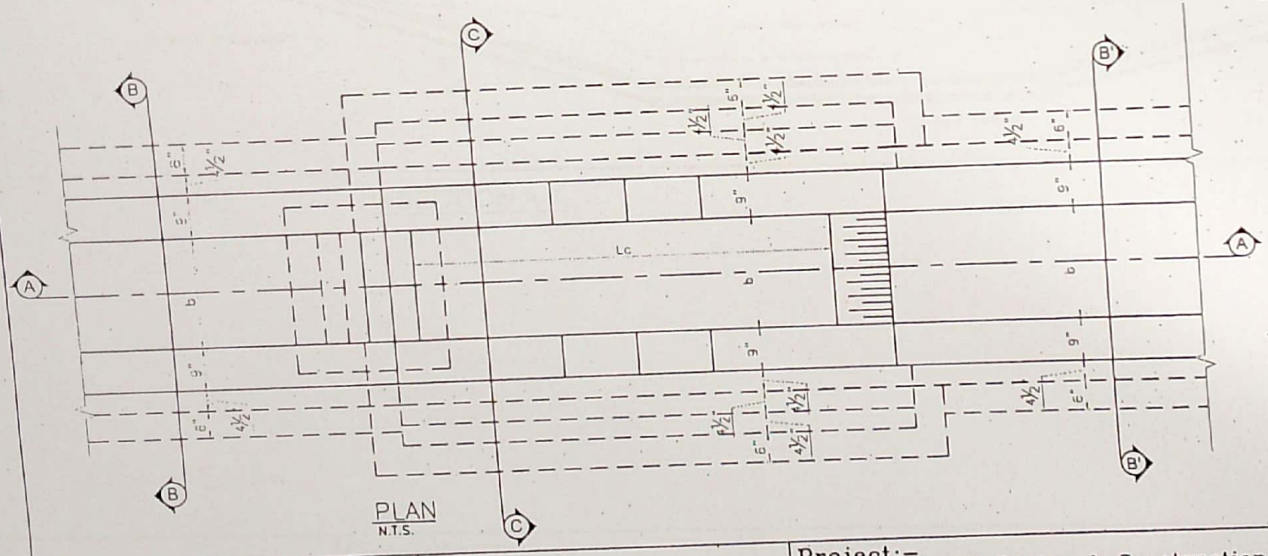
SECTION A–A
N.T.S.



SECTION B–B & B'–B'
N.T.S.



SECTION C–C
N.T.S.



PLAN
N.T.S.

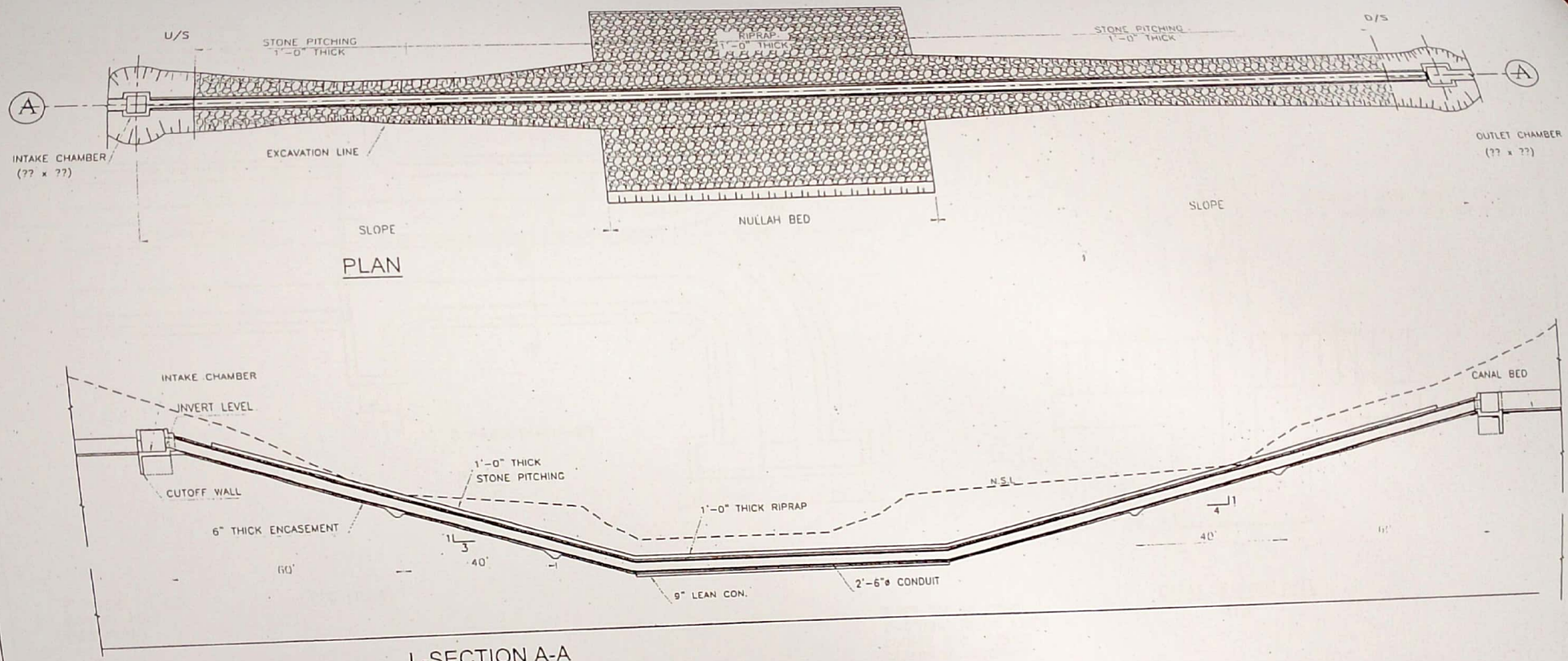
FORMULA FOR CISTERN DIMENSIONS

$L_c = 5\sqrt{H.H_t}$

$X = 0.168\,(H.H_t)^{3/2}$ WHERE

L_c, X, H & H_t ARE IN FEET.

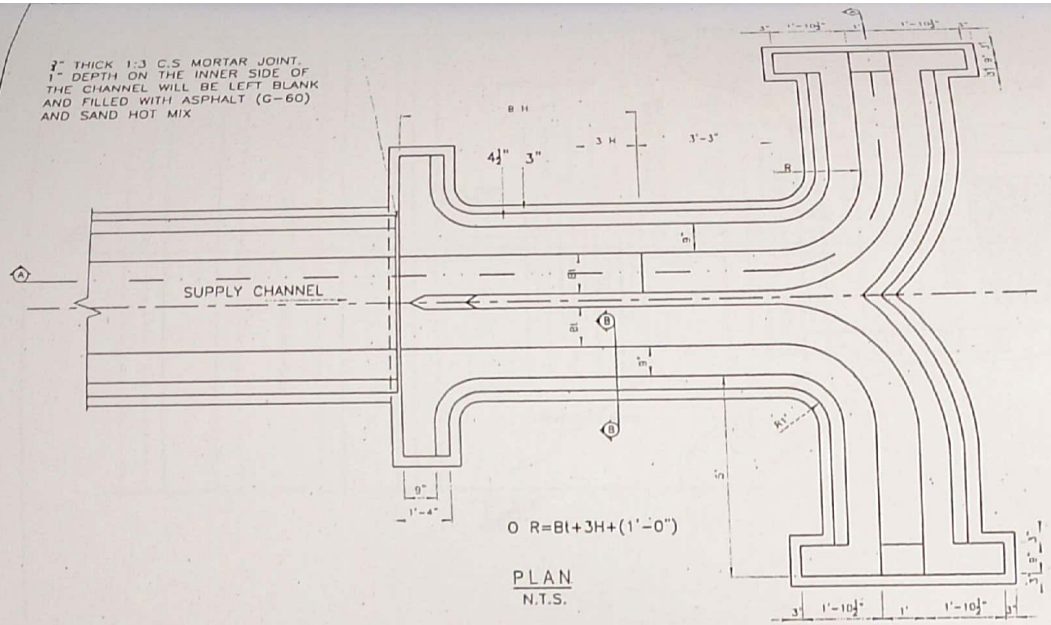
Client:–	Consultants:–	Project:–	Job:–	DRAWING NO :–
Directorate General Small Dams Irrigation Department Govt: of KPK Peshawar	Consulting Associates Peshawar	Detail Design & Construction Supervision of Package – F (Shah Kaleem Dam)	SHAH KALEEM DAM TYPICAL DROP FALL	SKD-IS-11



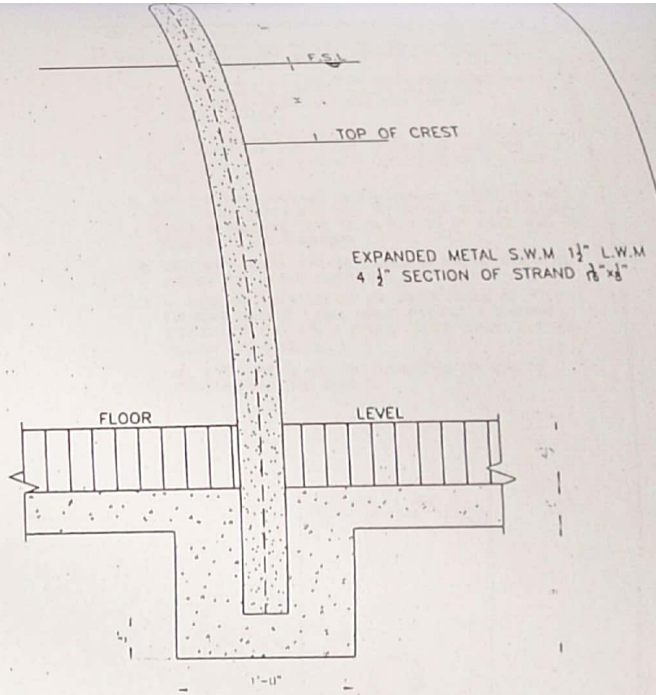
NOTES

1. ALL DIMENSIONS AND LEVELS ARE IN FEET

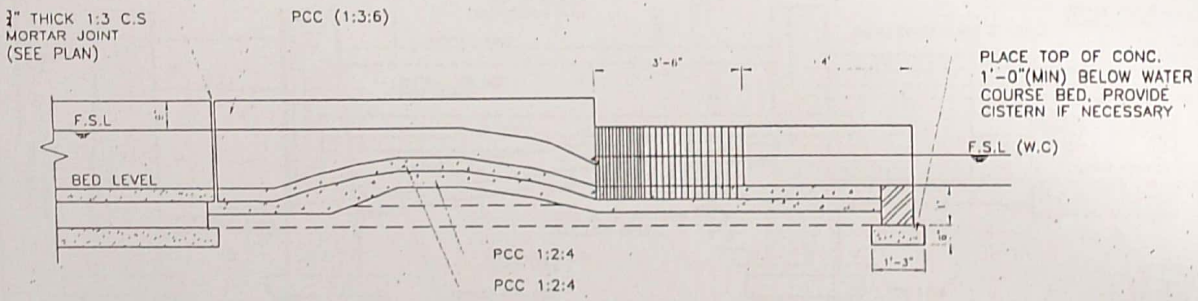
Client:-	Consultants:-	Project:-	Job:-	DRAWING NO :-
Directorate General Small Dams Irrigation Department	Consulting Associates Peshawar	Detail Design & Construction Supervision of Package - F (Shah Kaleem Dam)	SHAH KALEEM DAM SYPHON PLAN & SECTION	SKD-IS-12



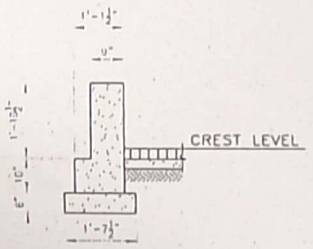
PLAN
N.T.S.



DETAIL OF DIVIDE WALL
N.T.S.

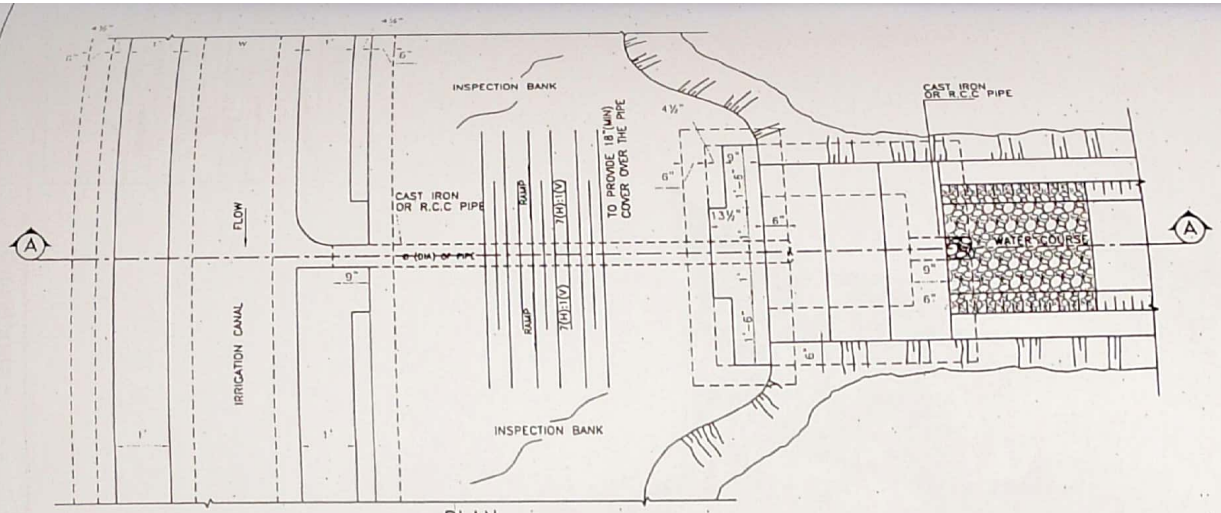


SECTION A-A
N.T.S.



SECTION B-B
N.T.S.

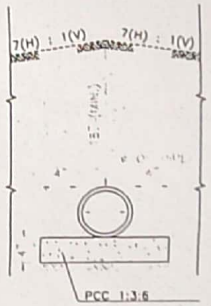
Client:-	Consultants:-	Project:-	Job:-	DRAWING NO :-
Directorate General Small Dams Irrigation Department Govt: of KPK Peshawar	Consulting Associates Peshawar	Detail Design & Construction Supervision of Package - F (Shah Kaleem Dam)	SHAH KALEEM DAM TYPICAL TAIL CLUSTER WITH TWO OUTLETS	SKD-IS-13



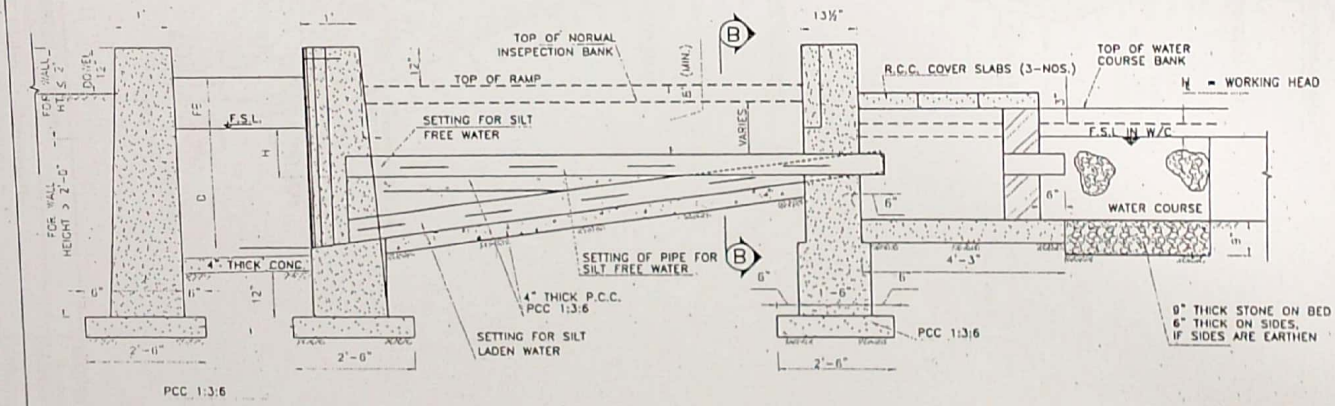
PLAN
N.T.S.

NOTES:

1. PIPE USED FOR THE OUTLET WILL BE OF CAST IRON, R.C.C. OR G.I. PIPE.
2. IF THE COVER OVER THE PIPE IS LESS THAN 18", A RAMP WITH 7(H) : 1(V) SLOPE WILL BE PROVIDED TO MAKE THE COVER 18" AS SHOWN.
3. PIPE OUTLETS WILL BE USED FOR DISCHARGES LESS THEN 1.0 CUSEC. HOWEVER, AT THE DISCRETION OF THE ENGINEER, THESE COULD BE USED FOR LARGER DISCHARGES AS WELL.
4. FOR SILT FREE WATER 'H' ≃ 10" AND 'H' ≃ D, FOR SILT LADEN WATER. HOWEVER EXACT SETTING OF THE PIPE WILL BE DECIDED BY THE ENGINEER DEPENDING ON THE SITE CONDITIONS.
5. THIS DRAWING COMBINES TWO DRAWINGS, 1 FOR THE SILT FREE CANAL WATER AND THE OTHER FOR THE SILT LADEN CANAL WATER. THE TYPE OF OUTLET TO BE USED WILL BE DECIDED BY THE ENGINEER.
6. MASONARY DOWEL WILL BE RAISED AT OUTLET SITES TO ASSURE 12" HEIGHT ABOVE THE RAMP TOP.
7. IN CASE OF INTERFERENCE OF INNER EDGES OF P.C.C. FOUNDATIONS FOR CANAL WALLS PROVIDE A COMMON FOUNDATION FOR THE 2 WALLS. OUTER PROJECTION WILL REMAIN THE SAME i.e. 6".
8. ALL EARTH WORK WILL BE COMPACTED TO 95% OF STANDARD PROCTOR DENSITY.

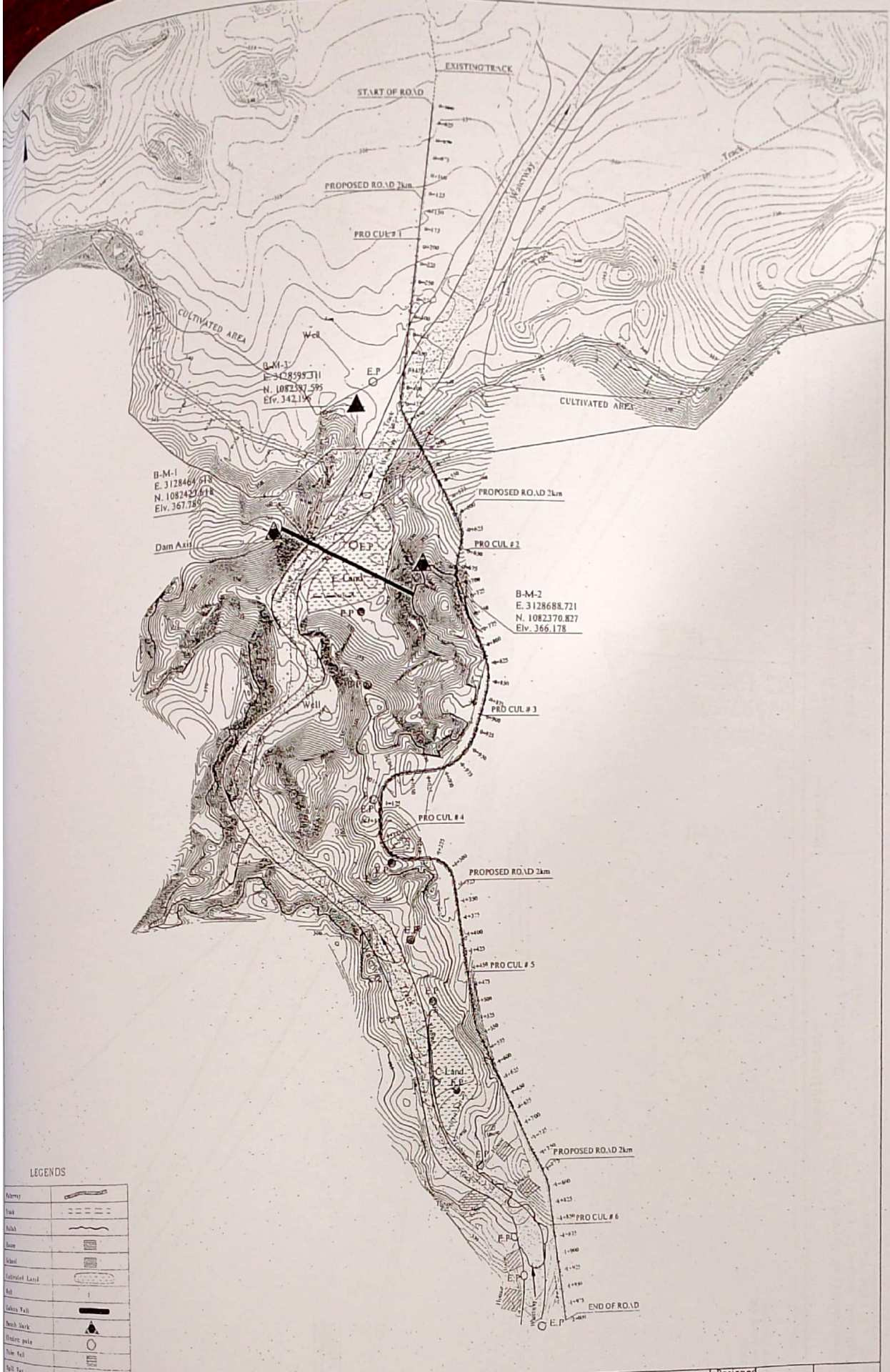


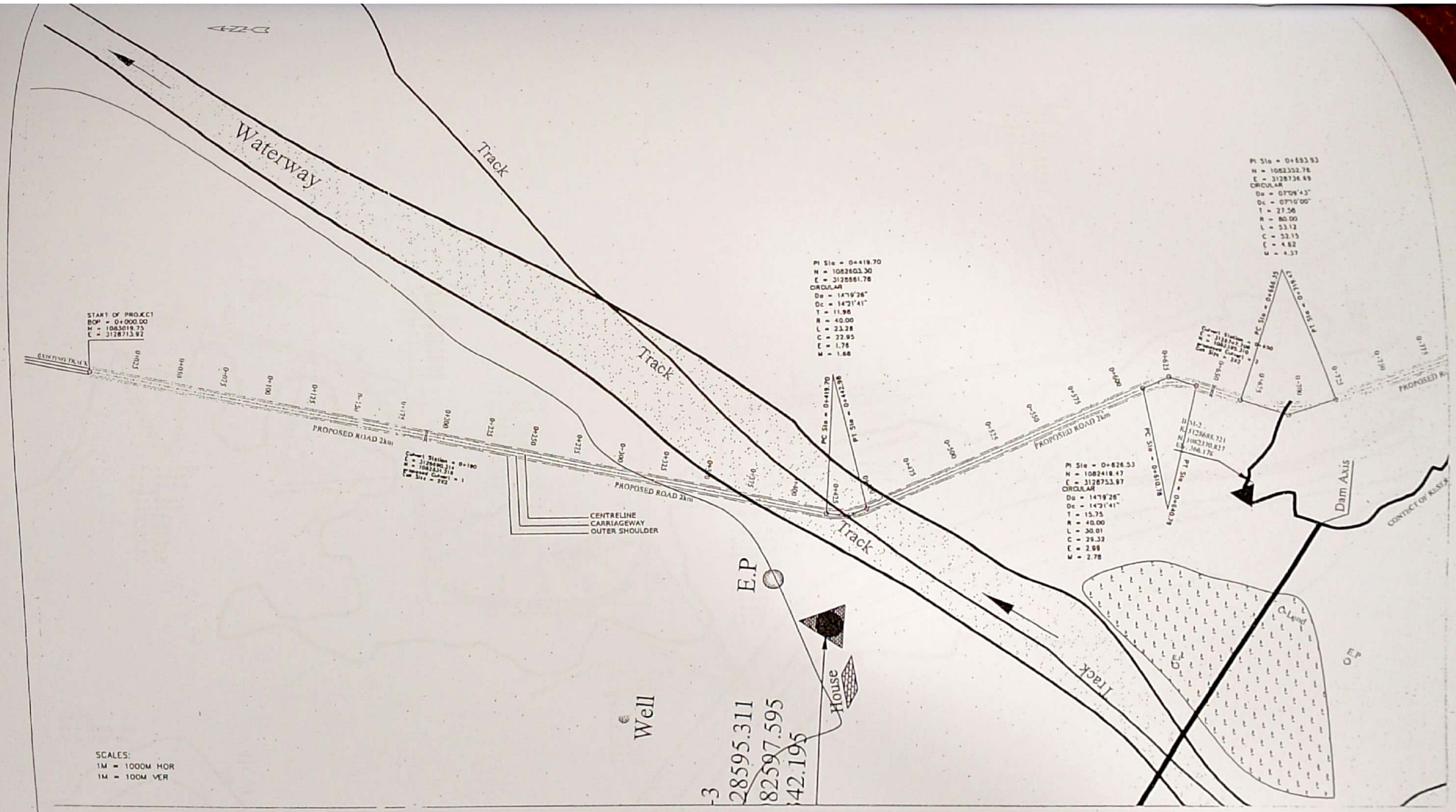
SECTION B-B



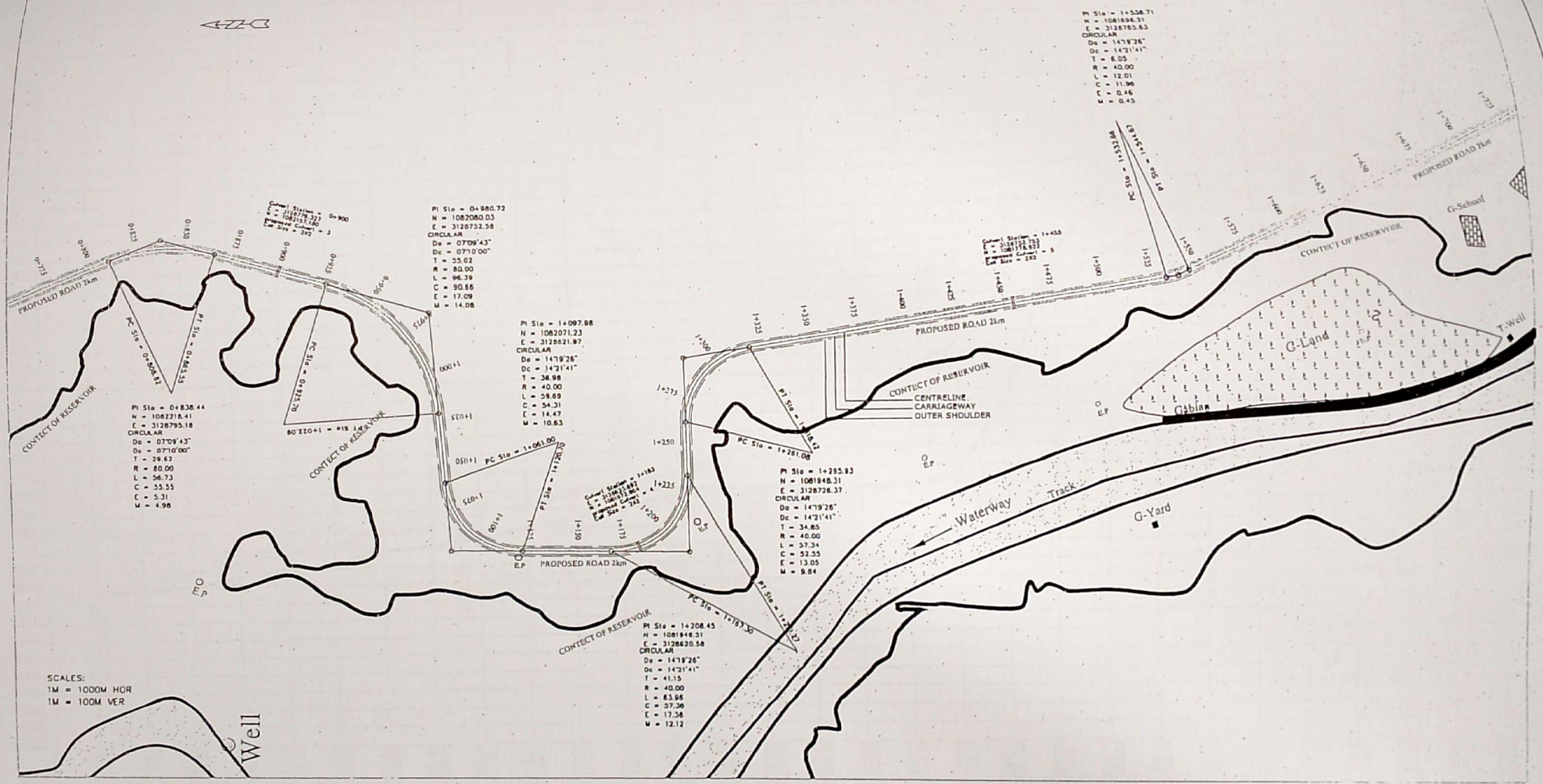
SECTION A-A
N.T.S.

Client:-	Consultants:-	Project:-	Job:-	DRAWING NO :-
Directorate General Small Dams Irrigation Department Govt: of KPK Peshawar	Consulting Associates Peshawar	Detail Design & Construction Supervision of Package - F (Shah Kaleem Dam)	SHAH KALEEM DAM TYPICAL PIPE OUTLET AND IRRIGATION CANAL X-SECTION DETAIL	SKD-IS-14

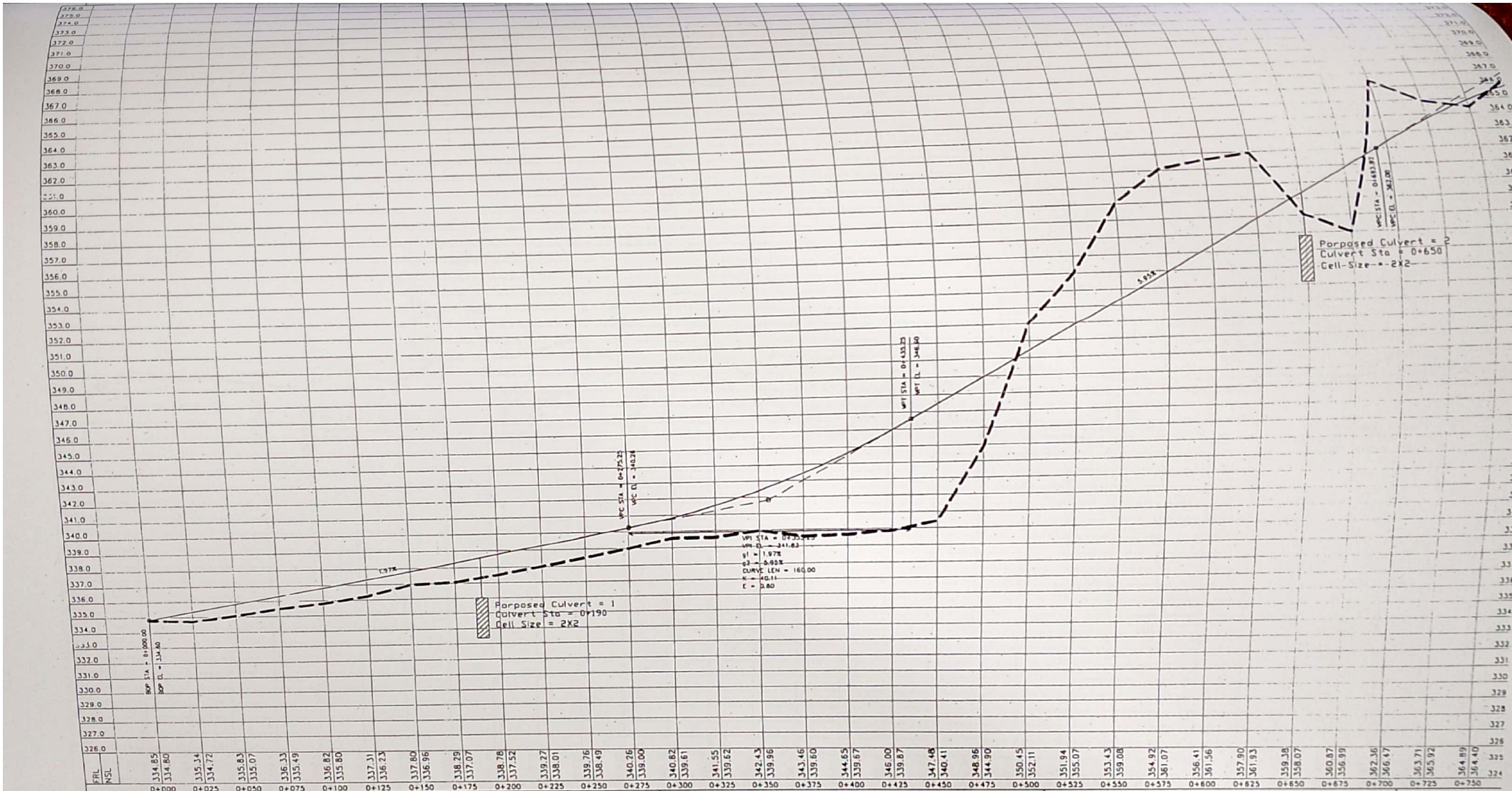

EXISTING TRACK
START OF ROAD
PROPOSED ROAD 2km
PRO CUL # 1
CULTIVATED AREA
Well
B-M-3
E. 3128595.311
N. 1082387.595
Elv. 342.196
E.P
CULTIVATED AREA
B-M-1
E. 3128464.618
N. 1082427.618
Elv. 367.789
PROPOSED ROAD 2km
Dam Axis
PRO CUL # 2
E. Land
B-M-2
E. 3128688.721
N. 1082370.827
Elv. 366.178
Well
PRO CUL # 3
PRO CUL # 4
PROPOSED ROAD 2km
PRO CUL # 5
E. Land
PROPOSED ROAD 2km
PRO CUL # 6
END OF ROAD
LEGENDS
Client:-
Directorate General Small Dams
Irrigation Department
Govt. of KPK Peshawar
Consultants:-
Consulting Associates
Peshawar
TENDER DRAWINGS
Project:- Detail Design & Construction
Supervision of Package - F
Topographic PLAN of Shah Kaleem Dam ROAD(2KM)
Designed. Muhammad Bilal
Checked. Shakeel Ahmad
APPROVED: Farid Khan Wazir
DRAWING NO:-
SKD-R-01



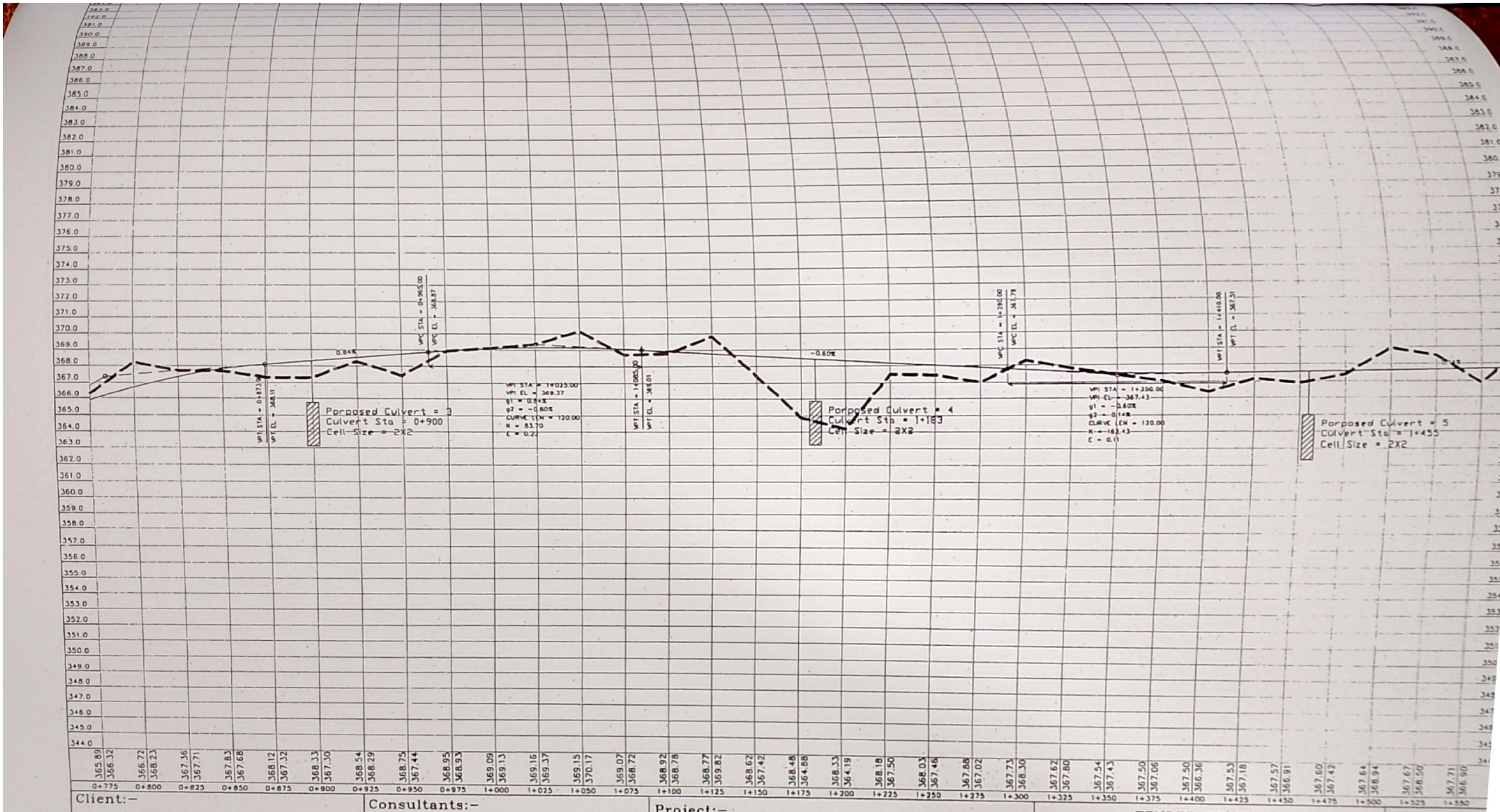
Client:–	Consultants:–	Project:–	TENDER DRAWINGS	DRAWING NO :–
Directorate General Small Dams Irrigation Department Govt: of KPK Peshawar	Consulting Associates Peshawar	Detail Design & Construction Supervision of Package – F (Shah Kaleem Dam 2km Road)	Job:– ROAD PLAN	SXD-R-03



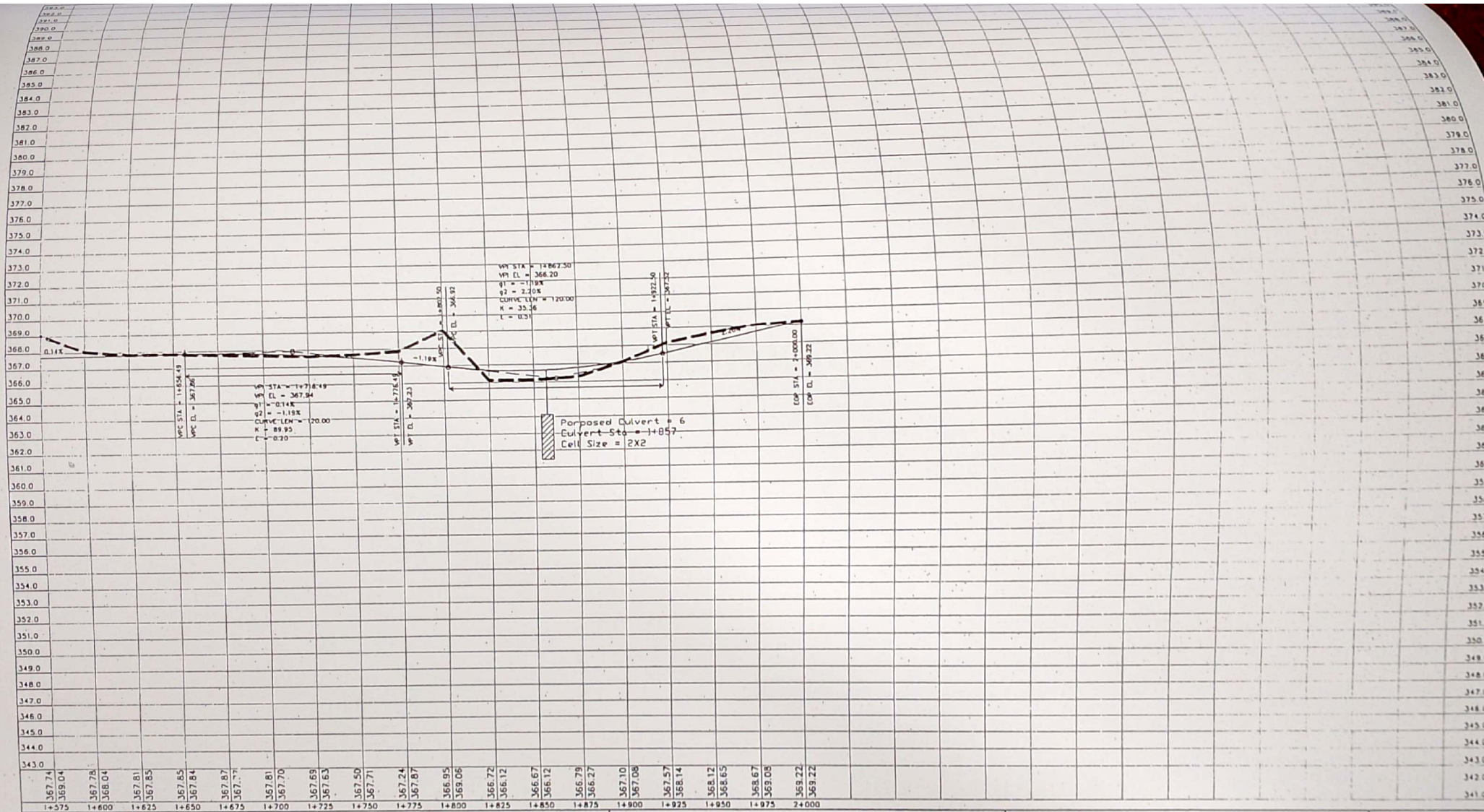
Client:–	Consultants:–	Project:–	TENDER DRAWINGS	DRAWING NO :–
Directorate General Small Dams Irrigation Department Govt: of KPK Peshawar	Consulting Associates Peshawar	Detail Design & Construction Supervision of Package – F (Shah Kaleem Dam 2km Road)	Job:– ROAD PLAN	SKD-R-04



Client:–	Consultants:–	Project:–		
Directorate General Small Dams Irrigation Department Govt: of KPK Peshawar	Consulting Associates Peshawar	Detail Design & Construction Supervision of Package – F (Shah Kaleem Dam 2km Road)	TENDER DRAWINGS Job:– ROAD PROFILE	DRAWING NO :– SKD-R-05

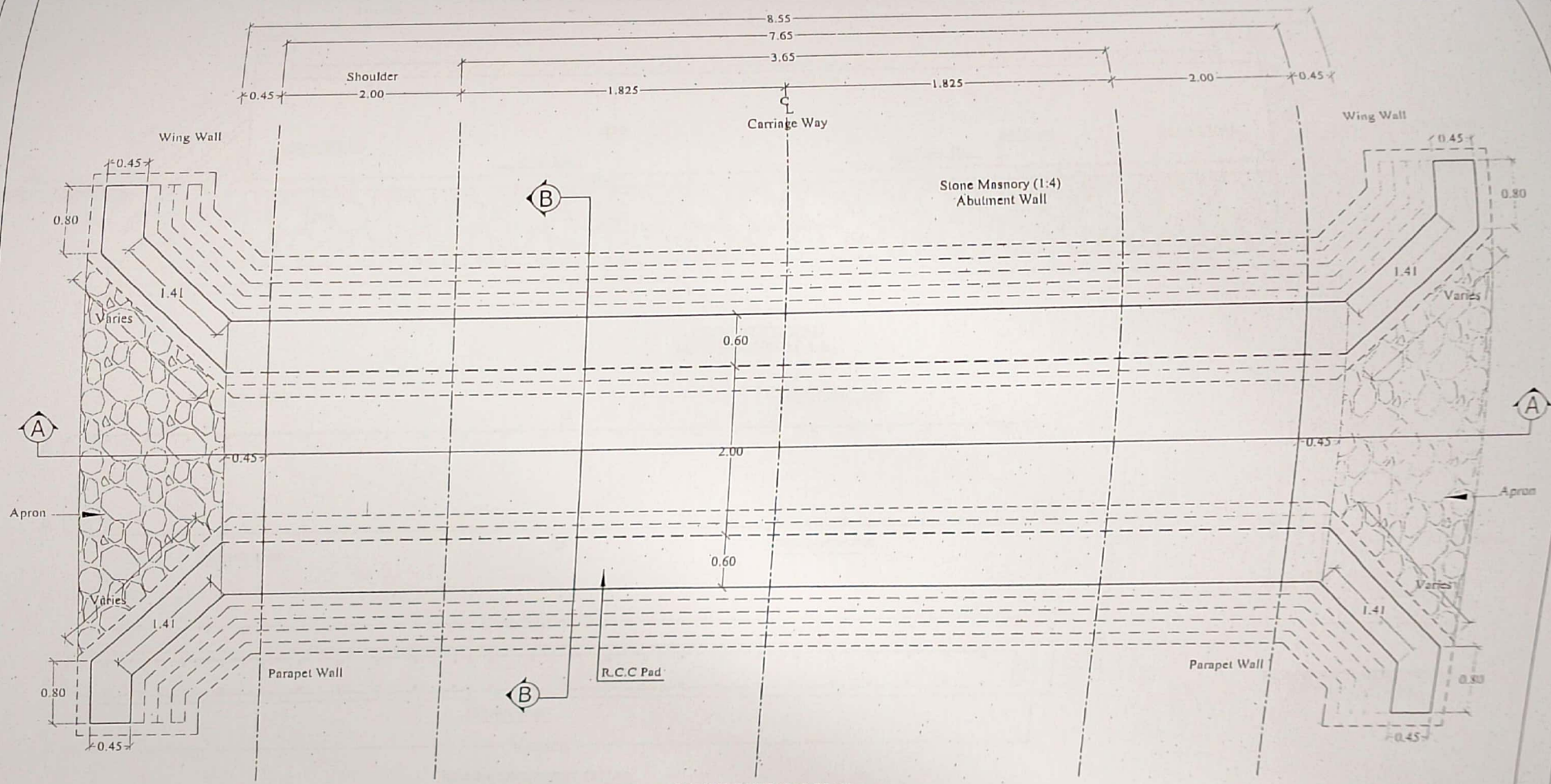


Client:– Directorate General Small Dams Irrigation Department Govt: of KPK Peshawar	Consultants:– Consulting Associates Peshawar	Project:– Detail Design & Construction Supervision of Package – F (Shah Kaleem Dam 2km Road)	TENDER DRAWINGS
		Job:– ROAD PROFILE	DRAWING NO :– SKD-R-06



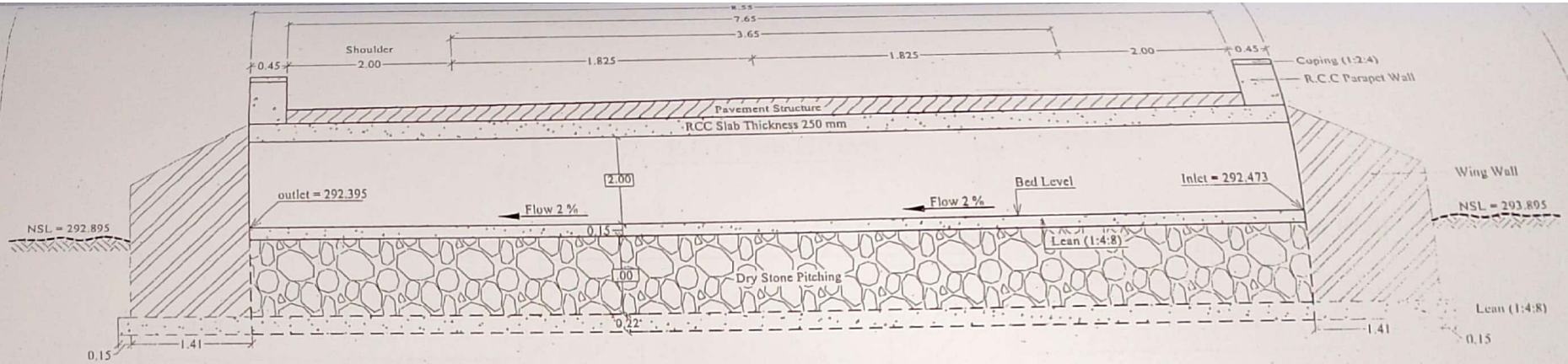
Client:-	Consultants:-	Project:-	TENDER DRAWINGS	DRAWING NO :-
Directorate General Small Dams Irrigation Department Govt: of KPK Peshawar	Consulting Associates Peshawar	Detail Design & Construction Supervision of Package - F (Shah Kaleem Dam 2km Road)	Job:- ROAD PROFILE	SKD-R-07

ROAD STRUCTURES

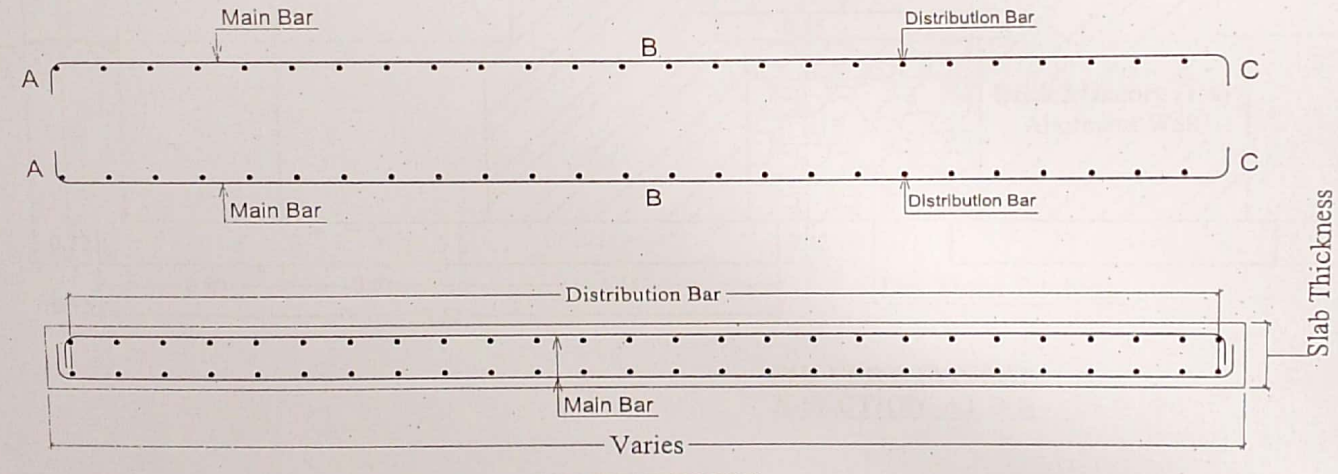


CULVERT TYPICAL PLAN

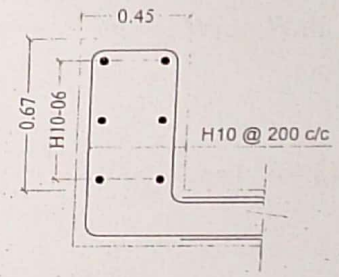
Client:- Directorate General Small Dams Irrigation Department Govt: of KPK Peshawar	Consultants:- Consulting Associates Peshawar	Project:- Detail Design & Construction Supervision of Package - F (Shah Kaleem Dam 2km Road)	TENDER DRAWINGS Job:- TYPICAL PLAN OF CULVERT	DRAWING NO:- SKD-RS-01



CULVERT TYPICAL
LONG SECTION AT A-A

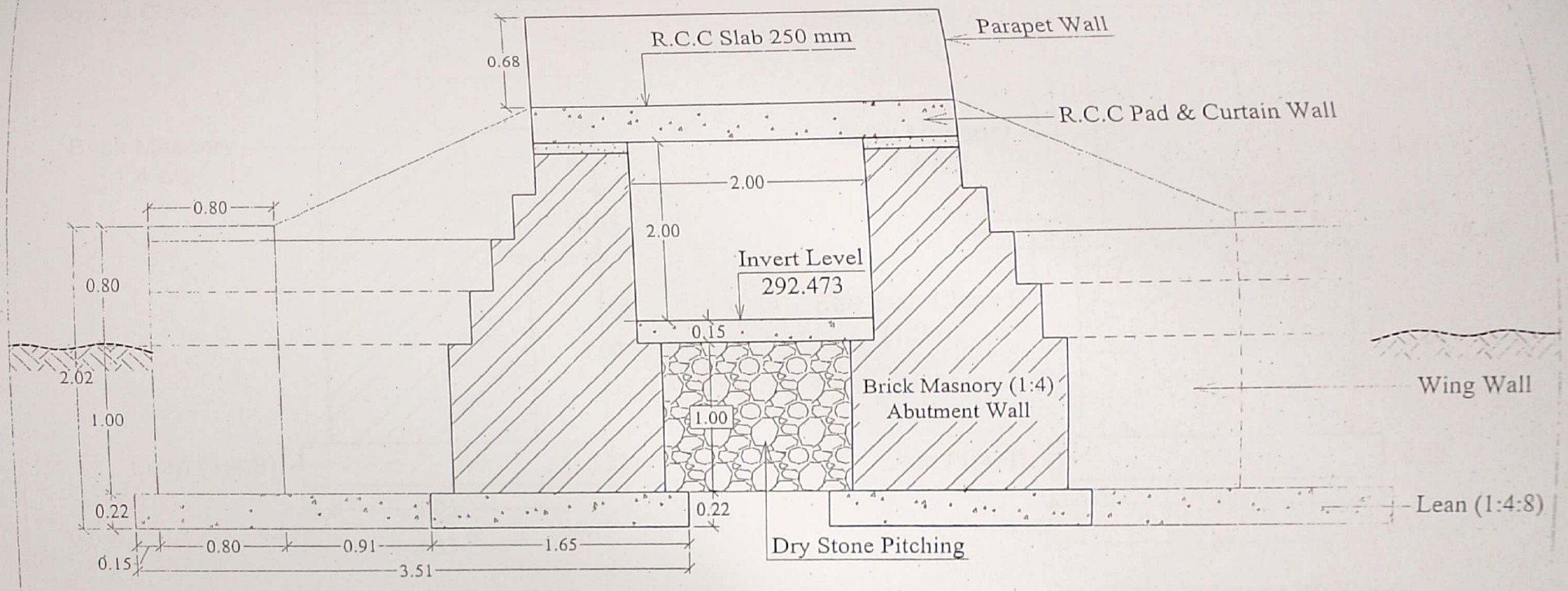


REAINFORCEMENT DETAIL
OF SLAB



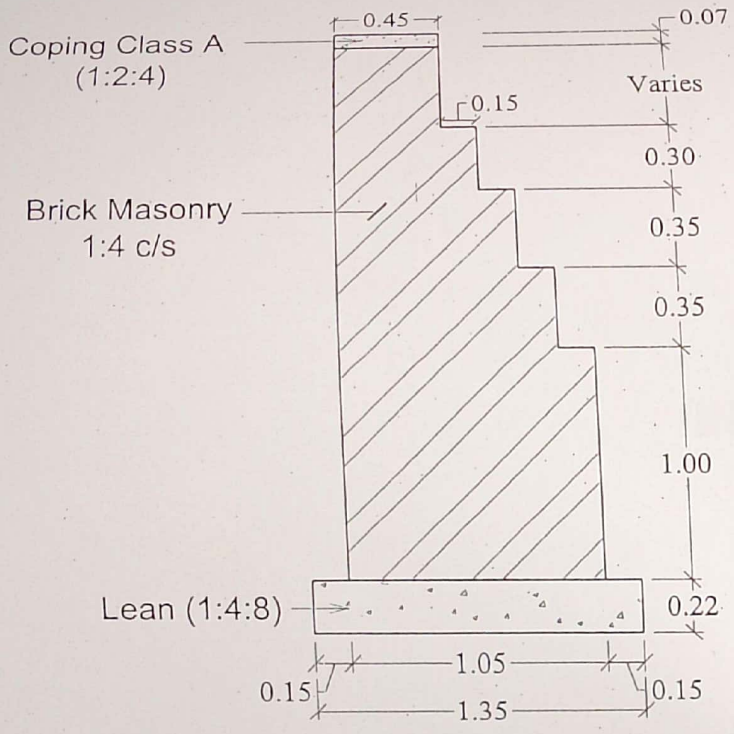
REAINFORCEMENT DETAIL
OF PARAPETWALL

Client:-	Consultants:-	Project:-	TENDER DRAWINGS	DRAWING NO :-
Directorate General Small Dams Irrigation Department Govt: of KPK Peshawar	Consulting Associates Peshawar	Detail Design & Construction Supervision of Package – F (Shah Kaleem Dam 2km Road)	Job:- TYPICAL L-SECTION OF CULVERT & REINFORCEMENT DETAIL	SKD-RS-02

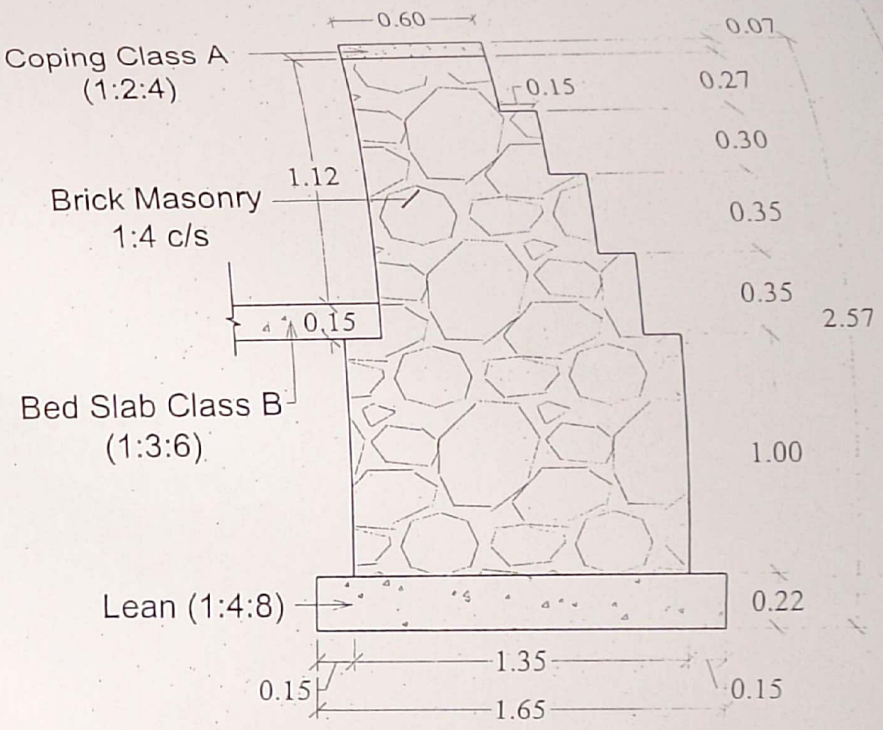


CULVERT TYPICAL
X-SECTION AT B-B

Client:–	Consultants:–	Project:–	TENDER DRAWINGS	DRAWING NO:–
Directorate General Small Dams Irrigation Depa tment Govt: of KPK Peshawar	Consulting Associates Peshawar	Detail Design & Construction Supervision of Package – F (Shah Kaleem Dam 2km Road)	Job:– TYPICAL X–SECTION OF CULVERT	SKD-RS-03



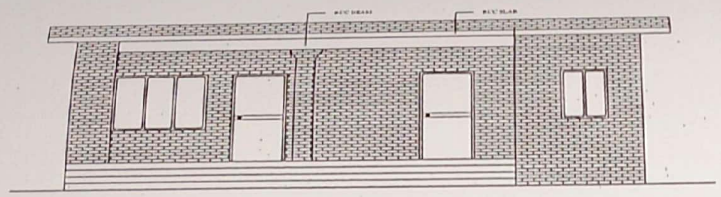
Detail of Wing Wall



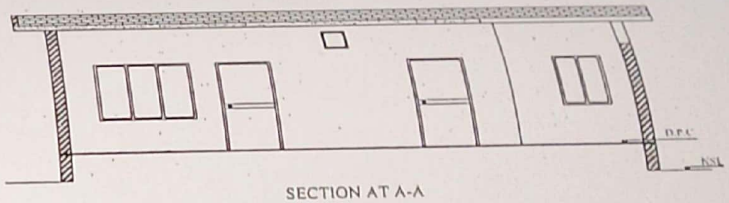
Detail of Abutment Wall for
1m ~ 1.5m Clear Height
Type = B

Client:- Directorate General Small Dams Irrigation Department Govt: of KPK Peshawar	Consultants:- Consulting Associates Peshawar	Project:- Detail Design & Construction Supervision of Package – F (Shah Kaleem Dam 2km Road)	TENDER DRAWINGS Job:- DETAIL OF CULVERT	DRAWING NO:- SKD-RS-04

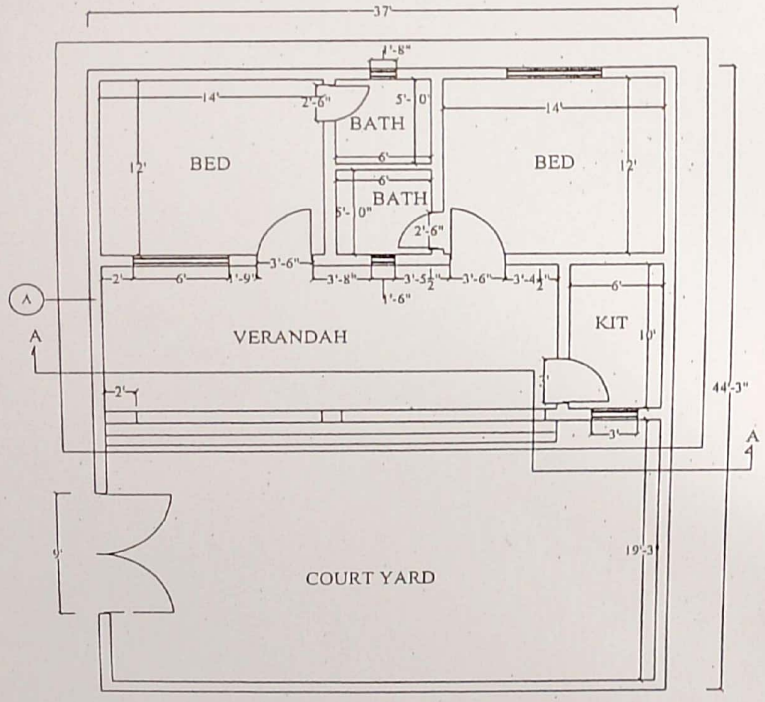
INSPECTION HUT



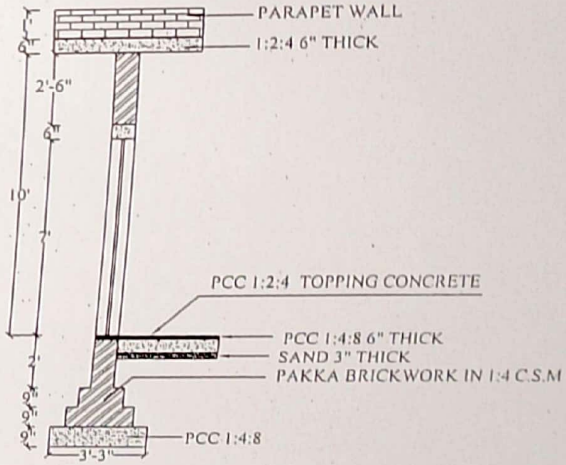
FRONT ELEVATION



SECTION AT A-A



GROUND FLOOR PLAN



DETAIL OF "A"

Client:–	Consultants:–	Project:–	Job:–	DRAWING NO:–
Directorate General Small Dams Irrigation Department Govt: of KPK Peshawar	Consulting Associates Peshawar	(Shah Kaleem Dam)	INSPECTION HUT	SKD–III–01