بسم الله الرحمن الرحيم

6.2 Records

RDC-01

No.CDA/DDGS-6(1)/84/1102

CAPITAL DEVELOPMENT AUTHORITY
SIMLY DAM PROJECT

Islamabad, August 30, 1984.

To

Mr. Satoshi Kadowaki
Team Leader,
Japan International Cooperation Agency(JICA),
3-B, Sitara Market,
ISLAMABAD.

Subject:- SCHEDULE OF WATER SUPPLY.

I am forwarding herewith a copy of Construction schedule of Housing Water Supply and Sector Road(Sector-wise) as desired.

Encl: One.

(A. R. Javaid)
D. D. G. (Services)

Copy to:-

Member(Planning),CDA - along-with a Schedule for information.

D. D. G.(Services),CDA.

Received Aug.30, 1984

C.VI-2

Construction Schedule of Housing, Water Supply and Sector Road by Sector-Wise.

Name of Sector	Commencement of Construction	Water Supply Facility	Housing	Sector Road
F-11	1984	1986	1988	1986
D-12	"	"	"	"
E-12	"	"	"	"
E-10	1985	1987	1989	1987
D-11	"	"	"	"
G-11	"	"	"	"
F-12	"	"	"	"
G-15	"	"	"	"
G-12	1986	1988	1990	1988
G-13	1987	1989	1991	1989
F-13	1988	1990	1992	1990
G-14	1989	1991	1993	1991
F-15	"	"	"	"
F-14	1990	1992	1994	1992
E-15	1991	1993	1995	1993
E-13	1992	1994	1996	1994
D-13	1993	1995	1997	1995
C-14	1994	1996	1998	1996
D-14	"	"	"	"
C-15	1995	1997	1999	1997
D-15	"	"	"	"
D-16	1996	1998	2000	1998
F-16	"	"	"	"
G-16	1997	1999	2001	1999
E-14	"	"	"	"
E-16	1998	2000	2002	2000
C-16	1999	2001	2003	2001

RDC-02

Minutes of Meeting on the Extent of Beneficiary Areas in the Rawalpindi District

Date: Aug. 30, 1984
Place: PHED, Rawalpindi
Attendants: Attached Note

The following was agreed to between PHED, Rawalpindi and JICA Study Team in the meeting held on Aug. 30, 1984.

The beneficiary areas in the Rawalpindi District in connection with the supplies of water from the Khanpur Dam Reservoir up to the year 2000 will be confined to the city areas under the jurisdiction of RMC, and the cantonment areas under the jurisdiction of CMES, CB and PAF.

As witnesses, the representatives of both parties have herewith signed.

Sep. 4, 1984

Mr. M. Saeed Mehtab Butt
Project Director,
PHED, Rawalpindi

Mr. Satoshi Kadowaki
Team Leader
JICA Study Team

Mr. A.R. Javaid
D.D.G. (Services)
C.D.A.
04/04/84

C.VI-3

List of Attendants

Pakistan Side:

Mr. M. Saeed Mehtab Butt, Project Director, PHED, Rawalpindi
Mr. A.R. Javaid, D.D.G (Services), CDA

Japanese Side

Mr. S. Kadowaki, Team Leader, JICA Study Team
Mr. N. Ishibashi, Project Economist, JICA Study Team
Mr. K. Kosaka, Water Supply Planner, JICA Study Team

Distribution to:

1. Mr. Makhdum Jamil Ahmed
   CMES (Army), Rawalpindi.
2. Brig. Jan Nadir Khan,
   Chairman, CDA.
3. Brig. Mohammad Anwar
   Member (Planning), CDA.
4. Mr. K. Wada
   Rep. in Pakistan, JICA

RDC-03

C.VI-4

بسم الله الرحمن الرحيم

CAPITAL DEVELOPMENT AUTHORITY
SIMLY DAM PROJECT

No.CDA/DDGS-6(1)/84/ 1098

Islamabad, August 30, 1984.

Mr. Satoshi Kadowaki,
Team Leader,
Japan International Cooperation Agency(Jica),
3-B, Sitara Market,
Islamabad.

Subject:- AGREEMENT OF KHANPUR WATER ALLOCATIONS.

Dear Sir,

Please refer to your No. KDIR-006 dated July 18, 1984. In this regard I am enclosing herewith a copy of Technical Officer, WAPDA letter No.KDW/W-66/6051/84 dated August 29, 1984 furnishing details of distribution of water for Municipal and irrigation requirements. Seasonal water allocating, and other information regarding reservoir operation and inflow discharge is being obtained and would be supplied to you shortly.

Yours sincerely,

(A. R. Javaid)
D. D. G.(Services)

30/8

Received Aug. 30, 1984

بسم الله الرحمن الرحيم

Water And Power Development Authority

Telephone 842415
Telegram :

KHANPUR DAM DIRECTORATE
WAPDA, 21-B SATELLITE TOWN
RAWALPINDI.

KDP/W-66/ 6051 /84

Date August 29, 1984.

The Deputy Director General (Services),
Capital Development Authority,
Islamabad.

Subject:- 4th Revised P.C. I Proforma of Khanpur Dam Project

Reference:- Telephonic discussion dated 27.8.1984.

...

A copy of the subject P.C. I Proforma in respect of Khanpur Dam Project costing Rs. 1385.100 million is sent herewith as desired please.

The distribution of water and irrigation water as provided in the P.C. I Proforma is reproduced below:

Water Supply

1. C.D.A.	33.00	MGD
2. POF Wah Cantt.	15.00	MGD
3. P.I.D.C. Projects.	13.50	MGD
4. Rawalpindi Town & Cantt.	69.37	MGD
Total:	130.87	MGD

Irrigation

a. Government of NWFP

i. For Existing Irrigation.	11.28	MGD
ii. For New Irrigation.	16.96	MGD
Total:	28.24	MGD

b. Government of Punjab

i. For Existing Irrigation.	14.90	MGD
ii. For New Irrigation.	12.10	MGD
Total:	27.00	MGD
Total: a + b	55.24	MGD

Encl: a.a.

Muhammad Fazil
(Muhammad Fazil Ch:)
Technical Officer 29/8

RDC-04

MINUTES OF MEETING
ON
THE RESULTS OF WATER BALANCE OF KHANPUR WATER

With regard the availability of Khanpur Water the discussion meeting was held at the room of Chief Engineer (Design), WAPDA House, Lahore in September 10th, 1984, with the participant of WAPDA, CDA and JICA Study Team as attached sheet.

The major items and conclusions which were discussed by the participants are summerized below:

1. JICA Study Team explained the results of water balance study on the Khanpur water.
2. Chief Engineer of WAPDA asked that adopted irrigation efficiency by the study is slightly lower than WAPDA standard. The Team replied that the irrigation efficiency is commonly consisting of canal conveyance efficiency and application efficiency. The comprehensive efficiency can be obtained multiplying both values. The Team adopted 90 percent for canal conveyance and 75 percent for application taking into consideration upland crop irrigation and without provision of water cources systems at farm level. WAPDA, recommendation was 80 percent for application efficiency.
3. WAPDA asked that actual lower water level of the reservoir at intake facility should be added about 10 feet on the projected lower water level of the reservoir in order to divert adequate design peak discharge at lowest water level. The volumes of water suggested was only about 6 MCM and this is quiet small amount compare to annual runoff of about 300 MCM in average.
4. WAPDA suggested the return periods for the drought are applying about 5 years for irrigation purpose and 10 years for non-irrigation project accordingly.
5. WAPDA, CDA and the Team confirmed that the results of discussion item No. 2 and 3 will not effect tendency of water shortages and the results of water balance study are no objection in principal.

September 10, 1984

MR. A.R. JAVAID
D D.C. (Services)
C.D.A.

MR. S. KADOWAKI
Team Leader of
JICA

Name List of Participants

Name	Official Position
MR. SATOSHI KADOWAKI	Team Leader of JICA
MR. YOSHIAKI KIMURA	Hydrologist of JICA
DR. YUNUS KHAN	Director (H), DRC (WAPDA)
Mr. M.S. WARSI	P.D. Surface Water Hydrology (WAPDA)
MR. ALTAF-UR-REHMAN	C.E. D.M.O. Lahore
MR. A.R. JAVAID	D.D.G (Services) CDA
MR. M. ASLAM QURESHI	C.E. CDO WAPDA Lahore
SYED REHMAT ALI	Deputy Director CDO WAPDA Lahore

RDC-05

بسم الله الرحمن الرحيم

WATER AND POWER DEVELOPMENT AUTHORITY

CHIEF ENGINEER, CENTRAL DESIGN OFFICE (W)

Telephone : 212121, 6991(A-3)

Room No. 710
Wapda House,
LAHORE

Ref. No. WW(Design)/401-5/4786 Date 2.10.84

Subject: MINUTES OF MEETING - KHANPUR DAM PROJECT

Minutes of the Meeting held on 24.9.84 in the office of Member (Water) WAPDA, Wapda House, Lahore, to discuss "Water Balance Study" prepared by JICA Team, are enclosed for information.

(Muhammad Aslam Qureshi)
CHIEF ENGINEER CDO(W).

Encl.
As above

Distribution

1) Member (Water) WAPDA, Lahore.
2) Ch. Altafur Rehman, Chief Engineer, D.M.O. Lahore.
3) Mr. Saleem Warsi, Project Director
   Surface Water Hydrology, WAPDA, Lahore.
4) Brig: Muhammad Anwar, Member Planning, C.D.A. Islamabad.
5) Mr. A.R. Javaid, Deputy D-G (Services) C.D.A. "
6) Mr. S. Kadowaki, JICA Survey Team, C/o D.D-G.(S) CDA.
7) Mr. Y. Kimura " "
8) Mr. Anwarul Haq, C/o A.C.E. (Ltd.) M.M.Alam Road, Gulberg-II, Lahore.

Received on 7.10.84

(Retyped from the Original)

MINUTES OF MEETING

A meeting was held on 24.9.84 at 10 AM in the office of Member (Water), WAPDA, Wapda House, Lahore to discuss Water Balance Study Report of Khanpur Dam Project prepared by M/s JICA of Japan. Mr. N.C. Syed, Member (Water) presided the proceedings. Mr. Anwarul Haq of ACE left at 11.30 A.M. with the permission of the Chair as he had to attend a meeting on Kalabagh Dam Project.

The following attended the meeting:-

WAPDA

1.	Mr. N.C. Syed	Member (Water) WAPDA
2.	Ch. Altafur Rehman	Chief Engineer D.M.O.
3.	Mr. Muhammad Aslam Qureshi	Chief Engineer C.D.O.(W)
4.	Mr. Saleem Warsi	P.D. Surface W/Hydrology.
5.	Syed Rehmat Ali	Deputy Director CDO (W).

CAPITAL DEVELOPMENT AUTHORITY

1.	Brigadier Muhammad Anwar	Member Planning.
2.	Mr. A.R. Javaid	Deputy D.G.(Services).
3.	Mr. S. Kadowaki	JICA Survey Team Leader.
4.	Mr. Y. Kimura	" " Hydrologist.

ASSOCIATED CONSULTING ENGINEERS (ACE) LTD.

1.	Mr. Anwarul Haq	Representative of ACE

Member (Water) WAPDA, initiating the discussion asked JICA Consultants to define safe yield as it is understood differently in many countries. JICA Hydrologist defined the safe yield as follows:

> "The safe yield of a reservoir is the quantity of water that can be supplied on a firm basis (even during critical period of draught) with a given reservoir storage."

Member (Water) explained that 100 percent water requirements of the consumers cannot be met. Water requirement is always on the increase. He elaborated his statement by the following examples:

a. Water supply in Samanabad Lahore was for 4 hours in the morning and 4 hours in the evening and then was increased to 24 hours. The inhabitants were satsified in both cases.
b. Last year power load shedding was of the order of 500 MW, this year of 1000 MW and next year it may be 1500 MW.

Under-developed countries cannot afford to provide the same facilities to the people which the Developed countries are providing. In those countires power load shedding of such a magnitude cannot be imagined. We have planned many water as well as power projects, but there is financial restraint and we do not get the financial help that we require to construct these projects on a lavish scale. Our people are used to such shortage of power and water. Keeping this aspect in view the safe yield of KHANPUR Reservoir be ascertained.

Mr. A.R. Javaid, DDG, CDA, asked whether WAPDA accepts the "Water Balance Study" prepared by M/s JICA, specially their calculations to work out safe yield and draught return period etc.

Mr. Anwarul Haq of ACE pointed out that Khanpur Dam was planned and designed solely for irrigation purpose and water supply aspect was an after-thought. Due to this fact and with lack of hydrologic data, the safe yeild could not be estimated as accurate as it should be for water supply schemes. ACE worked out average

annual run off as 280000 AF and later on revised it to 250,000 AF when flood date of about 10 years was made available.

Chief Engineer, Central Design Office (Water) WAPDA, expressed the view that we should first agree upon the annual average river inflow which had been worked out by M/s ACE and JICA team as 280,000 AF and 249,000 AF respectively. Mr. Anwarul Haq, pointed out that, M/s JICA figure is less due to the fact that they have neglected the diversions from the canal upstream of the gauging Station.

Member Planning, CDA, pointed out that there exists some small tributaries as well which join the Haro river downstream of the Khanpur Dam but upstream of the gauging station and this might balance the canal diversions.

As, A.C.E. had questioned the accuracy of the discharge measurements in a 'Note on Hydrological Aspects of Khanpur Dam Project, October 1972', so Mr. Saleem Warsi, P.D. Surface Water Hydrology Project, WAPDA, was requested to clear these doubts. He told the participants that actual measurements of discharge of Haro river at the point in question are carried out 40 times in a year. During monsoon gauge heights are observed round the clock. The equipments and the mthods employed to measure discharge are of International standard. The equipments were installed under the supervision of M/s Harza and the staff was also trained by them. He further said that M/s ACE evaluated the yield of the river basin by rainfall run off relationships as 280,000 AF and compared this figure with ten years of run-off record as published by Surface Water Hydrology Directorate. In fact M/s ACE should have compared 10 years of SWH discharge observations (1960-69) with equivalent length of time series of run off derived by them by using rainfall run off relationship. He has carried out this exercise and had calculated the river yield as 277,000 AF against 280,000 already worked out by M/s A.C.E Ltd.

The participants agreed to average annual river inflow at Khanpur Dam site as 280,000 AF.

Chief Engineer, C.D.O.(W) requested that safe yield of the reservoir may be debated next. He told that M/s ACE and M/s JICA have worked out safe yield as 250,000 AF and 168,000 AF respectively. CDO (W) has also drawn the 'Mass curve' with flow data from 1960-80 (21 years) and the safe yield so obtained is 184,000 AF. The most critical period when relatively low flows were observed is from 1973 to 1975.5 (2½ years in 21 years). He, therefore, opined that the safe yield would not be less than 200,000 AF. M/s JICA Team leader said that 'Mass curve ' method employed to work out safe yield is very preliminary and not very accurate.

Chief Engineer CDO(W) further told that M/s JICA Team have adopted cropping pattern of Punjab which is not correct. They should have used that of Turnab Agriculture Research Station. JICA Team Leader replied that they have adopted cropping pattern of Punjab according to PC-I, 1976.

Further, Chief Engineer CDO (W) pointed out that Left Bank Canal diversions have been written as 135.6 cusecs, in JICA Report, whereas it should be 67 cuses or less. He also enquired whether

this figure of 135.6 cusecs has been used in the Computer calculation or it is for record only? It was disclosed by Member Planning, CDA, that this figure has not been used in their calculations.

Chief Engineer CDO(W) WAPDA, objected the conveyance seepage losses assumed by JICA Team as 10 percent, whereas the canal is lined one. He recommended that it may be taken as 5%. After thorough discussion and examinations of the literature shown by Chief Engineer CDO(W), it was agreed by all the participants that the conveyance losses through the lined canal should be assumed as 7.5 percent.

The next point discussed was seepage and evaporation losses of the reservoir. M/S ACE assumed 9300 AF as evaporation losses, whereas JICA Team have assumed 26,000 AF as evaporation and seepage losses, which seems to be on higher side. JICA Team leader disclosed that it is 24,000 AF an d not 26,000 AF. It was agreed after some discussions by the members that the said losses may be taken as 24,000 AF.

Mr. A.R. Javaid of CDA pointed out that in the last meeting return prriod of draught was discussed and Chief Engr CDO(W) suggested that draught return period for irrigation and water supply schemes is normally different whereas JICA Team have assumed 1 in 10 years draught return period for both the schemes. M mber Planning, CDA, suggested that it should be taken as 1 in 5 years for both the schemes and all the participants agreed to this suggestion.

Keeping in view the above agreed parameters, JICA Team promised to revise thier calculations regarding the safe yield.

In the end Mr. A.R.Javaid Deputy D.G. CDA, enquired that in case of reduction in the safe yield, which of the beneficiary will suffer? He was told Mr. N.C. Syed, that settling of this issue is not in the jurisdiction of the participants of this meeting.

RDC-06

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

P.O. BOX 216 MITSUI BLDG
2-1, NISHI-SHINJUKU, SHINJUKU-KU TOKYO
160 JAPAN

KDIR-024

October 8, 1984

MR. JAN NADIR KHAN
CHAIRMAN, CDA
ISLAMABAD

Subject: MINUTES OF MEETING HELD ON 24 SEPT., 1984 IN THE OFFICE OF MEMBER(WATER), WAPDA AND ASSUMPTION TO BE EMPLOYED TO FINALISE KHANPUR WATER BALANCE STUDY

DEAR SIR,

This is to inform that the minutes of meeting held on 24.9.1984 in the office of Member (Water)WAPDA, Wapda House, Lahore, to discuss "Water Balance Study made by JICA team" prepared and undersigned dated on 2.10.1984 by Mr. M.A. Qureshi, Chief Engineer CDO (W), involves some inconsistencies and misunderstandings, and that, aiming at finalization of water balance study, an assumption made on the quantity of Haro river water being utilized for irrigating existing agricultural land is requested to be accepted at the earliest date.

Very truly yours,

S. Kadowaki

Satoshi KADOWAKI
JICA Team Leader

Distribution

1) Mr. N.C. Syed, Member (Water) WAPDA, Lahore
2) Mr. M.A. Qureshi, Chief Engineer, CDO(W), Lahore
3) Mr. Mohammad Anwar, Member (Planning), CDA, Islamabad
4) Mr. A.R. Javaid, D.D.G(Services), CDA

C.VI-10

1. Minutes of Meeting

(1) Average Annual Runoff

- In 1962 original F/S report, M/S A.C.E Ltd estimated the Haro river runoff on the basis of rainfall-runoff relationships at 325,000 AF as an average from 1931 to 1960.
- As stated in " 1976 P.C. I Proforma" as well as in " a Note on Hydrological Aspects", they revised the estimated yield from the catchment in the following procedures:

" The mean weighted rainfall in the catchment area amounts to 49.14" as worked out in Haro Basin Appraisal Report prepared by ACE and issued by P & I Directorate of WAPDA, Appendix 'A' Hydrology. The summer temperatures are also moderate in the higher regions of the catchment, and dry winds from the plains are checked by the Margalla Hills range, which acts as a barrier.

The above description is sufficient to prove that Khanpur catchment does not fall in the category of arid or semi-arid, and a mean coefficient of 35% runoff from this catchment will be a reasonable assumption. This gives an average annual depth of 17.5" which is equivalent to a runoff volume of about 3,00,000 acre feet, and there is no cogent reason why this figure should not be considered dependable".

- WAPDA has,however, taken a figure of 2,80,000 AF/yr which is still on the safer side.
- JICA study has been made based on the actual measurement of Haro river discharge made by SWHP, WAPDA. In fact as Mr. S. Warsi, P.D., SWHP, WAPDA expressed, measurements at the point of question are being

carried out with calibration of a rating curve about 40 times in a year. During monsoon gauge heights are observed round the clock.The equipments and methods employed are of international standard. The equipments were installed under the supervision of M/S Harza and the staff was also trained by them.

- Mr. S. Warsi also pointed out that ACE should have compared 10 years of SWHP discharge observations (1960-1969) with equivalent length of time series of runoff derived by them by using rainfall-runoff relationship. He carried out this exercise and obtained the river yield as 277,000 AF against 2,80,000 AF, but our study, based on the official publications from SWHP, WAPDA shows 214,000 AF as an average annual river yield.

WAPDA record (AF)

1960	185,000
61	337,000
62	155,000
63	173,000
64	192,000
1965	311,000
66	197,000
67	260,000
68	218,000
69	116,000
Total	2,144,000
Average	214,400

- The minutes stated that the participants agreed to average annual river inflow at Khanpur Dam Site as 280,000 AF. However, we must declare ourselves that we have not kept in our minds to achieve such agreement.

(2) Safe Yield

- Chief Engineer, C.D.O. (W) introduced the result of his study on the safe yield from Khanpur reservoir, and opined that the safe yield would not be less than 200,000 AF. JICA team leader expressed that " Mass Curve" method employed to work out safe yield is very preliminary and not accurate since water losses were neglected and the rate of water demand was not considered to be constant throughout a year.

(3) Conveyance Losses of Canal

- Chief Engineer CDO (W) objected the conveyance losses of canals assumed by us as 10% and recommended that it may be taken as 5%. " Applied Hydraulics", in which one example of conveyance losses is presented as 7.5%, was examined. In fact even if the main and distributory canals are lined, canal conveyance losses involve not only seepage but also evaporation and transpiration by vegetation in and around the canal up to the field, but excluding on-farm ditches.As a conclusion from discussions, we understood that agreement was achieved with 5% losses for the lined main canal plus 5% losses for the remainders inclusive of the smallest unit of branch canals.

- Regarding farm application losses, although it is quite uncommon low value, we agreed the use of 80% of irrigation field efficiencies.

Irrigation Field Efficiencies

Methods of irrigation	Range of efficiency,%
Graded borders	60 to 75
Basins and level borders	60 to 80
Contour ditch	50 to 55
Furrows	55 to 70
Corrugations	50 to 70
Subsurface	Up to 80
Sprinklers	65 to 75

Data Source : Handbook of Applied Hydrology, pp. 21-84

- An overall irrigation efficiency is given in terms of summation of conveyance and application efficiencies. For on-going study we applied 20% and 10% as application losses and conveyance losses, respectively and thus overall irrigation efficiency was produced as (1-0.2)x(1-0.1)= 72%. In many countries for upland crops, it is common standard that the irrigation efficiency is less than 60%, and in any case we have no idea to accept such values exceeding 72%.

- For your reference, "Applied Hydrology" also states as under.

  Delivery Losses. Canal or ditch seepage is the principal loss between the water source and the delivery point. This not only reduces supply, but may also cause damage to land adjacent to the canal or ditch. Seepage losses may vary from 10 to 70 per cent of the amount entering a canal.

(4) Again Haro River Runoff

- Mr. Anwarul Haq pointed out that JICA figure is less due to the fact that JICA has neglected the diversion from the canal upstream of the gauging station.

- However in fact, we have considered the effect of irrigation diversion by means of reduction of C.C.A. on the Left Bank Canal to 70%. And in this case the Haro river yield would be assessed to be 249,000 + 8,000 = 257,000 AF.

- A problem arose when Chief Engineer CDO(W) pointed out that the contribution of Left Bank Canal to irrigation should be 67 cusecs or less. The Left Bank Canal has been planned and constructed to provide irrigation water to the existing areas irrigated by the Haro river water from the past. Punj Katha head regulator was so constructed

with design capacity of 39 cusecs. We requested Chief Engineer CDO(W) to confirm the value of 69 cusecs or to provide the exact acreage of area which was being served by Punj Katha canal and now included in the command of the Left Bank Canal, so that we could revise our computations.

2. Khanpur

- We are going to proceed final computation of water balance study on Khanpur employing an assumption as under, for time available is quite limited and no conclusion regarding the subject 1.(4) has been reached yet from WAPDA.

- In regard to the runoff of the Haro river at Khanpur, the computation is to be made under the assumption that 60% of the C.C.A. on the Left Bank Canal was being irrigated by the Haro river water diverted upstream of the river gauging station. Thus, the Khanpur inflow would be WAPDA measurement plus irrigation requirement for 60% of C.C.A. (13685 x 60% = 8211), which is equivalent to 327.0 MCM/yr or 265,000 Af/yr.

WAPDA Measurement(1)	307.1 MCM/yr(249,000 AF/yr)	
C.C.A. on L.B.C.	13685 acre	
Existing (60%)	8211 acre	
Expansion (40%)	5474 acre	
Irrigation Requirement	33.227 MCM/yr(27,000 AF/yr)	
Existing (60%) (2)	19.936 MCM/yr(16,000 AF/yr)	
Expansion(40%)	13.291 MCM/yr(11,000 AF/yr)	
Khanpur Inflow(1)+(2)	327.0 MCM/yr(265,000 AF/yr)	

- The water balance computation will be finalized with average annual Khanpur inflow of 327.0 MCM/yr and with 100% (13685 acre) of Left Bank Canal C.C.A.

RDC-07

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

P. O. BOX 216 MITSUI BLDG
2-1, NISHI-SHINJUKU, SHINJUKU-KU TOKYO
160 JAPAN

KDIR - 016

Sept. 9, 1984

BRIG. JAN NADIR KHAN
CHAIRMAN, CDA
ISLAMABAD

RE: Water Balance of Khanpur Dam.

DEAR SIR,

Regarding captioned matter, following confirmations were required in order to proceed next stage study at the discussion meeting held on September 4th, 1984:

1) Determination of allowable return period for drought.

2) Priority of water allocation to respective consumers in drought year.

3) Design capacity of conduction main and related facilities.

We confirmed that CDA will be able to final reply on the above mentioned matters at the meeting which will be held on September 16, 1984 at WAPDA House, Lahore. This was mutual understanding that the CDA agreed to furnish this informations before the JICA study team embarks on the detailed planning for this project.

Your prompt action and reply on this matter will be highly appreciated, we remain

Very truly yours,

S. Kadowaki

Satoshi KADOWAKI
Team Leader, Khanpur Urban
Water Feasibility Study Team
JICA

Copy to:

1. Brig.(R) Mohammad Anwar,
Member (Planning), CDA.

2. Mr. A.R. Javaid,
Deputy Director General (Services), CDA.

3. Mr. K.Wada,
Representative of JICA in Pskistan.

CAPITAL DEVELOPMENT AUTHORITY
(Secretariat)

Mr. S. Kadowaki,
Team Leader,
Khanpur Urban Water Feasibility Team
(JICA)

No. CDA/PS(MP)/44/84 5346
Islamabad 30.9.1984.

Subject :- Water Balance of Khanpur Dam

Dear Sir,

Kindly refer to your letter No. KDIR - 16, dated 9.9. 1984. The matter has since been discussed with WAPDA in a meeting on 24th September 1984 and with Chairman, CDA on 25.9. 1984. Following decisions were taken :-

1) Allowable return period for drought.

It has been decided to adopt 5 years as return period of drought.

2) Priority of water allocation to respective consumers in drought year.

Priority will be given to urban water supply.

3) Criteria for design facilities.

The facilities should be designed for the allocations made for Rawalpindi/ Islamabad. Any short fall during the drought period will be made good by reducing supply to irrigation and also due to the fact that allocation made to PIDC projects are not likely to be utilized. CDA would be approaching the Government for the reallocation of PIDC share of water.

2. Another important factor for designing for full allocation is that CDA would have to consider other sources of water after years 2000 for meeting any short fall which may include supply from Tarbela Reservoir. If the system is designed to full capacity now then it could be continued to be utilized fully after water from these sources become available.

Brig (R)
(Mohammed Anwar)
Member (Planning)

Received Sept. 30, 1984

RDC-08

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

P.O. BOX 216 MITSUI BLDG
2-1, NISHI-SHINJUKU, SHINJUKU-KU TOKYO
160 JAPAN

KDIR-020

MR. JAN NADIR KHAN,
CHAIRMAN, CDA
ISLAMABAD

September 19, 1984

RE: Staged Development Plan of Khanpur Water.

Dear Sir,

Regarding captioned matter, we received informations from CDA and PHED as follows:

Year	Islamabad	Rawalpindi
1986-1990	17.00 MGD	17.00 MGD
1991-1995	16.00 MGD	17.00 MGD
1996-2000	-	17.00 MGD
2001-2005	-	18.37 MGD
Total	33.00 MGD	69.37 MGD

As the result of our survey and study on water demand and production capacity for twin cities of Islamabad and Rawalpindi, we found that these development plan shall be revised reasonably in order to supply adequate water taking into consideration tendency of increasing water demand, water production capacity, and water resources availability.

From the reasons mentioned above and attached materials, we would like to revise staged development plan of Khanpur Water Supply Scheme as follows:

Year	Islamabad		Rawalpindi		Total	
	MLD	(MGD)	MLD	(MGD)	MLD	(MGD)
1986-1990	79.6	(17.5)	168.4	(37.0)	248.0	(54.5)
1991-1995	40.0	(8.8)	84.2	(18.5)	124.2	(27.3)
1996-2000	39.6	(8.7)	84.2	(18.5)	123.8	(27.2)
Total:	159.2	(35.0)	336.8	(74.0)	496.0	(109)

We would like to proceed next stage study based on our proposal. If you have no objection after careful study

Contd...P/2

would be made by your staff concerned and confirmation would be done with PHED for Rawalpindi.

Your understanding and reply on this matter will be highly appreciated, we remain.

Very truly yours,

Satoshi KADOWAKI
Team Leader, Khanpur Urban
Water Feasibility Study Team
JICA

Copy to:

1. Brig. (R) Mohammad Anwar,
   Member (Planning), CDA.
2. Mr. A.R. Javaid,
   D.D.G. (Services) CDA.
3. Mr. A.Q. Nomani,
   Director (Water & Sewerage), CDA.
4. Mr. Saeed Mehiab Butt,
   Project Director,
   Rawalpindi Water Supply Project,
   PHED, Punjab.

C.VI-15

بسم الله الرحمن الرحيم

No;CDA/DDGS-6(1)/84/1310

CAPITAL DEVELOPMENT AUTHORITY
SIMLY DAM PROJECT

Islamabad, Oct. 18, 1984.

Mr. Satoshi Kadowaki,
Team Leader,
Khanpur Urban Water
Feasibility Study Team
J I C A - Islamabad.

Subject:- STAGE DEVELOPMENT PLAN OF KHANPUR WATER.

Please refer to your No.KDIR-020 dated 19.9.1984. Your proposal regarding the stage development of Khanpur water supply scheme which is as follows is agreed to by C. D. A. :-

Year	Islamabad		Rawalpindi		Total	
	MLD	(MGD)	MLD	(MGD)	MLD	(MGD)
1986-1990	79.6	(17.5)	168.4	(37.0)	248.0	(54.5)
1991-1995	40.0	(8.8)	84.2	(18.5)	124.2	(27.3)
1996-2000	39.6	(8.7)	84.2	(18.5)	123.8	(27.2)
Total:	159.2	(35.0)	336.8	(74.0)	496.0	(109.0)

You are kindly requested to proceed with next stage study based on your above proposals.

(A. R. Javaid)
D. D. G.(Services)

Received Oct. 20, 1984

RDC-09

No.CDA/DDGS-6(1)/84/1311

Islamabad, October 18, 1984.

Mr. S. KADOWAKI
JICA Team Leader,
Khanpur Dam Water Supply Project,
ISLAMABAD.

Subject:- COMPARATIVE STUDY OF CONDUCTION MAIN AND APPURTINANT STRUCTURES ON KHANPUR WATER SUPPLY SYSTEM.

Dear Sir,

Please refer to your above report dated 14th October 1984. CDA would like to have clarification on the following points :-

1. P.R.C.C. pipes proposed for distribution lines are supposed to have allowable design pressure on upto 12 K.g. per sq.c.m. P.R.C.C. pipes manufactured in the country are normally designed at working pressure of 85 Psi having test pressure of 170 Psi (12 K.g. per sq. c.m.). If the pressure in the distribution lines is going to be as high as 12.K.g. peer sq.c.m. then ductile cast iron pipes or PRCC pipes with steel core will have to be used.

2. The suspended materials in the raw water in alternate III would be less as compared to alternate I & II. These savings may please be reflected both in the design of the treatment plant as well as in the O&M cost.

3. Details of break down of power have already been given to JICA Team. CDA still insists that the capacity of services water storage reservoir should not be less than 12 hours where pumping is required. However where pumping is not required 6 hours storage is agreed.

Contd.....P/2

Received Oct. 20, 1984.

4. On page 13 design capacity of the service reservoir for different alternatives is given. The proposed capacities are different for different alternates which figure should have been the same on the criteria of 6 hours of storage adopted in the report.

5. If alternate III is adopted there would not be any conveyance losses. This may please be reflected on the economic evaluation of different proposals.

6. CDA is of the opinion that pressure zones for Rawalpindi as worked out by ASSL in thier report should be adopted. Design should be such that most parts of Rawalpindi and Cantonment should be supplied by gravity. Pumping should be resorted to as a last measures.

7. JICA Team may like to mark the pressure zones for Islamabad on the same lines as has been done by ASSL for Rawalpindo. Most economical method of distribution of water from Simly and Rawalpindo based on these pressure zones be worked out. Simly being available at more than RL 2000 in Islamabad, it should be possible to use this water for higher zones of Islamabad with less pumping. Khanpur water may be used for lower zones where possible by gravity.

8. The basis of cost of service reservoir may please be given. The cost of approx. Rs. 10/- per gallon seems to be higher than the present market rates.

Contd....P/3

9. The cost of water treatment plant as worked out on page 29 Annex. is Rs. 352 million, where as this cost has been taken as 397 million in the cost comparison table-II on page 31 ofthe main report. This requires to be reconciled.

10. The cost differiential of water treatment plant for alternats I & II as given at page 29 of Annex.is more than 20% This difference in cost is not understood as the site conditions are similar in both the places.

11. On page 31 table II cost comparison (financial cost) the cost of transmission lines has been given. The cost of alternate-III is more as compared to other alternatives.Where as the pumping capacity is about 40% of other alternates. The cost of transmission line requires to be rechecked.

12. The length of tunnel in alternate-III is different types of rocks along the tunnel routes is each different than adopted by WESPAK in their study in 1980-81. While preparing this study WESPAK had carried out extensive geological survey of the area, and had also consulted airial maps and other data available with WAPDA and other agencies. It would be advisible to adopt the WESPAK figures.

Contd.....P/4

The comparison of the two is given as under :-

Material type.	Tunnel length proposed by NESPAK.	Tunnel length proposed by JICA.
1.	2.	3.
Massive lime Stone	5000	2630 Meter
Argillaceous lime stone.	2942	5600 meter
Shale.	1676	2720 "
Over Burden	1493	700 "

The figures are required to be reconciled. CDA is of the view that it would be better to adopt NESPAK figures as they had carried out most extensive surveys as compared to JICA Team.

13. Time of construction of tunnel as adopted by JICA Team is much more than that adopted by Sanyu Consultants prepared in 1990. The same geological information which was available in 1990 has been used to-day. It is not understodd as to why time of completion has now been extended to nearly 5 years.

Contd.....P/5

14. The cost of raw water reservoir of 120 M.G. as worked out by NESPAK was 10.00 million. JICA TEam has taken cost at more than Rs. 94.00 million for alternate I and 109.00 million for alternate II-A for quantity of about 204 million gallons. The cost differential between the two proposals seems to be quite high. NESPAK had proposed to use the natural depression near Sangjani. This may have kept price down as compared to JICA proposal which proposed raw water reservoir in almost total cut.

15. On page 27 Annex. the unit cost of "others" for Alternate-III in table A-2 of cost of feeder facility has been shown as more than Rs. 30.00 million as against about 9.00 million shown against other alternates

Details of this abnormal increase for this alternate may kindly be supplied.

16. The basis of costing of tunnel has not been given anywhere in the report. These may kindly be supplied.

17. The cost of transmission lines for alternate-III is too high. The transmission should be from Rawalpindi and Islamabad grids, wherein the cost should be substantially less.

You are kindly requested to incorporate these points in your final reports and also supply necessary details as required.

(A. [illegible])
D. D. G.(Services)

RDC-10

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

P. O. BOX 216 MITSUI BLDG
2-1, NISHI-SHINJUKU, SHINJUKU-KU TOKYO
160 JAPAN

KDIR-030

October 22, 1984

BRIG. MOHAMMAD ANWAR
MEMBER, PLANNING,
CDA, ISLAMABAD.

Re: REPLY TO CDA's REQUEST AND COMMENTS.

DEAR SIR,

We are pleased to present our replies as attached hereinafter to CDA's request and comments, dated October 20, 1984, upon the report on the comparative study of conduction main and appurtenant structures on Khanpur Water Supply System prepared by the JICA Study Team. These points stated in this note will be incorporated in details in our final reports to be prepared in Japan.

Yours very truly,

S. Kadowaki

Satoshi KADOWAKI
Team Leader, Khanpur Urban Water
Feasibility Study Team
JICA

Copy to:

1. Mr. A.R. Javaid,
   D.D.G (Services)
   CDA, Islamabad.
2. Counterpart concerned

Item 1:

The type of PRCC pipes adopted for distribution lines is PRCC pipe with steel core which has been described in details on page-11 of the report.

Item 2:

The raw water to be taken from Khanpur reservoir contains suspended materials as runoff water from Haro river basin in rainy season has high density of suspended materials. Those materials in the raw water in Alternative I might be decreased at water treatment plant because raw water reservoir has function to settle down the materials.

In principle, the suspended materials in the raw water in Alternative III that conveys the raw water through long tunnels may be less to some extent as compared to Alternative I & II. However, such extent might be too small to reflect both in the preliminary design of the treatment plant and the preliminary estimate of O & M cost.

For reference, survey results of turbidity so far made are given as follows;

Location	Turbidity
- Surface water of Khanpur reservoir	8 to 10 units
- Water in the upper reach of main canal	12 to 16 units
- Water in the division works for irrigation near Mohara Mosado	16 units

Item 3:

Survey team would like to reserve the final conclusion until details discussion on the power receiving method of high voltage is made with WAPDA in Lahore

Item 4:

The designed effective storage capacity of the service reservoir is estimated based on the criteria of 6 hours storage, and resulting in 124,000 cu. m for Alternative I, II and III. However, PC reservoir need to provide dead storage, depending on topographic conditions, so as to maintain designed water head. The design capacity of service reservoir presented on page 13 includes the dead storage.

Item 5:

Construction joint interval of concrete lining tunnel, as a rule, is about 10 meters without waterstop materials. In case that ground water level of external tunnel is higher than water surface level in tunnel section, there is no seepage water losses, while the water surface level of tunnel is higher than external one, there is some water seepage losses same as open channel.

Evaporation lossess from water surface of the open channel are negligible small. This may not be reflected in the economic evaluation.

Item 6:

The results of re-examination have been submitted by our letter No. KDIR-028, dated 18th October, 1984.

Item 7:

The study team would like to reserve final conclusion until detailed study is conducted.

Item 8:

The average unti construction cost of service

reservoir, including earth works, are given below:

Alternative	Location	Structure	Total Capacity (cu.m)	Costs (Rs.1000)	Rs./gallon
I-A	S.Alladi-tta	PC	37,600	58,704	7.1
	D-13	RC	15,300	13,617	4.0
	G-13	PC	108,800	160,226	6.7
	Total		161,700	232,547	(6.5)
I-B	E-14	PC	26,200	38,565	6.7
	S.Alladi-tta	PC	37,600	58,704	7.1
	Tomar	RC	92,000	85,041	4.2
	Total		155,800	182,310	(5.3)
I-C	S. Alladi-tta	PC	37,600	58,704	7.1
	D-13	RC	15,300	13,617	4.0
	Tomar	RC	92,000	85,041	4.2
	Total		144,900	157,362	(4.9)
II	S.Alladi-tta	PC	37,600	58,704	7.1
	D-13	RC	15,300	13,617	4.0
	G-13	PC	108,800	160,226	6.7
	Total		161,700	232,547	(6.5)
III	Golra (1)	PC	33,200	81,821	11.2
	Golra (2)	RC	15,300	26,151	7.8
	H-11	PC	43,800	48,924	5.1
	I-13	PC	46,800	50,110	4.9
	Total		139,100	207,006	(6.8)

Note 1 cu.m = 220 gallon

( ) shows average values.

Item 9:

The cost of water treatment plant for Alternative III is Rs. 397,693,000 as given on page 31 of the main report. The table A-4 in Annex shall be corrected.

Item 10:

The cost of water treatment plant for Alternative II (Shah Alladitta) is higher by about 20% than that for Alternative III (Sang Jani) as tabulated on page 29 of Annex, because the site conditions are quite different in both places; rocks are found at Shah Alladitta site, while Sang Jani site is located on unconsolidated deposits.

Item 11:

The pumping capacity of Alternative III is smallest among alternatives. However, the length of proposed transmission line of Alternative III is longest among Alternatives, thus, resulting in highest costs. Besides, wiring cost for respective alternatives with different power requirement is not so much difference.

Item 12:

The Study Team as a first step made preliminary studies of aerophotographs and geological maps with a scale of 1:50,000, and during the course of preliminary studies, the Team received information on geology of Margala Hill from Geological Survey of Pakistan. Then, the Team reviewed the NESPAK reports, through which the Team had obtained sufficient information on the geology of Margala hill.

As a second step, the Team carried out geological reconnaissance surveys with the senior geologist of CDA along II-C, which roughly correspond to the routes of

alternate I and II proposed by NESPAK, respectively. As for Alternative III, the Team made in the field careful observation of geology and topographic characteristics to find out the correspondence between them, basing upon the information previously obtained from the analyses of aerophotographs. The field surveys were carried out four times and more together with the reconnaissance of Khanpur, Tarmakki, Golra, Shah Alladitta and Khuram Parucha.

With these data, the Team has developed geological sections of the proposed tunnel routes, making reference to aerophotographs, geological maps, topographic maps and NESPAK's sections.

2. According to the NESPAK report, geological sections of tunnels for alternate I and III were prepared on the basis of aerophotograph analysis, and surface geological surveys were made only for alternate II (corresponding to Alternative II-C). Reference is made to page 4-5 and 6-8, and notes of Fig. 7 and Fig 11 of the NESPAK report.

3. The NESPAK reports stated that there lay massive lime stone at distance from 1,000 ' to 8,000' from the intake of alternative III (roughly corresponding to Alternative III of this study). Field surveys made by the Study Team for the ground around this reach have revealed that there lay not only massive limestone but also much marl, and therefore geology of this reach has been classified into argillaceous by the Study Team. In addition, in this area, topography shows rather low relief, and a considerable part of the area is covered with unconsolidated deposits. Judging from geological common sense, this fact may suggests that rocks in this area are subject to errosion. It shall be quite dangerous for alternate III to classified the geology along such reaches into massive limestone that requires no support for tunnel excavation.

There shall exist one thrust along the Vally of Nilan Kas which extends east from Tarmakki. This was informed by a geologist of Geological Survey of Pakistan who has been engaged in geological survey of this area. The Study Team found easily the existence of the thrust from aerophotographs as informed by the geologist. However, unfortunately, the NESPAK's tunnel section missed this important fault.

The Study Team and senior geologist of CDA have confirmed in the field the presence of cretaceous sandstone which was not stated in the NESPAK report.

4. In Summary, the geological survey by the Study Team has been carried out for the purpose of supplementing the previous survey and studies including NESPAK studies, and has attained success results as mentioned above. CDA has commented that while preparing this study NESPAK had carried out extensive geological survey of the area and had also consulted aerial maps and other data available with WAPDA and other agencies. With regard this, we would like to request CDA to furnish us with such data for Alternative III available in WAPDA and other agencies, if any. They shall be usefull for the study.

5. CDA gave a table showing the proposed tunnel length by material type for Alternative III, as compared with that of NESPAK, and commented that the figures are required to be reconciled. A difference in tunnel length for over burden between the Study Team and NESPAK is only due to the fact that the tunnel routes are not the same, resulting in different length of Alternative III from the NESPAK proposal. More particularly, the length of over burden proposed by NESPAK is longer by about 500 m than the length proposed by the Study Team, and is proposed to run beneath the flat land where alluvium is deposited, while the route of the Study Team goes through

a limestone ridge near the outlet portal.

6. We would like to call your attention that the route of Alternative III proposed by the Study Team is more or less different from the route proposed by NESPAK, and the both the geological sections prepared by the Study Team and NESPAK, where most constituent is of limestone and the layers dip southward, are essentially similar, with the exception of upstream portion, as mentioned previously, where NESPAK's judgement seems to be optimistic.

To make the rock properties of tunnel routes more precise, it is needed to execute subsurface geological surveys such as seismic survey and drilling.

7. For these reasons mentioned above, the Study Team would not accept CDA's view that it would be better to adopt NESPAK figures as they had carried out most extensive surveys as compared to JICA Team.

Item 13:

The rate of advance of tunnel construction will depend on several factors, including type of rock, amount of ground water present, if any, power of the driving equipment, method of removing the muck, extent of ground support required and so on. The difference of geological conditions of Alternative III from NESPAK survey is explained in Item 12. Chemical treatment and excavation of fractured fault zone will need at least about five months. Time required for tunnel construction is estimated is reasonably estimated, after consideration of the above mentioned factors, and from the experience gained in Japan and other countries.

Item 14:

The estimated costs of raw water reservoirs are Rs. 94 952,000 for Alternative I and Rs. 109,931,000 for Alternative II-A, breakdown of which is summarized as below:

Alternative I (Sang Jani)

(244 M.G.)

Item	Rs.1,000
1. Reservoir excavation 280x10^{3}cu.m	16,380
2. Dam embankment	51,215
3. Spillway and emergency drawoff	5,992
4. River improvement	8,663
5. Others	12,702
Total	94,952

Alternative II-A (Khuram Paracha)

(244 M. G.)

Item	Rs. 1,000
1.1. Excavation 720x10^{3}cu.m	74,948
2. Dam embankment	20,644
3. Others	14,339
Total	109,931

The Sang Jani Site that dams up a existing river channel has been proposed, after due consideration of three alternative reservoir sites. However, the impoundment is not sufficient to meet the proposed storage requirement of 242 M.C, and excavation of 280×10^3 cu.m is to be made to supplement the storage capacity. In addition to excavation in the reservoir, river improvement has been proposed to shift the river course so as not to inflow into the proposed raw water reservoir.

The NESPAK report estimated the construction cost of Sang Jani raw water reservoir of Rs. 10 million; however, details were not annexed to the report. CDA has commented that NESPAK had proposed to use the natural depression near Sang Jani. However, no natural depression is found on the Figure 4 showing Layout of Alternate Alignement attached to the NESPAK report and the topographic map with the scale of 1:4.000.

Item 15:

The cost of "Others" for Alternative III in table A-2 on page 27 of Annex, totalling Rs. 30,142,000, includes the cost of Rs. 16,318,000 for valves with a diameter of 1,000 mm and civil works for pressure break basin. The cost of "Others" for Alternative III less Rs. 16,318,000 shall come to Rs. 13,824,000.

Item 16:

The costs and length of tunnel are presented in Table A-3 on page 28 of Annex. The unit construction costs of tunnel including temporary works and overhead expenses are summarized as follows:

Type	Rs./m	Diameter
A	15,844	2,100 mm
B	26,657	-do-
C	34,441	-do-
A	17,779	2,400 mm
B	28,708	-do-
C	37,550	-do-

Item 17:

According to informal suggestion made by WAPDA, it is not advisable for preliminary layout of the project to draw electric power from the existing transmission networks of 11 KV and 132 KV around Islamabad and Rawalpindi, because of limited power availability. Therefore, transmission lines for every Alternatives have been proposed to draw electric power from Burlan. As explained in item 11, the cost of transmission lines for Alternative III is highest one among alternatives. However, it shall depend on the decision by WAPDA whether the transmission can be from Rawalpindi and Islamabad grid, or not.

ANNEX NOTES

I. REPLY TO ITEM NO. 7

II. WATER LOSSES OF WATER TREATMENT PLANT

I. REPLY TO ITEM NO. 7.

1. Sampled Service Area of the Study

According to the results of water balance study of the Simly reservoir made by the JICA study team, the availability of water resources of the reservoir after installation of spillway control gates and emergency spillway is about 36 MGD (163,800 cu. m per day) when critical drought is occurred once in five years. CDA has been constructed No. 1 and No. 2 conduction main with capacity of 24 MGD from Simly filtration plant upto service reservoirs in Islamabad.

The third conduction main will be made with 12 MGD capacity to the developing sectors of H and I series. On the other hand, the Khanpur water will be supplied directly from Khanpur reservoir to commandable area of 11 to 15 sector through Margala long tunnel, water treatment plant and pumping facilities which was recommended as optimum water supply systems.

In this connection, following sectors were selected to compare from technical and economical point of view whether supply methods by gravity and or high and low head pumping systems are more suitable.

Sector	Max. Demand	Sector	Max. Demand
H-8	0.161 cu.m/sec	D-11	0.045 cu.m/sec
I-8	0.242	E-11	0.223
H-9	0.219	F-11	0.193
I-9	0.308	G-11	0.172
H-10	0.204	H-11	0.155
I-10	0.305	I-11	0.182
D-12	0.077	I-12	0.151
E-12	0.122	D-13	0.019
F-12	0.124	E-13	0.040
G-12	0.204	F-13	0.089
H-12	0.125		

2 Alternative Plan

2.1. Case-A

Case-A is namely series wise distribution of commandable area. The area can be roughly divided into three categories, such as high lift pump area, low lift pump area and gravity zone, which is shown in Figure-1.

2.2. Case-B

The case is namely sector wise distribution of service area by the elevation of ground surface as shown in Figure-2.

3. Hydraulic Design and Pipe Works

As result of hydraulic design for respectives case, the following pipe works will be required.

Diameter of Pipe	Materials	Case-A	Case-B
(1) Gravity Zone		(m)	(m)
1100 mm	PRCC	6,000	-
900 "	"	6,500	-
700 "	"	2,000	-
Sub-total		14,500	-
(2) High Lift Zone			
1500 mm	PRCC	3,00	3,000
800 "	"	2,000	8,500
700 "	DCP	-	3,500
600 "	PRCC	2,000	-
500 "	"	-	2,000
500 "	DCP	500	-
450 "	PRCC	2,000	2,000
Sub-total		9,500	19,000
(3) Low Lift Zone			
1500 mm	PRCC	-	4,000
1350 "	"	-	4,000
1100 "	DCP	-	5000
1000 "	PRCC	4,000	-
900 "	"	4,000	-
800 "	"	-	4,000
700 "	DCP	500	2,000
600 "	PRCC	2,000	2,000
Sub-total		10,500	14,500
Total		34,500	33,500

4. Pump Design and Specification

Item	Case-A	Case-B
(1) High Lift Zone		
Pump	250 MM x 6 Units	250 mm x 6 units
Motor	230 KW x 6 Units	180 KW x 6 Units
(2) Loaw Lidr Zone		
Pump	250 MM x 6 units	400 MM x 6 units
Motor	150 KW x 6 units	360 KW x 6 units

5. Service Reservoir Desing

Unit : CU.M

Item	Case-A	Case-B
(1) Gravity Zone	25,000	-
(2) High Lift Zone	16,400	16,400
(3) Low Lift Zone	17,000	41,800
Total	58,400	58,200

6. Construction Cost Comparison

Item	Case-A (Rs 1000)	Case-B (Rs 1000)
Pump Plants	31,180	41,450
Pump House	5,000	5,000
Pipe Works	90,762	102,556
Service Reservoir	64,240	64,020
Physical Contingencies	19,118	21,274
Total	210,300	234,300
(Ratio)	(100)	(111)

7. Operation and Maintenance Cost

Item	Case-A (Rs 1000)	(%)	Case-B (Rs 1000)	(%)
High Lift Zone	3,881	(100)	3,037	(78)
Low Lift Zone	2,531	(100)	6,073	(240)
Total	6,412	(100)	9,110	(142)

8. Conclusion

The results of comparison on the construction and operation and maintenance cost show that case-A is more feasible than that of Case-B. Therefore, the plan proposed by the Team is suitable plan.

Figure - 1 Commandable area distribution

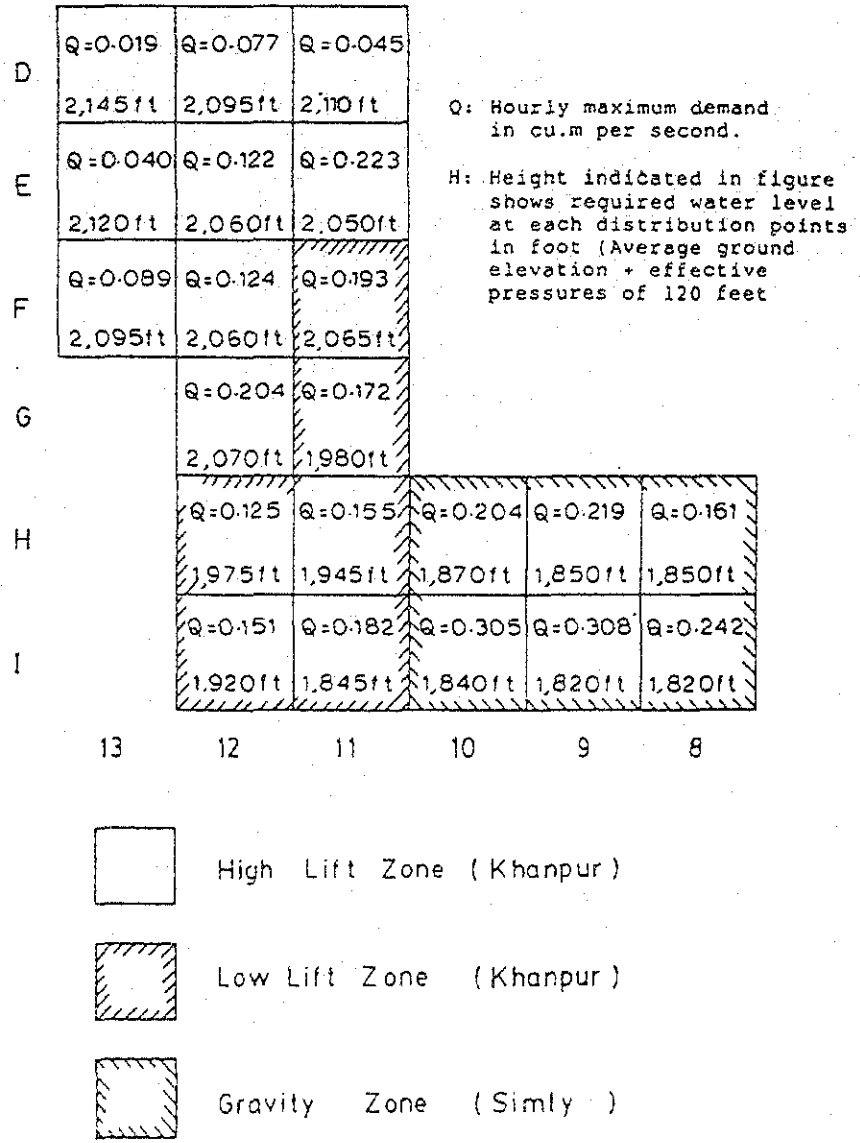
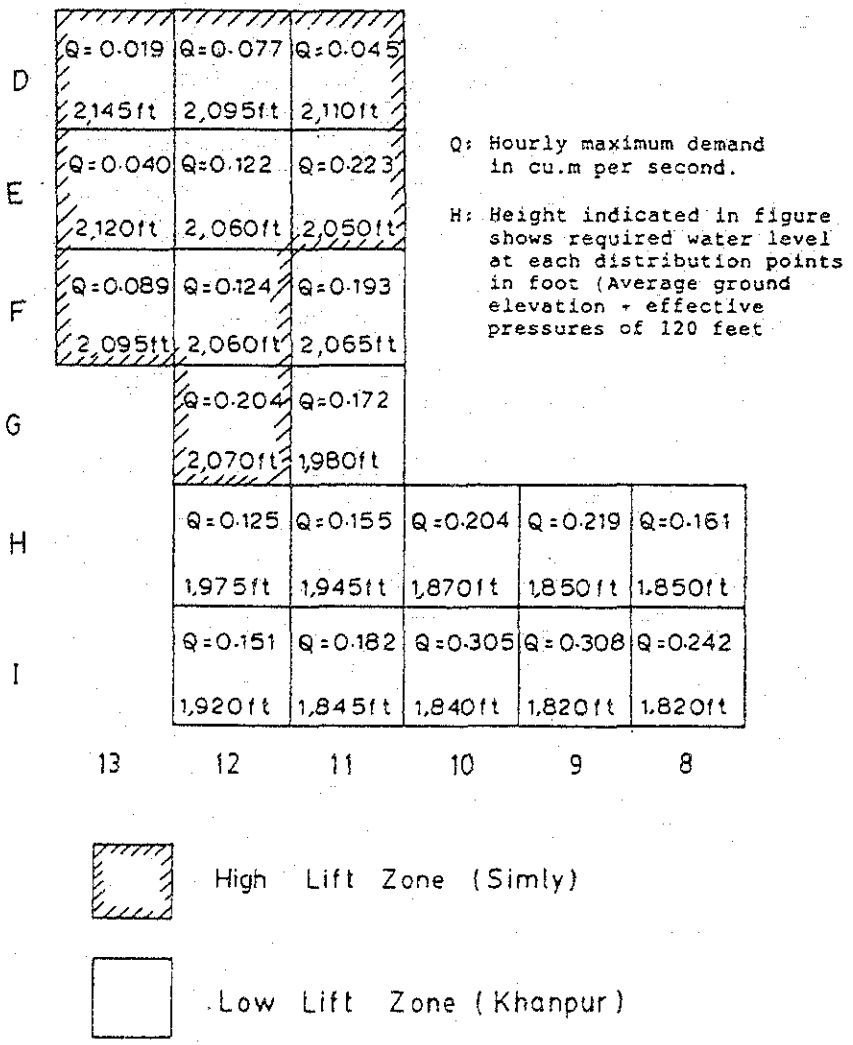


Figure - 2 Commandable area distribution



II. WATER LOSSES OF WATER TREATMENT PLANT

Two alternatives are proposed for reducing water losses at the treatment plant, namely A: reusing supernatant water after treating for precipitation, and B: reusing wastewater directly without treating. The investment and O/M costs are shown below:

Investment Cost unit: Rs. 1,000

	Civil Works	Pumps & Appurtenances	Total
Alternative A	5,620	4,340	9,960
Alternative B	2,360	5,200	7,560

	O/M Cost Unit : Rs. 1,000/year		
	Power	Chemical	Total
Alternative A	220	-	220
Alternative B	330	3,700	4,030

Whereas, the benefit to be derived by reusing wastewater is 8.8 million Rs./year. As the result, it is clear that reusing wastewater is economical. Whichever alternative is adopted, the water losses in treatment plant will be 2.3 to 3.0 percent of total porduction (see page-28). However, in the reuse of wastewater major problems are to be faced, including the difficulties associated with the management of chemicals infusion and the environmental pollutions in the downstream areas resulting from the discharges of highly concentrated wastewater. For these reasons, the JICA Study Team does not recommend the reuse of wastewater. If wastewater is not recycled, water losses at the treatment plant come to 4.2 to 8.2 percent (see page-29). In consequence, the Team concludes that planning will be made on the assumptions that water treatment losses be 5 percent.

Assumptions for Alternatives A&B

Filtration rate	: 120 cu.m/sq.m/day
Area of filter bed	: $\frac{553,000}{120}$ x 1.1 =5,100 sq.m
No. of filter beds	: 40 bes
Washing rate	: 1.0 cu.m/min/sq. m x 5 min= 5.0 cu.m/sq.m
Amount of washing water	: 5 cu.m/sq.m x 5,100 sq.m= 25,500 cu.m
Interval of washing	: $\frac{24 \text{ hrs}}{40 \text{ beds}}$ = 0.6 hrs/bed
Capacity of wastewater basin	: $\frac{25,500 \text{ cu.m}}{40 \text{ bes}}$ =640 cu.m/basin
Amount of supernatant water	: 25,500 x 80% = 20,400 cu.m
Benefit to be derived	: 5.37 Rs./1,000 gal

Assumptions for Alternative A

No. of wastewater basins	: $\frac{4 \text{ hrs}}{0.6 \text{ hrs}}$ = 6.7 say 8 basins
Reposing hour for wastewater	: 4 hrs

Assumptions for Alternative B

No. of wastewater basins	: 1 basin
Alum dosage	: 30 ppm, 150 percent of average dosing rate

Water Losses in Water Treatment Plant

IN REUSE

1. Treatment Flow Rate

$102.37 \times 1.25^{*} \times 0.95^{**} = 121.6$ mgd (553,000 cu.m/day)

*: $\frac{\text{max.day demand}}{\text{ave.day demand}} = 1.25$

** : conveyance water loss of 5%

2. Clarified Wastewater

Q1=553,000 x (0.3 to 1.0%)=1,660 to 5,530 cu.m

3. Washing Water of Filter Bed

Filtration rate : 120 cu.m/sq.m/day

Area of filter bed: $\frac{553,000}{120} \times 1.1 = 5,100$ sq.m

Washing rate : 1.0 cu.m/min x 5min

Q2 = 5 x 5,100 x 20% = 5,100 cu.m

4. Leakage from Facilities

Q3 = 553,000x 1.0% = 5,530 cu.m

5. Solution of Chemicals, Cleaning Gardening and Others

Q4 = 500 cu.m

6. Total Amount of Water to be Used in Plant

Q1 + Q2 + Q3 + Q4 = 12,790 to 16,660 cu.m

$\frac{12,790 \text{ to } 16,660}{553,000} = 2.3\%$ to 3.0%

Water Losses in Water Treatment Plant

WITHOUT REUSE

1. Treatment Flow Rate

$102.37 \times 1.25^{*} \times 0.95^{**} = 121.6$ mgd (553,000 cu.m/day)

* : $\frac{\text{max.day demand}}{\text{ave.day demand}} = 1.25$

** : conveyance water loss of 5%

2. Clarified Wastewater

Q1=553,000 x (0.3 to 1.0%) =1,660 to 5,530 cu.m

3. Washing Water of Filter Bed

Filtration rate : 120 cu.m/sq.m/day

Area of filter bed : $\frac{553,000}{120} \times 1.1 = 5,100$ sq.m

Washing rate : (0.75 to 1.1 cu.m/min) x (4 to 6 min)

= 3.0 to 6.6 cu.m/sq.m

Q2 = (3.0 to 6.6) x 5,100 = 15,300 to 33,660 cu.m

4. Leakage from Facilites

Q3 = 553,000 x 1.0% = 5,530 cu.m

5. Solution of Chemicals, Cleaning, Gardening and Others

Q 4 = 500 cu.m

6. Total Amount of Water to be Used in Plant

Q1 + Q2 + Q3 + Q4 = 22,990 to 45,220 cu.m

$\frac{22,990 \text{ to } 45,220}{553,000} = 4.2\%$ to 8.2%

ANNEX QUESTIONNAIRES ON WATER AND TARIFF

ANNEX-1 QUESTIONNAIRES FOR DOMESTIC USERS

Questionnaires on Water and Tariff for the Citizens of Islamabad/Rawalpindi

DOMESTIC WATER ONLY

(Face Items)

1. Name of the wage-earner in your household and his sex
   Name : ( )
   Sex : 1) Male 2) Female

2. His age
   1) Less than 20 years ( ) 2) 20 to 29 years ( )
   3) 30 to 39 years ( ) 4) 40 to 49 years ( )
   5) 50 to 59 years ( ) 6) 60 to 69 years ( )
   7) 70 years or more ( )

3. His vocation
   1) Farmer 2) Construction 3) Manufacturing
   4) Commerce 5) Service (Excluding Civil Servant)
   6) Civil Servant 7) Others ( )

4. Monthly wage of your household
   1) Less than Rs. 500 ( ) 2) Rs. 500 to 999 ( )
   3) Rs. 1,000 to 1,999 ( ) 4) Rs. 2,000 to 2,999 ( )
   5) Rs. 3,000 to 3,999 ( ) 6) Rs. 4,000 to 4,999 ( )
   7) Rs. 5,000 or more ( )

5. Number of members of your household
   1) 1 2) 2 3) 3 4) 4 5) 5 6) 6
   7) 7 8) 8 9) 9 10) 10 11) More than 10 ( )

6. Address of your household
   City : a) Islamabad b) Rawalpindi
   Address : ( )

7. Educational background of the wage-earner
   1) Primary School 2) Middle School 3) High School
   4) College 5) University 6) Others ( )

- Cont'd -

(Questions)

1. How much water do you think your household consumes per day ?
   Note : 1 litre = 0.22 gal. ; 1 gal. = 4.55 litres
   1) Less than 200 litres 2) 200 to 399 litres
   3) 400 to 599 litres 4) 600 to 799 litres
   5) 800 to 999 litres 6) 1,000 to 1,399 litres
   7) 1,400 to 1,799 litres 8) 1,800 to 2,199 litres
   9) 2,200 to 2,599 litres 10) 2,600 to 2,999 litres
   11) 3,000 litres or more ( )

2. What are the sources of the water your household uses ?
   Give rough percentage of water consumption for each source.

1) Pipe supplied water	(%)
2) Private well	(%)
3) Water from rivers, springs and ponds	(%)
4) Others ( )	(%)
Total	100 %

3. What will be the charge of water supply your household is willing to pay per month ?
   1) Less than Rs. 5 2) Rs. 5 to 9 3) Rs. 10 to 19
   4) Rs. 20 to 29 5) Rs. 30 to 39 6) Rs. 40 to 49
   7) Rs. 50 to 59 8) Rs. 60 to 79 9) Rs. 80 to 99
   10) Rs. 100 or more ( )

4. For what purposes does your household use water ? Give rough percentages of water consumption for the respective usages classified below.

1) Cooking	(%)
2) Drinking	(%)
3) Washing	(%)
4) Bathing	(%)
5) Toilet	(%)
6) Sprinkling gardens and lawns	(%)
7) Others ( )	(%)
Total	100 %

- Cont'd -

5. Please answer the following questions.

a) Is the supply of water sufficient for your household ?

1) Yes 2) No

b) Does interruption of water supply often occur ?

1) Yes 2) No

c) Is the quality of water good ?

1) Yes 2) No

d) Are you satisfied with the existing water charge ?

1) Yes 2) No

ANNEX-2 QUESTIONNAIRES FOR COMMERCIAL/INDUSTRIAL USERS

Questionnaires on Water and Tariff for the Industries of Islamabad/Rawalpindi

COMMERCIAL AND INDUSTRIAL WATER

(Face Items)

1. Name and address of your establishment
   Name : ( )
   Address : ( )

2. Name of the owner or representative of your establishment
   His name : ( )

3. Kind of business your establishment is engaged in

   1) Construction : ( )
      ex. Building,Road, etc.

   2) Manufacturing : ( )
      ex. Food, Textiles, Paper, Woodwork, Printing and Publishing, Leathercraft, Pottery, Brick, Cement, Chemicals, Metalwork, Machinery, etc.

   3) Commerce : ( )
      ex. Retail, Wholesale, Restaurant, etc

   4) Service: ( )
      ex. Bank, Transport, Hotel, Laundry, Repairs, Medical Service, Barber Shop, etc.

   5) Others : ( )

- Cont'd -

4. Sales amount of your establishment per year

1) Less than Rs. 250,000 ( )
2) Rs. 250,000 to 499,999 ( )
3) Rs. 500,000 to 999,999 ( )
4) Rs. 1,000,000 to 1,499,999 ( )
5) Rs. 1,500,000 to 2,499,999 ( )
6) Rs. 2,500,000 to 3,499,999 ( )
7) Rs. 3,500,000 to 4,999,999 ( )
8 Rs. 5,000,000 or more ( )

5. Number of workers (including managers and management) in your establishment

1) Less than 5 ( ) 2) 5 to 9 ( )
3) 10 to 19 ( ) 4) 20 to 29 ( )
5) 30 to 49 ( ) 6) 50 to 69 ( )
7) 70 to 99 ( ) 8) 100 or more ( )

(Questions)

1. How much water do you think your establishment uses on the average per day ?

Note: 1 litre = 0.22 gal. 1 gal. = 4.55 litres

1) Less than 1,000 litres 2) 1,000 to 1,999 litres
3) 2,000 to 3,999 litres 4) 4,000 to 5,999 litres
5) 6,000 to 8,999 litres 6) 9,000 to 11,999 litres
7) 12,000 to 15,999 litres 8) 16,000 to 19,999 litres
9) 20,000 to 24,999 litres 10) 25,000 to 29,999 litres
11) 30,000 litres or more ( )

- Cont'd -

2. What are the sources of the water your establishment uses? Give rough percentage of water consumption for each source.

1) Pipe supplied water	(%)
2) Private well	(%)
3) Water from rivers, springs and ponds	(%)
4) Others ( )	(%)
Total	100%

3. What will be the charge of water supply your establishment is willing to pay per month?

1) Less than Rs. 50	2) Rs. 50 to 99
3) Rs. 100 to 199	4) Rs. 200 to 299
5) Rs. 300 to 399	6) Rs. 400 to 499
7) Rs. 500 to 599	8) Rs. 600 to 799
9) Rs. 800 to 999	10) Rs. 1,000 or more ( )

4. Please answer the following questions.

a) Is the supply of water sufficient for your establishment?
   1) Yes 2) No

b) Does interruption of water supply often occur?
   1) Yes 2) No

c) Is the quality of water good?
   1) Yes 2) No

d) Are you satisfied with the existing water charge?
   1) Yes 2) No