ISLAMIC REPUBLIC OF PAKISTAN

IRRIGATION DEPARTMENT
GOVERNMENT OF THE PUNJAB

SMALL DAMS ORGANIZATION, ISLAMABAD

PC – II (CORRECTED)

FEASIBILITY STUDY AND PROPOSING SOLUTIONS OF PROBLEMATIC SMALL DAMS IN DEVELOPMENT ZONE

COST RS. 247.648 MILLION

January, 2020

SMALL DAMS ORGANIZATION ISLAMABAD
RAWAL DAM COLONY ISLAMABAD

IRRIGATION DEVELOPMENT ZONE, LAHORE

FEASIBILITY STUDY AND PROPOSING SOLUTIONS OF PROBLEMATIC SMALL DAMS IN DEVELOPMENT ZONE

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SECTION - 1

PC – II PROFORMA

PC-II FORM FOR

FEASIBILITY STUDY AND PROPOSING SOLUTIONS OF PROBLEMATIC SMALL DAMS IN DEVELOPMENT ZONE

S.No._____

(To be filled in by Planning Commission)

1.	**Name by which the name will be identified:**	**FEASIBILITY STUDY AND PROPOSING SOLUTIONS OF PROBLEMATIC SMALL DAMS IN DEVELOPMENT ZONE**
2.	**Administrative authorities responsible for :-**	
	a) Sponsoring:	Irrigation Department, Government of the Punjab.
	b) Execution:	Small Dams Organization, Islamabad, Irrigation Department, Government of the Punjab
3.	**Detail of Survey / Feasibility study**	
	General Description of the Scheme	The land of Potohar Plateau is broken and un-even. The average run-off generated is about 1.88 MAF out of which only 0.26 MAF (14%) has been tapped so far by small dams reservoirs. In the area, two third of annual precipitation occurs during the monsoon season i.e July to September, whereas the remaining nine months are nearly dry. Due to steep ground slopes, the rain water from numerous streams running at high velocities result in erosion of agriculture land. Further, the high velocity do not permit the water to soak down and recharge aquifer. Moreover, a little delay in rainfall at time of sowing and growing result in reduction of crop yield to less than half. The drought cycle adds further uncertainty towards agriculture in the area. Presently 56 No. small dams have been constructed and in operation under control of Small Dams Organization, Islamabad, Irrigation Department, Punjab. These projects were initiated after year 2000 but are yet to be completed / commissioned wherein technical issues are being faced. There are 12 No. problematic dams. These dams are not performing as per design and target fixed in PC-I.

The targets are not achieved after construction of mentioned dams one way or other except Cherah dam. The Cherah dam has not been constructed, whose PC-I was approved in 2008 and the project was not taken-up at site due to in-sufficient funding, non-completion of land acquisition and escalated cost.

Location

1. Tajabara Dam: is located near Tajabara Village in Tehsil Fateh Jang District Attock on Tanaza Kas, which is tributary of Dotal Kas.
2. Sadrial Dam: is located near Sadrial village in Tehsil Fateh Jang District Attock on Dotal Kas.
3. Jalwal Dam: is located about 2 KM from Jalwala village and about 18 km from Rawalpindi-Kohat Road, Tehsil Jand District Attock. Located on Sankhi Kas which outfall in River Indus.
4. Jamal Dam: is located near village Manghot 06 K.M from Mandra Chakwal Road and 50 K.M from Chakwal City Tehsil Gujjar Khan District Rawalpindi. Located on Ranjali Kass Tributary of Wadala Kas.
5. Minwal Dam: is located 35 Km from Chakwal near Village Minwal on Wadnawali Kass, a tributary of Soan River in Tehsil & District Chakwal.
6. Arrar Mughlan Dam: is located in Tehsil & District Chakwal about 25Km from Chakwal city on Chakwal – Sohawa Road near village Dhuman on Dagar Nullah.
7. Shah Habib Dam: is located at about 2 KM south west of Jammergal village, 55 KM from Jhelum city. Dam is located on local nullah kas, tributary of Jammergal Kas, which out falls in Jhelum River.
8. Fatehpur Dam: Dam is located at a distance of about 34 KM from south west of Domeli town, 84 KM from Jhelum city. Dam is located on a tributary of Bunha River which outfalls in Jhelum River.
9. Lehri Dam: is located at a distance of about 34 KM from south west of Domeli town, 84 KM from Jhelum city. Dam is located on a tributary of Bunha River which outfalls in Jhelum River.
10. Domeli Dam: is located at about 3 KM north-west of Domeli town, tehsil Sohawa District Jhelum. Dam is located on junction of Nili Nullah and Pamal Nullah, tributary of Kahan River, which out falls in Jhelum River.

11. Gurah Uttam Singh Dam: is located at about 25 KM south-west of Domeli town, and 75 KM from Jhelum city, tehsil and District Jhelum. Dam is located on Sore Kas, tributary of Kahan River, which out falls in Jhelum River.
12. Cherah Dam: is located on Soan river at about 2 Km Southeast of Cherah Village of Islamabad District.

General Features

Name of Dam	Catchment Area (Sq Mile)	Gross Storage (Aft)	Live Storage (Aft)	Command Area (CCA)	Spillway Capacity (CFS)
1. Tajabara Dam	7.43	2250	1500	1300	5500
2. Sadrial Dam	6.80	2750	1344	325	4914
3. Jalwal Dam	15.83	5000	2820	2364	2402
4. Jamal Dam	4.84	1860	1286	988	2897
5. Minwal Dam	5.00	2000	1003	750	1575
6. Arrar Mughlan Dam	54.83	5200	2200	1500	14540
7. Shah Habib Dam	1.35	1655	536	450	325
8. Fatehpur Dam	3.5 (Sq Km)	1733	650	300	1305
9. Lehri Dam	26.42	5705	4595	3000	4255
10. Domeli Dam	65.70	8690	4636	3000	41800
11. Gurah Uttam Singh Dam	35.5	2679	1029	1500	7240
12. Cherah Dam	87.5	24750	19250	15 (MGD)	49543

Physiography

The problematic dams are located in Rawalpindi, Attock, Chakwal and Jehlum districts of the Punjab, lying between the Indus and Jehlum rivers and bounded on the north by the Hazara Hills and on the south by the Salt Range. Its elevation varies from 1,000 to 2,000 ft (300 to 600 m) in a system of residual hills and hillocks formed from glacial debris as remnants of the Ice Age. The Kala Chitta Range thrusts eastward across the plateau toward Rawalpindi; the valleys of the Haro and Soan rivers cross the plateau from the eastern foothills to the Indus.

The rock exposed in the area belong to Dhok Pathan formation (Siwalik of middle Miocene age) the Dhok Pathan formation is typically represented by cyclic alternation of sandstone, siltstone and shale

Project Components

There are 12 No. problematic dams; these dams are not performing as per design and targets fixed in PC-I.

Sr. No.	Dam Name	Field Data			Studies / Reports							
		Geological Investigation	Topographic Survey	Material Testing	Hydrological	Geological	Hydraulic	Dam Design	Channel Design	Resettlement Action Plan	Environmental Report	Detailed design
1	Taja Bara Dam	Ok	Ok	Ok	Ok	Ok	Ok	Ok	Ok	Ok	-	Ok
2	Sadrial Dam	Ok	Ok	Ok	Ok	Ok	Ok	Ok	Ok	Ok	-	Ok
3	Jalwal Dam	-	Ok	-	-	-	Ok	-	Ok	-	-	-
4	Jamal Dam	-	Ok	-	-	-	Ok	-	Ok	-	-	-
5	Minwal Dam	-	Ok	-	-	-	Ok	-	Ok	-	-	-
6	Arrar Mughlan	-	-	Ok	-	-	-	-	-	-	Ok	-
7	Shah Habib Dam	Ok	-	Ok	Ok	Ok	-	-	-	-	-	-
8	Fatehpur Dam	-	Ok	-	Ok	Ok	-	-	-	-	-	-
9	Lehri Dam	Ok	-	Ok		Ok	Ok	Ok	-	-	-	-
10	Domeli Dam	-	Ok	-	-	-	Ok	-	Ok	-	-	-
11	Gurah Uttam Singh Dam	-	Ok	-	-	-	Ok	-	Ok	-	-	-
12	Cherah Dam	Ok	Ok	Ok	Ok	Ok	Ok	Ok	Ok	Ok	Ok	Ok

Feasibility Study

The main objective of the project is to gain professional and intellectual input in solving the functional deficiencies / problems in 12 No. problematic dam projects by hiring the services of Consultants. The Consultants will be required to consider the data provided by the client, improve the required data bank by gathering additional data / information, if required, to arrive at technically feasible and economically viable engineering solutions of the problematic dams. In addition, comparison of different alternatives / remedial measures to individual problems of each dam to achieve the intended benefits of these dams will be performed by the Consultants. Furthermore, preparation of Feasibility Reports, detailed designs, PC-I, tender documents, etc will also be carried out by the Consultants.

Justification of the Scheme

Over the course of time, various issues / problems have emerged in different dam projects which are either not delivering their intended benefits or could not be implemented owing to various technical issues. The dams which are facing command area benefits issues include Jalwal, Jamal, Minwal, Domeli and Gurah Uttam Singh Dams. Tajabara and Sadrial dams could not be implemented completely because of technical, legal and quality issues. Likewise, Shah Habib and Fatehpur Dams are facing live storage deficiency and command area issues. Lehri Dam is facing technical issues in outlet structure and requires comprehensive technical solution / remedy. Arrar Mughlan Dam is facing reservoir contamination and needs detailed environmental study. Contrary to above, Cherah Dam project could not be implemented due to in-

sufficient funding and therefore needs updation of feasibility study, PC-I and detailed design.

Analysis of work involved

The study will be carried out for 12 No. problematic dam projects. The detailed feasibility study, technical solution of problem areas, detailed design, etc includes the field data collection and office work.

The description is as follows: -

Surveys, Investigations and Studies

To address problem areas of different dams, the Consultants will ascertain the need and extent of surveys, investigations and other studies. The field activities may include, but not limited to, topographic surveys, geological investigations, EIA reports, preparation of resettlement plans, land acquisition plans and detailed designs.

Geological Investigation

Geological investigations of following dams will be carried out, as per requirement of the Consultants;

i. Tajabara Dam
ii. Sadrial Dam
iii. Shah Habib Dam
iv. Fatehpur Dam
v. Cherah Dam

The geological investigations include:

1) Surface Geological Mapping

Surface geological mapping of area including reservoir, dam site and spillway site.

2) *Sub Surface Investigation*

a) Core Drilling at Structure Area

As per site requirement core drilling on mentioned dam site, spillway site and other structures etc.

b) Test Pits

As per site requirement test pits on each dam site, reservoir, spillway and channel sites.

c) Sampling

Extraction of undisturbed samples from cohesive layers, samples including preservation, transportation to approved labs.

d) Field Testing

Standard penetration test (SPT), preservation of SPOT core sample and transportation to approved labs.

e) Laboratory Testing

Selected construction material sample collection and testing in approved laboratory.

Topographic Survey

For following dams, topographic survey of command area, survey of alignment of irrigation channel, L & X sections of irrigation channel will be carried out, as per requirement of the Consultants;

i. Tajabara Dam
ii. Sadrial Dam
iii. Jalwal Dam
iv. Jamal Dam
v. Minwal Dam
vi. Fatehpur Dam
vii. Domeli Dam
viii. Gurrah Uttam Singh Dam
ix. Cherah Dam (topographic survey of Pond area)

Other Studies
This may include:

i. Hydrological studies
ii. Hydraulic studies
iii. Structural designs
iv. Stability, settlement & seepage analysis
v. Structural designs
vi. Agronomy
vii. Environmental studies (EIA/IEE, EMP)
viii. Resettlement Action Plans (RAP)
ix. Land acquisition plans
x. Cost estimates
xi. Economic analysis
xii. Financial, sensitivity analysis
xiii. Feasibility study reports, PC-I's, BOQ, tender documents etc

SCOPE OF SERVICES / TERMS OF REFERENCE (T.O.R)

Attached as Section - IV

4. Implementation Period

The proposed study will take 24 months to complete.

5. Year wise Estimated Cost

Activities	Cost (Rs. Millions)			
	2019-20	2020-21	2021-22	Total
Survey, Investigation & data collection	5.000	58.389	-	63.389
Consultancy cost	45.000	70.000	69.259	184.259
Total	**50.000**	**128.389**	**69.259**	**247.648**

6. Man Power Requirements

The Consultants will be hired through competitive bidding process for the identification of problem areas, proposing solutions for problem areas, preparation of detailed feasibility reports, preparation of detailed designs and drawings, BOQ's, tender documents, etc.

7. Financial Plan

2019-20	2020-21	2021-22	Total
50.000	**128.389**	**69.259**	**247.648**

Expected Outcome of the Study

The study is expected to yield best possible engineering solutions by addressing problem areas of problematic dam projects to achieve the intended benefits of these projects envisioned at the time of their conception. The expected deliverables of the project include, but not limited to;

- Inception report
- Monthly & fortnightly progress reports and presentations
- Detail feasibility reports
- Detailed design reports, drawings and design calculations
- Geological reports
- Environmental reports
- Resettlement plans
- Command area & Irrigation system network design reports
- Economic analysis
- PC-I's
- Project Planning Report
- Detail Engineering Drawings for construction
- Engineering estimates
- BOQ's
- Tender documents
- Pre-qualification criteria of contractors, etc

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SECTION – 2

REPORT

FEASIBILITY STUDY AND PROPOSING SOLUTIONS OF PROBLEMATIC SMALL DAMS IN DEVELOPMENT ZONE

GENERAL REPORT

BACKGROUND:

Potohar Plateau is called Punjab's Barani Zone and is characterized by deteriorating land resources, negligible infrastructural development small fragmented land holdings with limited agricultural options and poor employment possibilities. The majority of farmers have holding of less than five hectares of land and farm income is considerably below than those of irrigated areas. One of assured means of improving the livelihood of rural population in the barani area is to develop the limited water resources where possible to provide a reliable irrigation water supply. The hydrograph of rivers of Soan, Haro, Resh, Kanshi, Kahan and Bunha show a seasonal pattern. Peak discharges coincide with rainfall period and generally occur during the months of July and august. During the remaining months of the year, rivers carry limited discharge and many tributaries of major rivers are even dry. Surface water quality is suitable for irrigation apart from turbidity during peak discharge periods; mostly quality of water is also suitable for drinking as well as for other domestic uses. Ground water resources are limited in the project area.

Total Basin Area of Potohar is about 22300 Sq. Kilometers, divided in to six numbers of Basins. Average yearly Run-off is 1.88 MAF, which used to go to waste in the sea. In early sixties, a plan was initiated to develop as many as water reservoirs by constructing small to medium dams across various tributaries of main rivers. Uptill now Total 56 No. dams have been completed, gross storage capacity of constructed dams is 252,619 Aft with CCA 72,209 acres. There are 09 No. small dams projects are under construction, after the completion of under construction project further gross storage capacity of 153,717 AFT & 52,600 acres of CCA will be added.

Over the course of time, various issues / problems have emerged in different dam projects which are either not delivering their intended benefits or could not be implemented owing to various technical issues. The dams which are facing command area benefits issues include Jalwal, Jamal, Minwal, Domeli and Gurah Uttam Singh Dams. Tajabara and Sadrial dams could not be implemented completely because of technical, legal and quality issues. Likewise, Shah Habib and Fatehpur Dams are facing live storage deficiency and command area issues. Lehri Dam is facing technical issues in outlet structure and requires comprehensive technical solution / remedy. Arrar Mughlan Dam is facing reservoir contamination and needs detailed environmental study. Contrary to above, Cherah Dam project could not be implemented due to in-sufficient funding and therefore needs updation of feasibility study, PC-I and detailed design.

OBJECTIVES AND JUSTIFICATION:

The main objective of the project is to gain professional and intellectual input in solving the functional deficiencies / problems in 12 No. problematic dam projects by hiring the services of Consultants. The Consultant will be required to consider the data provided by the IA, improve the required data bank by gathering additional data / information, if required, to arrive at technically feasible and economically viable engineering solutions of the problematic dams. In addition, comparison of different alternatives / remedial measures to individual problems of each dam to achieve the intended benefits of these dams will be performed by the Consultants. Furthermore, preparation of Feasibility Reports, detailed designs, PC-I, tender documents, etc will also be carried out by the Consultants.

DETAIL OF PROBLEMATIC DAMS:

1. TAJABARA DAM

Tajabara Dam Project is located near Tajabara Village in Tehsil Fateh Jang District Attock on Tanaza Kas, which is tributary of Dotal Kas. Catchment area up to the dam site is 19.25 sq. km. Minimum live storage required for irrigating proposed command area of 1300 acers has been kept as 1500 Aft. Gross storage capacity of dam is 2250 Aft. including dead storage capacity of 750 Aft. An earth fill zoned dam was proposed having central impervious zone with top width 15 feet. An irrigation channel having 12.25 cusecs discharge and length 26+400 ft. including 02 minors were proposed to irrigate 1300 acres of barani land.

The original PC-I namely “Construction of Small Dams in District Attock (Taja Bara, Sadrial & Shahbazpur Dam) was approved vide No. SO(EVL)IRRI/1-21/2007, Dated: 19.11.2007 for Rs. 404.376 Million. The Taja Bara dam was package-A in the approved PC-I with estimated cost of Rs. 203.176 Million. The original estimate was technically sanctioned by Chief Engineer, Development Zone, Lahore vide No. DB/2007/DEV/11721-22/07, Dated: 24.12.2007 for Rs. 422.941 Million with cost of Rs. 206.331 Million of Taja Bara dam.

The Executive Engineer, Development Division No. VI pointed out certain discrepancies regarding executed work of Tajabara dam vide letter No. 870/41-W, dated: 08.01.2010 and at site work was stopped which is still pending.

- Checking & expert committee constituted by the department to evaluate works.
- The Enquiry Committee was constituted by Chief Minister on 28.02.2011 as per PEEDA Act.
- One of the official filed petition in Lahore High Court and stay order granted by honorable Lahore High Court, Lahore against enquiry committee recommendations.

- Lahore High Court passed orders on 29.01.2018 that Secretary Irrigation Department after hearing officials will issue speaking order & Compliance report shall be furnished to Court through Deputy Registrar (Judicial).
- Regarding these dams project, there is also inquiry in NAB.
- For Taja Bara dam, contractor applied for arbitration on 28.03.2014, the arbitration process completed by Arbitration committee.
- For court ruling case is filed in Civil Court RWP by contractor.

The present status of the project is stated as below:

1	Main Dam	About 65% work was completed up to 2010. When work was stopped due to an enquiry initiated at the deficiencies reported by then Engineer In-chrage. A relief cut was made by the Executive Engineer In-charge during 2011 at deepest point of main dam body when pond level raised to dangerous level due to non-execution level of spillway. 50% of main dam body washed out. Moreover, less chimney filter was provided.
2	Spillway	Spillway location was changed during execution stage as per recommendations of Senior Geologist. A little work was carried out before suspension of work during 2010.
3	Outlet Structure	Structural work was completed without installation of regulation machinery.
4	Irrigation Channel	No work executed
5	Approach Road	Partially done
6	Land Acquisition	Partially done
7	Miscellaneous Allied Works	Partially done

It is proposed to update feasibility study report, PC-I, detailed design and fresh cost estimate to arrive at viable proposal to address problem areas.

2. SADRIAL DAM

The Sadrial Dam project is located near Sadrial village in Tehsil Fateh Jang District Attock on Dotal Kas, catchment area up to the dam site is 17.60 Sq. Km. Minimum live storage required for irrigating proposed command area of 325 acres has been kept as 1344 Aft. Gross storage capacity of dam is 2750 Aft. including dead storage capacity of 1406 Aft. An earth fill zoned dam has been constructed having central impervious zone. The capacity of spillway is 4914 Cs, which is equal to the highest flood of 1000 years return period after routing through reservoir. An Irrigation channel having 7.75 Cs discharge and length 14000 feet has been provided to irrigate 325 acres of barani land.

The original PC-I namely “Construction of Small Dams in District Attock (Taja Bara, Sadrial & Shahbazpur Dam) was approved vide No. SO(EVL)IRRI/1-21/2007, Dated: 19.11.2007 amounting to Rs. 404.376 Million. The Sadrial dam was package-B in the approved PC-I with estimated cost of Rs. 97.117 Million. The original estimate was technically sanctioned vide Chief Engineer, Development Zone, Lahore No. DB/2007/DEV/11721-22/07, Dated: 24.12.2007 amounting to Rs. 422.941 Million with cost of Rs. 104.722 Million of Sadrial dam.

The Executive Engineer, Development Division No. VI pointed out certain discrepancies regarding executed work of Sadrial dam vide letter No. 870/41-W, dated: 08.01.2010 and at site work was stopped which is still pending.

- Checking & expert committee constituted by the department to evaluate works.
- The Enquiry Committee was constituted by Chief Minister on 28.02.2011 as per PEEDA Act.
- One of the official filed petition in Lahore High Court and stay order granted by honorable Lahore High Court, Lahore against enquiry committee recommendations.
- Lahore High Court passed orders on 29.01.2018 that Secretary Irrigation Department after hearing officials will issue speaking order & compliance report shall be furnished to Court through Deputy Registrar (Judicial).
- Regarding these dams project, there is also inquiry in NAB.
- For Sadrial dam, contractor applied for arbitration on 24.11.2015.
- For Sadrial dam arbitration process completed by Arbitration committee.
- For court ruling case is filed in Civil Court RWP by contractor.

The present status of the project is stated as below:

1	Main Dam	Main dam body completed except catch water drains, wave wash wall and toe drain. Upstream stone pitching requires partial replenishment.
2	Spillway	Only excavation of spillway channel was executed by the contractor. Balance work including bridge over the spillway channel yet to be carried out.
3	Outlet Structure	Structural components are completed. Regulation machinery was fixed by the contractor which needs replacement being not functional. D/S sump needs repair work.
4	Irrigation Channel	Irrigation channel in a length of about 6500 Rft. out of 14000 was executed by the contractor. With the passage of time, the condition of executed work has been deteriorated and it requires rectification. Balance work from RD 6+500 to RD 14+000 yet not executed.

5	Approach Road		Partially Executed
6	Land Acquisition		Partially Executed
7	Miscellaneous Works	Allied	Partially Executed
8	Building Work		Gauge reader quarter structure (brick work, R.C.C roof slab) is being constructed, the finishing works are required to be executed

It is proposed to update feasibility study report, PC-I, detailed design and fresh cost estimate to arrive at viable proposal to address problem areas. Furthermore, it is also required to check viability of raising of dam to enhance command area and benefits derived from dam.

3. JALWAL DAM

The project construction of Jalwal Dam is located on Sankhi Kass which outfalls in River Indus. The dam is located about 2 KM from Jalwal village. The catchment area of dam is 41.00 sq. km. Capacity of irrigation channel is 23 Cs. In PC-I, proposed irrigation through this dam was 2364 acres. The live storage capacity is 2820 AFT. Gross storage capacity is 5000 AFT including the dead storage capacity of 2180 AFT. The dam is earth fill type with the maximum height of 60 ft and having top length of dam is 2000 ft. Wide open channel chute spillway of 1315 ft in width has been constructed to accommodate 2400 cusec flood water, outlet structure consists of pre-stressed reinforced concrete pipe laid in the right side abutment with control on upstream side has been constructed.

The scheme was administratively approved vide No. SO(EVL)/IRRI/1-05/2004 dated 25.08.2004 of Rs. 95.03 Million and Revised vide No. SO(EVL)IRRI/1-5/2004 dated 17.10.2005 of Rs. 98.76 Million. Scheme was technically sanctioned vide No. DB/2004/10944-45/58/2004 dated 17.10.2005 of Rs. 98.76 Million. Project was divided into two packages.

- In original PC-I irrigation channel was proposed in a length of 40000 ft. with allied structure but detailed survey revealed that the proposed channel passes through highly intricate route and ultimately do not meet with the targets of desired benefits. Therefore, keeping in view site condition, length was curtailed and main irrigation channel was completed upto 11500 ft.
- At the moment only 180 acres are being irrigated through existing irrigation channel against 2364 acres.
- A katcha road was joining two villages from the pond area. After accumulation of water in reservoir connection between villages has been disconnected. There is need of construction of vented causeway or village road bridge to connect villages.

A detailed study of command area and irrigation channel network system design is required to arrive at technically viable solution to overcome deficiency of command area and original PC-I targets to be achieved.

4. JAMAL DAM

Jamal Dam is situated near village Manghot 06 Km from Mandra Chakwal Road and 50 Km from Chakwal city, Tehsil Gujar Khan, District Rawalpindi. The scheme was administratively approved for Rs. 78.47 Million and was Technically Sanctioned for Rs. 84.237 Million. The project was started in the year 2004 and was completed during the year 2006. The catchment area of dam is 4.84 Sq. Mile. Capacity of irrigation channels of dam is 8.75 Cs. The length of channels is 27700 ft. to irrigate 1488 acres of barani land. The live storage capacity of dam is 1286 AFT and Gross storage capacity is 1860 AFT. The dam is concrete gravity type with maximum height of 87 ft and top length of dam is 570 ft. The spillway is centrally located ogee type spillway having clear water way of 69 ft and design discharge of the spillway is 2897 Cs.

- The irrigation channel is not operational.
- The alignment of channel was proposed along the natural nullah in the head reach. The siphon portion reach RD-0+000 to 15+575 was laid with P.R.C.C. Pipe in haphazard manners. The Department made several efforts to make the irrigation channel functional but the leakage of joints could not be redressed. In addition, P.R.C.C. pipes do not sustain water pressure which results in bursting / cracking action.
- At the moment no area is being irrigated through existing irrigation channel against 1488 acres.

A detailed study of command area and irrigation channel network system design is required to arrive at technically viable solution to overcome deficiency of command area and original PC-I targets to be achieved.

5. MINWAL DAM

The Minwal Dam is located 35 Km from Chakwal near Village Minwal on Wadnawali Kass, a tributary of Soan River in Tehsil & District Chakwal. This dam was constructed in 2008 with 1003 Aft live storage to irrigate 300 Acres command area of village Minwal. This project was completed at cost of Rs. 97.73 Million to irrigated 750 Acre land. The irrigation network is of composite type i.e. comprising of syphon and open channel of PCC lining of trapezoidal section having 06 cusecs discharge capacity. The irrigators have requested that the command area may be developed by constructing water courses etc, so that the benefits of the constructed dam could be delivered to the maximum land owners. In this respect, the detail survey has been carried out by the field formation. The tentative length of water courses has been proposed in 22688 Rft length to provide the irrigation water at farm gate. At the moment only 120 acres are being irrigated through existing irrigation channel against 750 acres. A detailed study of command area and irrigation channel network system design is required to arrive at technically viable solution to overcome deficiency of command area and original PC-I targets to be achieved.

6. ARRAR MUGHLAN DAM

The project was originally approved for Rs. 651.984 Million vide No. SO(Evl)irri/1-9/2011, dated 17-03-2012 and original T.S Estimate for Rs. 662.539 Million vide No. DB/Dev/2012/3497-98/130/2011, dated 16-04-2012 and 1st revised PC-I was approved vide No. SO(Evl) irri/1-9/2011, dated 23-07-2013 for Rs. 829.375 Millions. Accordingly, the estimate was sanctioned by the competent authority vide No. DB/Dev/2014/1521-22/130/2014, dated 28-02-2014 for Rs. 816.013 Millions.

Sewage water of Chakwal City, Punjain Village and chak Baqar Shah flows in to Nullah Daggar. The end point / tail of reservoir of Arrar Mughlan Dam touches village Chak Baqar Shah. Sewage water of Chakwal & other villages on upstream of Dam stagnate at this spot & slope of drainage water of Chak Baqar Shah is also towards the pond of dam. There is contamination of stored water due to sewerage effluents and causing health hazards, bad smell & contamination of underground drinking water.

There is need to identify sources of sewerage effluents, water quality test and proposing viable / economical solutions for water quality improvement. Moreover, environmental study needs to be carried out to arrive at a viable solution.

7. SHAH HABIB DAM

Dam site is located at about 2 KM south west of Jammergal village, 55 KM from Jhelum city. Dam is located on local nullah kas, tributary of Jammergal Kas, which out falls in Jhelum River. The catchment area of dam is 3.5 sq. km. Capacity of irrigation channel of dam is 3 Cs. In PC-I, proposed irrigation through this dam was 450 acres. The live storage capacity is 536 AFT. Gross storage capacity is 1655.46 AFT including the dead storage capacity of 392.70 AFT. The dam is earth fill type with the maximum height of 77 ft and having 325 ft top length of dam. The open cut spillway of 33 ft in width has been constructed to accommodate 325 Cs flood water, outlet structure consists of pre-stressed reinforced concrete pipe laid in the right side abutment with control on upstream side.

The scheme was administratively approved vide No. SO(EVL)/IRRI/1-10/2005 dated 29.10.2005 of Rs. 191.950 Million and Revised vide No. SO(EVL)IRRI/1-10/2005(Vol-I) dated 31.08.2008 of Rs. 198.876 Million. Scheme was technically sanctioned vide No. DB/DEV/2008/10215-16/95/2008 dated 25.10.2008 of Rs. 197.559 Million (Part B: Shah Habib Dam Rs. 40.558 Million).

- The irrigation channel is not operational due to non-availability of live storage in reservoir since its completion.
- Low inflows from catchment area are being generated. Moreover, percolation of stored water in the reservoir area has been observed.

- Designed inflows are not being received from small catchment area. Moreover, pond level gradually drops even without the operation of irrigation channel. It can be inferred that there are some hydrological & geological issues with the catchment as well as reservoir area.

Hydrological & Geological studies are required to arrive at some feasible as well as technically viable solution to cater for problems so that intended benefits of dam may be accrued.

8. FATEHPUR DAM

The dam site is at a distance of about 34 KM from south west of Domeli town, 84 KM from Jhelum city. Dam is located on a tributary of Bunha River which outfalls in Jhelum River. The catchment area of dam is 3.5 sq. km. Capacity of irrigation channel of dam is 4 Cs. In PC-I, proposed irrigation through this dam was 315 acres. The live storage capacity is 441 AFT. Gross storage capacity is 1733 AFT including the dead storage capacity of 1292 AFT. The dam is earth fill type with the maximum height of 78 ft and having top length of dam 375 ft. Open cut spillway of 35 ft in width has been constructed to accommodate 1305 Cs flood water. The outlet structure consists of pre-stressed reinforced concrete pipe with control on upstream side.

The scheme was administratively approved vide No. SO(EVL)/IRRI/1-28/2006 dated 09.12.2006 of Rs. 52.311 Million. Scheme was technically sanctioned vide No. DB/2007/DEV2438-39/103/06 dated 14.03.2007 of Rs. 57.130 Million.

- The irrigation channel is not operational due to non-availability of live storage in reservoir since its completion.
- Low inflows from small catchment area are being generated.
- Designed inflows are not being received from small catchment area. As a result, designed reservoir levels have not been attained since construction to feed irrigation channel. It can be inferred that there are some hydrological issues with the small catchment area.

Hydrological studies are required to arrive at some feasible as well as technically viable solution to cater for problems so that intended benefits may be accrued.

9. LEHRI DAM

The dam site is situated at a distance of about 15 KM from Dina town on Dina-Mangla road in District Jhelum. Dam is located on Pathawala Kas which outfalls in Jhelum River. The catchment area of dam is 26.42 sq. km. Capacity of irrigation channel is 30 Cs. In PC-I, proposed irrigation through this dam was 2220 acres. The live storage capacity is 4595 AFT. Gross storage capacity is 5705 AFT including the dead storage capacity of 1110 AFT. The dam is earth fill type with the maximum height of 109 ft and having top length of dam is 475 ft. Chute type spillway of 65 ft in width has been constructed to accommodate 4250 cusec flood water. The outlet structure consists of pre-stressed reinforced concrete pipe with control on upstream side.

The scheme was administratively approved vide No. SO(EVL)/IRRI/1-11/2002 dated 23.10.2003 of Rs. 127.514 Million. Scheme was technically sanctioned vide No. WII/LHR/2003/22085-86/78/2003 dated 15.11.2003 of Rs. 123.943 Million.

- The settlement and seepage problem was observed in dam during first year of operation. The settlement in dam embankment has been observed up to 2.0 ft.
- Due to settlement, some pipe segments of outlet conduit inside dam embankment were damaged / cracked.
- A viable solution is required to overcome the problem of settlement of buried concrete pipe of outlet besides cracking and disjoining of pipe joints within the dam body.

A detailed study is required to arrive at technically viable solution to the problem.

10. DOMELI DAM

Dam site is located at about 3 KM north-west of Domeli town, tehsil Sohawa District Jhelum. Dam is located on junction of Nili Nullah and Pamal Nullah, tributary of Kahan River, which out falls in Jhelum River. The catchment area of dam is 170 sq. km. Capacity of irrigation channel is 30 Cs. In PC-I, proposed irrigation through this dam was 3000 acres. The live storage capacity is 4636 AFT. Gross storage capacity is 8690 AFT including the dead storage capacity of 4054 AFT. The dam is earth fill zoned type with the maximum height of 120 ft and having top length of dam 1100 ft. The open cut spillway of 230 ft in width has been constructed to accommodate 41840 Cs flood water.

The scheme was administratively approved vide No. SO(EVL)/IRRI/1-11/2004 dated 17.12.2004 of Rs. 259.924 Million and Revised vide No. SO(EVL)IRRI/1-11/2007 dated 19.11.2007 of Rs. 321.389 Million. Scheme was technically sanctioned vide No. D.B/2007/DEV/13-14/34/04 dated 01.01.2008 of Rs. 320.537 Million.

- Due to very large catchment area of dam, the reservoir attains NPL in every monsoon season.
- The dam is operational since its construction. However, the entire command area is not being irrigated.
- Maximum area booked so far is 1519 acres out of proposed 3000 acres.
- The reason for less booking is uneven terrain, smaller size of land holding and lack of awareness of efficient irrigation practices.

A detailed study of command area and irrigation channel network system design is required to arrive at technically viable solution to overcome deficiency of command area and original PC-I targets to be achieved

11. GURHA UTAM SINGH DAM

Dam site is located at about 25 KM south-west of Domeli town, and 75 KM from Jhelum city, tehsil and District Jhelum. Dam is located on Sore Kas, tributary of Kahan River, which out falls in

Jhelum River. The catchment area of dam is 35.5 sq. km. Capacity of irrigation channel is 12.25 Cs. In PC-I, proposed irrigation through this dam was 1500 acres. The live storage capacity is 1029 AFT. Gross storage capacity is 2679 AFT including the dead storage capacity of 1650 AFT. The dam is earth fill zoned type with the maximum height of 94 ft and having top length of dam 500 ft. The open cut spillway of 98.40 ft in width has been constructed to accommodate 7240 cusec flood water.

The scheme was administratively approved vide No. SO(EVL)/IRRI/1-10/2005 dated 29.10.2005 of Rs. 150.842 Million and Revised vide No. SO(EVL)IRRI/1-10/2005(Vol-I) dated 30.08.2008 of Rs. 198.876 Million. Scheme was technically sanctioned vide No. DB/DEV/2008/10215-16/95/2008 dated 25.10.2008 of Rs. 197.559 Million (Part A: Gurha Utam Singh Rs. 157.001 Million).

- Due to large catchment area of dam, the reservoir attains NPL in every monsoon season.
- The dam is operational since its construction. However, the entire command area is not being irrigated.
- Maximum area booked so far is 368 acres out of proposed 1500 acres.
- The reason for less booking is uneven terrain, smaller size of land holding and lack of awareness of efficient irrigation practices.

A detailed study of command area and irrigation channel network system design is required to arrive at technically viable solution to overcome deficiency of command area and original PC-I targets to be achieved

12. CHERAH DAM

Cherah Dam Site is located on Soan river at about 2 Km Southeast of Cherah Village of Islamabad District. The effective catchment area is 225 Sq. Km. The gross storage capacity is 24750 Aft, out of which live storage capacity is 19250 Aft and dead storage capacity is 5500 Aft with adopted life of dam of 50 years.

The proposed dam will provide an assured supplying of drinking water of 15.00 MGD to twin cities i.e. Rawalpindi and Islamabad through gravity at 50/50 % sharing basis (Punjab & Federal Govt). The scheme was administratively approved vide Government of the Punjab No. SO (Evl) Irri / 1-1 / 2007 dated 07.04.2009 for an amount of Rs.5307.22 Million civil work cost is Rs. 4109.224 Million & land acquisition cost is Rs. 1197.996 Million.

For land acquisition process, section 4 of the land acquisition act 1894 has been published vide gazette notification No. 537/2(159)-DRA dated 13.06.2009. PC-I was approved in 2009, being in the vicinity of Islamabad territory there is increase in settlement in pond area of dam since 2009. It is proposed to update feasibility study report, PC-I, detailed design and fresh cost estimate to arrive at viable proposal to address problem areas.

IMPLEMENTATION ARRANGEMENTS:

The Consultants will be hired to complete following two assignments:

Assignment – A

Assignment – A includes identification of problem areas of dams, considering available and additionally gathered field data through surveys, geological investigations or any other studies, as required by the Consultants. In this assignment, the Consultants will further provide comparison of various technical alternatives to reach upon technically and economically feasible solutions to address respective problem areas of dams.

Assignment – B

Assignment – B includes finalization of the solutions of all the problematic dams by the client, from one or more solutions proposed by the Consultants for each dam. In view of finalized solutions, the Consultants will prepare detailed feasibility reports, detailed engineering designs (including but not limited to, hydraulic and structural designs of dams and spillways, irrigation network system designs, etc), carry out command area assessments, prepare EIA reports, Resettlement Action Plans (RAPs), cost estimates, PC-I documents, tender documents, BOQ's, pre-qualification criteria of contractors or any other task entrusted by the client.

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PROJECT DIRECTOR
Small Dams Organization
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SECTION – 3

COST ESTIMATE

FEASIBILITY STUDY AND PROPOSING SOLUTIONS OF PROBLEMATIC SMALL DAMS IN DEVELOPMENT ZONE

GENERAL ABSTRACT OF COST

Sr. No.	Description	Amount
A	Hiring of consultants (key + support staff) for field data collection, to carry out hydrological study, preparation of feasibility and detail engineering desin, EIA report, resettlement plan, cost estimation, preparation of PC-I, operational cost, Land Acquisition etc complete	184,258,638
B	Geological Investigations, Topographic Survey and Material Testing for data collection	63,389,088
	Sub Total	**247,647,726**
	G. Total (Rs.)	**247,647,726**
	Rs. In Million	**247.648**

The provisions made in PC-II are correct and justified

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A. BUDGET ESTIMATE
FEASIBILITY STUDY AND PROPOSING SOLUTIONS OF PROBLEMATIC SMALL DAMS IN DEVELOPMENT ZONE

	Description	Unit	Quantity	Amount (M. Rs.)
A	**RENUMERATIONS**			
1.	Salary cost for Project Office	Person-Months	290	97,950,000
	Total (A): (Renumerations)		**290**	**97,950,000**
B	**OUT-OF-POCKET EXPENSES (OPE)**			
(a)	***Support Staff***			
	Technical Support Staff, Computer Operator (02), Quantity surveyors (2), Field Surveyor (2), Draftsman (02), Nabib Qasid / drivers (04) etc	Person-Months	264	21,720,000
	Total (a): (Support Staff)		264	21,720,000
(b)	***Direct Cost***			
	Project Office			
	Miscellaneous (Operational Cost)			44,156,438
	Total (b): (Direct Cost)			44,156,438
	Total (B) (a+b): (OPE)			**65,876,438**
C	**PROVISIONAL SUMS**			
	Estimated Income Tax on renumerations & Support Staff @16%			19,147,200
	Total (C): (Provisional Sums)			**19,147,200**
D	**LAND ACQUISITION (DOCUMENTATION / PUBLICATION)**			**1,285,000**
	GRAND TOTAL (A+B+C+D):			**184,258,638**

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A. ESTIMATED SALARY / RENUMERATION COST

FEASIBILITY STUDY AND PROPOSING SOLUTIONS OF PROBLEMATIC SMALL DAMS IN DEVELOPMENT ZONE

Sr #	Position	No.	Unit	Quantity	Rate Rs.	Amount Rs.
A	**Salary Cost**					
1	Team Leader / Project Manager	1	Man Month	24	650000	15,600,000
2	Principal Hydrologist	1	Man Month	18	575000	10,350,000
3	Principal Hydraulics / Irrigation Design Engineer	1	Man Month	18	575000	10,350,000
4	Principal Engineer (Dam Design Engg)	1	Man Month	18	575000	10,350,000
5	Sr. Structure Design Engineer	1	Man Month	12	450000	5,400,000
6	Sr. Geologist / Geotech Specialist	1	Man Month	12	450000	5,400,000
7	Jr. Geologist	1	Man Month	12	140000	1,680,000
8	Irrigation Specialist Engineer	1	Man Month	18	450000	8,100,000
9	Sociologist / Resettlement Specialist	1	Man Month	5	450000	2,250,000
10	Environmental Specialist	1	Man Month	3	450000	1,350,000
11	Agricutural Agronomist	1	Man Month	4	450000	1,800,000
12	Public Health Engineering Specialist	1	Man Month	5	450000	2,250,000
13	Agricultural Engineer / Water Management Specialist	1	Man Month	4	450000	1,800,000
14	Horticulturist	1	Man Month	2	450000	900,000
15	Economist	1	Man Month	5	350000	1,750,000
16	Procurement & Contract Specialist	1	Man Month	4	350000	1,400,000
17	GIS Specialist / Data Analyst	1	Man Month	6	350000	2,100,000
18	Junior Engineer	6	Man Month	18	140000	15,120,000
	Total Salary Cost (A)				**Rs.**	**97,950,000**

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B. ESTIMATED SALARY OF SUPPORT STAFF

FEASIBILITY STUDY AND PROPOSING SOLUTIONS OF PROBLEMATIC SMALL DAMS IN DEVELOPMENT ZONE

Sr #	Position	No. of Persons	Unit	Quantity	Rate Rs.	Amount Rs.
B	**Salary Cost**					
Support Staff						
1	Draftsman / Autocated Technician	2	Man Month	18	115000	4,140,000
2	Quantity Surveyor	2	Man Month	18	115000	4,140,000
3	Surveyor	2	Man Month	24	115000	5,520,000
4	Computer Operators	2	Man Month	24	75000	3,600,000
5	Naib Qasid / Drivers	4	Man Month	24	45000	4,320,000
	Total Salary Cost (A)					**21,720,000**

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FEASIBILITY STUDY AND PROPOSING SOLUTIONS OF PROBLEMATIC SMALL DAMS IN DEVELOPMENT ZONE

COST ESTIMATE

Sr #	Position	Unit	Quantity	Rate (Rs.)	Amount (Rs.)
C	**Direct Cost**				
1	Laptop (latest model, approved brand)	P.No.	2	204000	408,000
2	Mutimedia	P.No.	1	185000	185,000
3	Destop Computers Core i7	P. No.	4	198000	792,000
4	HP laser printers hp	P. No.	4	77000	308,000
5	Color Laser printer A3 size hp	P. No.	1	472000	472,000
6	Digital cameras	P.No.	2	96000	192,000
7	Photo copy machine (40 to 60 cpm)	P.No.	1	525000	525,000
8	Split AC (1.5 tons)	P.No.	3	102000	306,000
9	Total Station (approve brand)	P.No.	1	995000	995,000
10	LED / Smart TV (40")	P.No.	1	95000	95,000
11	Refrigerator (18 cft)	P.No.	1	94500	94,500
12	Microware oven	P.No.	1	21700	21,700
13	**Vehicles**				
i	Suzuli Cultus VXL	P.No.	1	1885000	1,885,000
ii	Toyota Double Cabin (4x4) 2755 CC	P.No.	2	5884000	11,768,000
iii	Registration	Lumpsum			435,575
iv	POL & Repair (3 No. vehicles)	Months	24	250000	6,000,000
v	Insurance of vehicle @ 3% of total cost				546,120
14	UPS (2000 Watts)	P.No.	2	96000	192,000
15	Generator (7.5 Kva)	P.No.	1	185000	185,000
16	Office furniture (office tables, office chairs, computer tables, almirah, racks, conference table & chairs etc)	Lumpsum			1,500,000
17	Field Allowance (T.A /D.A)	Months	24	60000	1,440,000
18	Telephone and Telex etc	Months	24	50000	1,200,000

19	Stationery and Drafting supplies etc	Months	24	80000	1,920,000
20	Preparation and Printing of feasibility, design report, PC-I, tender documents, Maps, drawings etc	Lumpsum			1,200,000
21	Camping facility for conducting field investigations, survey work, land acquisition process etc	Months	12	100000	1,200,000
	Total Direct cost (A)				**33,865,895**
B	**Accomodation / Office**				
1	Rent for the office / accomodation i/c utilities bills & messing	Months	24	175000	**4,200,000**
C	**Adding 16% PST**				**6,090,543**
	Sub Total : (A+B)				**44,156,438**

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B. BUDGET ESTIMATE (DATA COLLECTION)

FEASIBILITY STUDY AND PROPOSING SOLUTIONS OF PROBLEMATIC SMALL DAMS IN DEVELOPMENT ZONE

Sr. No.	Description	Rate	Quantity	Amount (M. Rs.)
1	Sub-surface geological investigations for 5 No. dam sites	3,428,030	5	17,140,150
2	Topographic survey for 8 No. dam sites	3,583,050	9	32,247,450
3	Material testing for 12 No. dam sites	775,500	12	9,306,000
	SUB TOTAL (Rs.)			**58,693,600**
	Adding 5% PST			2,934,680
	Adding 3% Contigency			1,760,808
	TOTAL (Rs.)			**63,389,088**

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FEASIBILITY STUDY AND PROPOSING SOLUTIONS OF PROBLEMATIC SMALL DAMS IN DEVELOPMENT ZONE

SUB-SURFACE GEOLOGICAL INVESTIGATIONS FOR 1 NO. DAM SITE

A. Core Recovery Drilling including water pressure tests for permeability of strata @ 10ft interval

Total length of drilling per site has been assumed to be 1000 Rft, which may include left and right abutment, nullah bed, spillway, periphery of pond area etc.

It is assumed that 5 No. boreholes will be made at 1 dam site, thus requiring 4 times shifting of machinery

Sr. No.	Description	Qty		Unit	Rate (Rs)	Amount (Rs)
1	Mobilization and Demobilization	1	1	Job	77832.00	77,832
2	Shifting of Machinery from hole to hole	4	1	No.	7152.00	28,608
3	Drilling of bore holes for sub surface geological investigation to assess foundation condition, depth of over burden or bed rock, type of under lying strata, permeability of strata, different structures and characteristics of strata	1000	1	Rft	2612.45	2,612,450
4	Water presuure test @ 10 ft interval	100	1	No.	7091.40	709,140
			Sub Total (A)			**3,428,030**

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FEASIBILITY STUDY AND PROPOSING SOLUTIONS OF PROBLEMATIC SMALL DAMS IN DEVELOPMENT ZONE

Topo Graphic Survey Work for 1 No. Dam Site

S #	Description	No	Unit	Rate / Acre	Amount
1	Surveying and supplying maps as per prevailing coordinate system in Pakistan (3 copies on paper, one on tracing paper and one soft copy of all survey on CD) of dam axis and spillway showing 3 ft. contour interval scale 1:500 with vertical and horozontal tolerance 0.25± inch and i/c shifting and fixing B.Ms. R.C.C pillar (size 2'x2'x3') at suitable places on right and left abutment of nullah and spillway site i/c showing important features complete in all respects. Shifting of B.M from nearest SOP (Survey of Pakistan) B.M and closing on same B.M (recording readings on level book and providing to checking agency). As per direction and entire satisfaction of Engineering incharge. i) Spillway site. ii) Dam axis	75	Acre	1038	77,850
2	Surveying and supplying maps as per prevailing coordinate system in Pakistan (3 copies on paper, one on tracing paper and one soft copy of all survey on CD) of pond area alignment showing 3 ft. contour interval scale 1:2000 with vertical and horizontal tolerance 0.25± inch and i/c shifting and fixing B.Ms. R.C.C pillar (size 2'x2'x3') at suitable places in the pond area i/c showing importing features complete in all respects. Shifting of B.M from nearest SOP (Survey of Pakistan) B.M and closing on same B.M (recording readings on level book and providing to checking agency). As per direction and entire satisfaction of Engineering incharge.	1000	Acre	976	976,000
3	Surveying and supplying maps as per prevailing coordinate system in Pakistan (3 copies on paper, one on tracing paper and one soft copy of all survey on CD) of command area / channel alignment showing 3 ft. contour interval scale 1:2000 with vertical and horizontal tolerance 0.25±inch and i/c shifting and fixing B.Ms. R.C.C pillar (size 2'x2'x3') at suitable places in the pond area i/c showing importing features complete in all respects. Shifting of B.M from nearest SOP (Survey of Pakistan) B.M and closing on same B.M (recording readings on level bokk and providing to checking agency).As per	2000	Acre	976	1,952,000

	direction and entire satisfaction of Engineering incharge.				
4	Observing X- Sections and L- Sections of Dam, Spillway and Irrigation Channel (One soft copy on CD and two printouts on graphical sheets) complete in all respects as per entire satisfaction of engineer incharge	65000	Rft	8.88	577,200
		Total (A)			**3,583,050**

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FEASIBILITY STUDY AND PROPOSING SOLUTIONS OF PROBLEMATIC SMALL DAMS IN DEVELOPMENT ZONE

MATERIAL TESTING FOR 1 NO. DAM SITE

Sr. No.	Description	Quantity	Rate	Unit		Amout (Rs.)
1	Moisture content (lab.)	10	600	1	No.	6,000
2	Unit weight (lab.)	10	600	1	No.	6,000
3	a) Sieve analysis (dry)	10	1,500	1	No.	15,000
4	Hydrometer	10	5,000	1	No.	50,000
5	Liquid limit & Plastic limit	10	1,500	1	No.	15,000
6	Shrinkage limit	10	600	1	No.	6,000
7	a) Permeability (constant head)	10	3,000	1	No.	30,000
8	Direct shear	10	5,000	1	No.	50,000
9	Consolidation	10	8,000	1	No.	80,000
10	a) Specific gravity (fine grain)	10	1,500	1	No.	15,000
	b) Specific gravity (coarse grain)	10	1,500	1	No.	15,000
11	b) Modified compaction (6" mould)	10	3,000	1	No.	30,000
12	Organic Matter	10	3,000	1	No.	30,000
13	Triaxial Test	15	5,000	1	No.	75,000
14	Unconfined test	15	2,500	1	No.	37,500
15	Soil Resistivity test	15	20,000	1	No.	300,000
16	Water quality test	5	3000	2	No.	15,000
	Total (Rs.)					**775,500**

Note:- All rates are as per lab test rates of UET Taxila.

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FEASIBILITY STUDY AND PROPOSING SOLUTIONS OF PROBLEMATIC SMALL DAMS IN DEVELOPMENT ZONE

LAND ACQUISITION (PUBLICATION / DOCUMENTATION)

Sr. No.	Description	Quantity	Rate	Unit		Amout (Rs.)
1	Publication of Gazette Notification (06 No. Dams. Per dam 10 No. Pages)	60	4750	1	No.	285,000
2	Stationary Charges (Tracing paper, tracing pens, maps,		Lump sum			500,000
3	Photocopies of revenue record	2000	20	5	No.	200,000
4	Printing charges	1000	50	6	No.	300,000
	Total (Rs.)					**1,285,000**

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SECTION – 4

TERMS OF REFERENCE (T.O.R) OF CONSULTANTS

TERMS OF REFERENCE

TERMS OF REFERENCE OF CONSULTANTS FOR FEASIBILITY STUDY AND PROPOSING SOLUTIONS OF PROBLEMATIC SMALL DAMS IN DEVELOPMENT ZONE

1. Introduction

Presently 56 No. small dams have been constructed and are in operation under control of Small Dams Organization, Islamabad, Irrigation Department, Punjab. These reservoirs provide irrigation supplies beside domestic & drinking water supplies to the adjoining abadies (cities / villages). The designed command area has not yet been fully developed due to lack of resources with farmers in respect of costly inputs like land leveling, construction of water courses and awareness about high value crops and its marketing.

Ground water in potohar plateau is very scarce. It is generally available along the natural streams, however in other areas ground water is not available even up to 300 feet depth. Thus, only available sources of water are mini to medium size reservoirs. The water needs of rapidly growing population of cities, towns & villages are met through existing reservoirs, mini ponds, ground water pumpage, which are also under threat in respect of future requirements.

1.1 Background

The Potohar region consists of four districts namely Rawalpindi, Attock, Chakwal and Jhelum. Total Area of Potohar region is 5.55 million acres. Presently cultivated area is 35-45 per cent. Population of Potohar is 10.007 million (2017 census data). Rural Population is 70 per cent. Area equipped with irrigation system is 11 per cent. Rainfall intensity during monsoon is 60-70 per cent. Total runoff is 2.31 billion cubic meters (1.88 MAF). Total tapped water by existing Small Dams is 14 per cent.

Total 56 No. dams have been completed; gross storage capacity of constructed dams is 252,619 Aft with CCA 72,209 acres. 09 No. small dams projects are under construction. After the completion of under construction projects, further gross storage capacity of 153,717 AFT & irrigation supply to 52,600 acres of CCA will be available.

There are 12 No. problematic dams which are not performing as per design and as per their intended purpose as narrated in PC-I. The targets were not achieved after construction of mentioned dams, one way or other, except Cherah dam. The Cherah dam could not be constructed despite lapse of more than 10 years; PC-I was approved in 2008 and this project was not taken-up at site due to in-sufficient funding, deficiency in detailed design and highly escalated cost. Similarly, one way or the other, distinct problems are being faced on all 12 no. dams

1.2 Implementing Agencies and Nature of the Program

The Small Dams Organization Islamabad (SDOI) through technical support of its administrative división is implementing agency (IA) for supervisión of detailed feasibility / technical study of all 12 problematic dams. This Project will be executed through existing setup of IA and with the consultation / input of SDOI and the Cosultants. The Consulting Firm (herein after called 'Consultants') selected under these Terms of Reference (TOR) will be required to povide profesional and intelectual technical services in the following areas:

(i) Identification of problema áreas of all the problematic dams, through available and additional gathered field data;

(ii) Supervision and verification of field data collection and field studies to the extent determined by them;

(iii) Comparative análysis of various avaiable technical solutions to address problem áreas of problematic dams;

(iv) Preparation of detailed feasibility reports, in line with the solutions finalized for each dam by the IA;

(v) Preparation of detailed engineering designs / drawings, PC-I documents, BOQ's, tender documents, pre-qualification criteria of contractors or any other document required for the approval of project from the competent forum

1.3 Project Location/Area

The Project is located in Potohar Plateau, situated in north-east of Pakistan, forming the northern part of Punjab. It is bounded on the east by the Jhelum River, on the west by the Indus River, on the north by the Kala Chitta Range & Margalla Hills, and on the south by the Salt Range. The Potohar Plateau lies from 32.5°N to 34.0°N Latitude and from about 72°E to 74°E Longitude.

2. Objectives of Consultancy Services

The main objective of the proposed consultancy services is to gain professional and intellectual input in solving the functional deficiencies / problems in 12 No. problematic dam projects. The Consultants will be required to consider the data provided by the IA, improve the required data bank by gathering additional data / information, if required, to arrive at technically feasible and economically viable engineering solutions of the problematic dams to address their problem areas. To meet this end, the Consultants will provide comparison of different alternatives / remedial measures to individual problems of each dam to achieve the intended benefits of these dams. After finalization of solutions / remedial measures by the SDOI and IA, the Consultants will then undertake preparation of detailed feasibility reports, detailed designs, PC-I's, tender documents, pre-qualification criteria of contractors etc. A brief description of problem areas and consultancy services required for all the problematic dams is tabulated below, to serve as a start point for the Consultants.

Sr. No.	Name of Dam	Problem Areas	Services Required
1	Taja Bara Dam	Various irregularities and discrepancies were pointed out in the executed works under original project by the various inspecting teams; Quality and quantity of executed works remained controversial; Owing to incomplete spillway, a deliberate cut in main body of dam was made in year 2012; Detailed examination and certification of usefulness of existing works has not been carried out; The project is incomplete & suspended till then; technically viable and economical solution to decide the	Services include, but not limited to, detailed site inspections of existing work portions; review of reports and already collected data; to further ascertain needs of additional field data; updating feasibility study to decide the most viable way forward; to prepare detailed design and revised PC-I as per latest conditions, design for command area development, preparation of land acquisition documents, resettlement action plan, tender documents, BOQ, etc.

		way forward and detailed design, if decided to proceed towards completion of project, is required.	
2	Sadrial Dam	Various irregularities and discrepancies were pointed out in the executed works under original project by the various inspecting teams; Quality and quantity of executed works remained controversial; Detailed examination and certification of usefulness of existing works has not been carried out; The channel of the dam could not be construed; The targeted command area is yet to be explored at site; The project is incomplete & suspended for last 8 years; technically viable and economical solution to decide the way forward and detailed design, if decided to proceed towards completion of project, is required.	Services include, but not limited to, detailed site inspections of existing work portions; review of reports and already collected data; to ascertain needs of additional field data; updating feasibility study to decide the most viable way forward for most viable use of the project; to prepare detailed design and revised PC-I as per latest conditions, design for command area development, preparation of land acquisition documents, resettlement action plan, tender documents, BOQ, etc.
3	Jalwal Dam	The intended benefits to the designed command area could not be delivered.	Services include, but not limited to, detailed site inspections of existing work portions; review of reports and already collected data; to ascertain needs of additional field data; preparation of feasibility study to decide the most viable way forward for most effective use of the project; to prepare detailed design and PC-I as per latest conditions, design for command area development, preparation of land acquisition documents, tender documents, BOQ, etc.
4	Jamal Dam	The intended benefits to the designed command area could not be delivered.	Services include, but not limited to, detailed site inspections of existing work portions; review of reports and already collected data; to ascertain needs of additional field data; preparation of feasibility study to decide the most viable way forward for most effective use of the project; to prepare detailed design and PC-I as per latest conditions, design for command area development, preparation of land acquisition

			documents, tender documents, BOQ, etc.
5	Minwal Dam	The intended benefits to the designed command area could not be delivered.	Services include, but not limited to, detailed site inspections of existing work portions; review of reports and already collected data; to ascertain needs of additional field data; preparation of feasibility study to decide the most viable way forward for most effective use of the project; to prepare detailed design and PC-I as per latest conditions, design for command area development, preparation of land acquisition documents, tender documents, BOQ, etc.
6	Arrar Mughlan	The effluents and sewage water from urban areas of Chakwal are making the reservoir water contaminated and polluted.	Services include, but not limited to, detailed site inspections of existing work portions; review of reports and already collected data; to ascertain needs of additional field data; to carry out environmental study; preparation of feasibility study to decide the most viable way forward for most effective use of the project; to prepare detailed design and PC-I as per latest conditions, preparation of land acquisition documents, tender documents, BOQ, etc.
7	Shah Habib Dam	The intended benefits to the designed command area could not be delivered besides less receipt of inflows in reservoir and non-availability of live storage.	Services include, but not limited to, Hydrological & Geological studies of reservoir, to address percolation problem and to increase inflows in the reservoir considering various alternatives and possible improvements in watershed management, to arrive at some technically and economically viable solution to make the irrigation system operational and to accrue the best possible benefits of the project. Moreover, feasibility study, detailed design and PC-I as per latest conditions shall be updated, design for command area development, land acquisition, resettlement action plan, tender documents, BOQ, etc shall also be prepared.

8	Fatehpur Dam	The intended benefits to the designed command area could not be delivered besides less receipt of inflows in reservoir and non-availability of live storage.	Services include, but not limited to, Hydrological & Geological studies of reservoir, to address percolation problem and to increase inflows in the reservoir considering various alternatives and possible improvements in watershed management, to arrive at some technically and economically viable solution to make the irrigation system operational and to accrue the best possible benefits of the project. Moreover, feasibility study, detailed design and PC-I as per latest conditions shall be updated, design for command area development, land acquisition, resettlement action plan, tender documents, BOQ, etc shall also be prepared.
9	Lehri Dam	Settlement has occurred in the dam embankment. Some pipe segments of outlet conduit inside dam embankment have been reportedly damaged / cracked which may be hazard for the safety of dam embankment.	Services include, but not limited to, hydrological, hydraulic, geological, structural design studies and stability analysis of dam embankment to propose solution to settlement problem and repair / replacement of outlet structure and conduit considering various alternatives to make the irrigation channel fully operational and prevent future settlement of dam embankment. Moreover, feasibility study, detailed design and PC-I as per latest conditions shall be updated, land acquisition, resettlement action plan, tender documents, BOQ, etc shall also be prepared.
10	Domeli Dam	The intended benefits to the designed command area could not be delivered.	Services include, but not limited to, detailed study of command area to identify the causes of problem, proposing modification / extension in irrigation system by considering various alternatives, to increase cultivable area falling in the command area of the dam. Any other intervention to overcome the problem shall also be proposed. Moreover, feasibility study, detailed design and PC-I as per latest conditions shall be updated, design for command area

			development, land acquisition, resettlement action plan, tender documents, BOQ, etc shall also be prepared.
11	Gurah Uttam Singh Dam	The intended benefits to the designed command area could not be delivered.	Services include, but not limited to, detailed study of command area to identify the causes of problem, proposing modification / extension in irrigation system by considering various alternatives, to increase cultivable area falling in the command area of the dam. Any other intervention to overcome the problem shall also be proposed. Moreover, feasibility study, detailed design and PC-I as per latest conditions shall be updated, design for command area development, land acquisition, resettlement action plan, tender documents, BOQ, etc shall also be prepared.
12	Cherah Dam	The project could not be implemented due to less release of funds, deficient feasibility and design and highly escalated cost of the project. The cost of land acquisition and re-settlement has increased besides cost of civil works. Economics of project is to updated. The revised PC-I could not be got approved from the competent forum. Therefore, the design and cost of the project needs to be updated as per latest site, social and environmental conditions.	Services include, but not limited to, review of reports and already collected data; Re-visit feasibility study to explore technically & economically more viable alternate; to ascertain needs and scope of additional data collection for updating feasibility study as well as preparing detail design; If project is found technically and economically viable to proceed further, preparation of updated feasibility study and detailed design and PC-I as per latest conditions will be required. Preparation of updated land acquisition documentation & resettlement action plan, tender documents, BOQ, etc shall also be carried out by the consultants.

3. Scope of Work

3.1 Phasing of Assignment

The assignment of Consulting Services is divided into two phases (single contract):

3.1.1 Assignment – A

Assignment – A includes identification of problem areas of dams, considering available and additionally gathered field data through surveys, geological investigations or any other studies, as required by the Consultants. In this assignment, the Consultants will further provide comparison of various technical alternatives to reach upon technically and economically feasible solutions to address respective problem areas of dams. To meet this end, the Consultants will be required to carry out:

- Analysis of available data / design parameters and its correlation with existing site conditions besides other social and environmental factors
- Review of existing design, drawings and other parameters
- Collection of additional primary and secondary data and any site investigations / surveys and studies, if required
- Supervision of data collection process to the nature and extent determined by the Consultants being outsourced by IA, to ensure its correctness, authenticity and viability
- Identification of problem areas after detailed analysis of data, design parameters and site conditions
- Comparative analysis of various available technical solutions / alternatives for further detailed deliberations in order to evolve most economical and viable solution

3.1.2 Assignment – B

Assignment – B includes finalization of the solutions of all the problematic dams by the IA, from one or more solutions proposed by the Consultants for each dam. In view of finalized solutions, the Consultants will:

- Prepare detailed feasibility reports, in line with the finalized solution / remedial measures
- Prepare detailed engineering designs (including but not limited to, hydraulic and structural designs of dams and spillways, irrigation network system designs, design for command area development, etc.)
- Carry out command area assessments, prepare EIA reports, Resettlement Action Plans (RAPs), cost estimates, PC-I documents, tender documents, BOQ's, pre-qualification criteria of contractors or any other task entrusted by the IA.

Assignment A & B will span over the period of 24 months in a single contract.

The contract for Assignment A & B will be financed from Annual Development Program (ADP) Punjab through its own resources and the processes of all the necessary approvals will be completed accordingly.

3.1.3 Description of Assignment – A

The services under Assignment-A will include review of available data and to develop its correlation with the existing site conditions besides social and environmental factors. Subsequently, existing

drawings, designs and related parameters shall be reviewed by the Consultants to further ascertain need for collection of any primary or secondary data including geotechnical investigations and topographic survey, if so required. Any other data, if required for proper identification of problems, shall be collected at this stage. Foregoing in view, the Consultants shall identify the problem areas in problematic dams and will provide comparative analysis of various available technical solutions / alternatives for further detailed deliberations in order to evolve most economical and viable solution of respective problem areas of each problematic dam.

The activities and the scope of work for the Assignment – A will include, but not limited to the following:

(i) To carry out review of already collected data including feasibility studies, subsurface geological investigations, topographical surveys, meteorological data, etc.

(ii) Review available designs, drawings, PC-I's and other related documents.

(iii) To carry out review of available hydrological studies including catchment area characteristics, water availability studies, sediment inflow study, reservoir operation studies, water availability / needs, frequency analysis, peak discharge, flood studies, flood routing, flood estimation, water demand and water requirement analysis and mathematical modeling studies (HEC-HMS) etc. of problematic dams.

(iv) To carry out review of social and environmental impact assessment and resettlement plans.

(v) To carry out field visits, correlate available data with site conditions and other social and environmental factors, to identify problem areas in all the problematic dams.

(vi) Ascertain need and extent of additional field investigations / GIS surveys / hydrological, hydraulic, geological, or any other investigations / studies required for accomplishing the assignment.

(vii) Carry out field supervision of geological investigations, including camping at site etc. necessary for the completion of task. The geological investigations may include, but not limited to, sub surface exploration through straight rotary drilling rigs in over burden and rocky strata, performing water pressure tests, SPT, logging of bore holes, core recovery details and preservation of core and preparation of selected samples of recovered core for laboratory testing etc.

(viii) To supervise the topographic survey as per requirements of completion of different type of studies. The Consultants shall be responsible to ensure the correctness and completion of topographic survey and geological investigations to their entire satisfaction.

(ix) To ascertain the needs of field tests and construction material testing from approved lab required for geological, designing purpose and compilation of social / environmental and resettlement plan studies.

(x) Secondary data collection from different resources and departments required for technical reports design / solutions purposes.

(xi) Carrying out command area studies with the view to enhance canal irrigation through adequate and relevant interventions, whether technical or social.

(xii) Study of various alternatives and identification of the most suitable alternate with due consideration to technical, geological, ecological and environmental aspects.

(xiii) Preparation of detailed technical reports of each problematic dam for consideration and approval of IA. The reports shall highlight comparative analysis of various available technical solutions / alternatives to address the problem areas and to decide technically and economically viable solutions.

3.1.4 Description of Assignment – B

The services under Assignment-B will include, on the basis of data collected under the Assignment – A, and solutions finalized by the IA, preparation of detailed feasibility studies in light of the remedial / corrective measures to address individual problem areas, preparation of detailed designs and drawings with design calculations, preparation of cost estimates, PC-I's, BOQ's, tender documents, pre-qualification criteria of contractors etc, as per requirements of IA. The Consultants shall remain associated with IA till getting the approval of projects from competent forums.

The activities and the scope of work for the Assignment – B will include, but not limited to the following:

(i) Review of already collected data in Assignment – A, detailed study of feasibility reports, previous PC-I's, etc and site conditions.

(ii) Prepare draft feasibility reports of the project including detailed EIA report as required under Government regulations. The draft feasibility reports shall be submitted to the IA for review and comments.

(iii) After clearance of the draft feasibility reports and EIA reports, submit the final version of the reports for arranging approval from competent forums.

(iv) The Consultants will gather necessary data and information and prepare all the environment related documents.

(v) Needs assessment of extra field (primary & secondary) data collection and supervision of data collection.

(vi) Preparation of geological reports on the basis of subsurface geological investigation, geological maps, geological x-section, foundation analysis, grouting plan etc.

(vii) Carrying out irrigation network system design / layout i/c canals, minors, watercourses, chakbandi plans covering all technical and social aspects for better command area irrigation / management. Consultants shall prepare command area maps indicating area which can be irrigated through gravity from the designed canal system.

(viii) Carrying out structural design covering all parameters / aspects related to main dam / embankment, saddle bunds (if any), spillway, outlet structures, irrigation water supply system, diversion channels etc.

(ix) Carrying out hydraulic design covering all parameters / aspects related to main embankment, saddle bunds (if any), spillway, outlet structures, irrigation water supply system, diversion channels etc.

(x) Carrying out agronomy studies of command area with respect to soil & crops etc.

(xi) Analyse the possibility of installation of High Efficiency Irrigation Systems (HEIS) in command areas, in conjunction with gravity irrigation, construction of community water courses, LASER land levelling, development of dug wells, construction of water storage tanks and prepare plans for their implementation.

(xii) Carryout reservoir operation studies with respect to inflow (standard dry year), evaporation, crop water requirement, water loss etc. of problematic dams where command area benefits need to be improved.

(xiii) Seismic risk evaluation to determine seismic design parameters where structural improvements are required.

(xiv) Study of the present downstream water rights / uses and study the potential of water supply to nearby areas to increase benefits of the problematic dams.

(xv) Carry out social assessment studies of the project and prepare a resettlement plan according to the GOP policies. Prepare alternatives to minimize resettlement and displacement. Describe method of valuation used for affected structures, land, trees, and other assets; and prepare entitlement matrix; describe grievance redress procedures, for registering complaints, mechanisms for appeal, and process for approaching the civil courts; for Cherah dam.

(xvi) Prepare feasibility level design of the selected alternatives including various components of the project including Engineer's cost estimates of the project. These shall include reasonable breakdown by major items like civil works, project engineering and management expenses, contingencies etc., prepare an indicative construction schedule, carryout the financial analysis, sensitivity analysis, to work out the benefits available from project.

(xvii) Carrying out detailed environmental survey / report for identification of sources of contamination / pollutants in inflow from catchment area of Arrar Mughlan dam.

(xviii) Preparation of land acquisition documents as per Land acquisition Act 1894. The Consultants shall provide the Khasra / Killa wise detail of land required for the project along with the copies of Aks-Shajra duly supported by the record of Revenue Department.

(xix) Preparation of detailed design reports for the proposed project interventions to address problem areas. The reports shall include technical / engineering studies, hydraulic, hydrologic, structural, institutional, and economical analysis, environmental and social impact assessments (resettlement cost and impacts) and management plans.

(xx) Assistance in approval of technical & feasibility reports from the competent forums as required by IA.

(xxi) On the basis final feasibility study report, preparation of PC-I as per requirements of IA, preparation of presentation for PDWP or CDWP, assist IA for getting approval of PC-I from competent forum.

(xxii) Preparation of detailed structural, hydraulic designs and drawings.

(xxiii) Preparation of detailed engineering cost estimate based on approved drawings by the competent authority.

(xxiv) The Consultants shall prepare the rate analysis of all non-schedule items as per procedure and criteria of Finance Department, Government of Punjab.

(xxv) Preparation of bidding documents; including institutional and implementation arrangements; this includes, but not limited to:

a. prepare the detailed design, construction drawings, bills of quantities (BOQ), technical specifications and tender documents for all aspects of the works;
b. preparing time bound implementation work plans and prepare bidding documents, keeping in view PPRA rules;

(xxvi) Development of criteria for contractor pre-qualification, assistance in bid evaluation etc.

(xxvii) All the documents be provided to the IA in shape of hard copies & soft copies (editable format).

(xxviii) Providing all data and calculation sheets of detailed design for review at different forums indicated by IA and collaboration with reviewing agency.

3.2 Role of Consultants in Field Data Collection

The Consultants will be required to provide most economical and technically viable solutions to address the issues of problematic dams. Since the solutions proposed by the Consultants will depend on the quality of field data gathered through topographical surveys, geological investigations, or any other field study, therefore, the Consultants will supervise the entire work of data collection being outsourced. Further, they will ensure the correctness and authenticity of gathered data upto their entire satisfaction. To achieve this end, the Consultants shall carry out the following activities:

3.2.1 Need Assessment

The Consultants shall ascertain the need and define the extent of topographical survey, geological investigation or any other study required to identify the problem areas and reach upon technically and economically viable solutions for all the dams.

3.2.2 Quality Assurance

The Consultants shall supervise the work of data collection and will ensure the correctness, quality, quantity and authenticity of work as per scope and technical specifications.

3.2.3 Certification

The Consultant shall certify the correctness and authenticity of gathered data for further use in detailed design for addressing the problem areas of respective dams. Moreover, the Consultant shall also certify the payment of contractor.

3.3 Reporting

The schedule for various reports, the Consultants will prepare is given below. The Consultants will prepare reports in English and provide ten (10) copies along with a soft copy of the key reports to the IA. Additionally, reports may have to be prepared as and when desired by the project authorities, from time to time.

	Interim Progress / Reports	Reporting Duration
Assignment - A	Submission of Inception Report, based on; a) Analysis of available data / design parameters and its correlation with existing site conditions besides other social and environmental factors b) Review of existing design, drawings and other parameters	1.5 months after the award of study
	Report on collection of additional primary and secondary data	3 months after the award of study
	Report on identification of problem areas after detailed analysis of data, design parameters and site conditions	05 months after the award of study
	Report on comparative analysis of various available technical solutions / alternatives for further detailed deliberations in order to evolve most economical and viable solution	08 month after the award of study
Assignment - B	Preparation of detailed feasibility studies including conceptual design and estimates	12 months after the award of study
	Preparation of detailed design and drawings with design calculations	18 months after the award of study
	Preparation of cost estimate, PC-I, BOQ and tender documents, pre-qualification criteria of contractors etc, as per requirements of IA in the light of PPRA Rules	21 months after the award of study
	Preparation of contractor's pre-qualification criteria, etc.	23 months after the award of study
	Monthly & fortnightly progress reports & monthly presentations	Within 1st & 3rd week of every month

3.4 Staffing Requirements

The consultants are encouraged to use the expertise available in Pakistan to the extent possible. The consultants are free to propose a staffing plan and skill mix necessary to meet the objectives and scope of services. If all the required skills are not available within the consulting firms as per PEC guidelines, they are encouraged to make joint ventures with other firms. Following is an indicative skill list required for carrying out the assignment:

Sr. #	Position	Qualification	General / overall experience (Years)	Job specific experience (Years)
	Task A[1]			
1.	Project Manager/Team Leader / [*Key Staff*]	Graduate Civil Engineer. Preference will be given to Master's Degree or PhD in Water Resources/Hydraulic Engineering.	25	15 (Multi-sectoral Water Resources Project)
2.	Principal Hydrologist. [*Key Staff*]	Degree in Civil /Agri Engineering. Preference will be given to Master's Degree in Civil / Agri Engineering with a major in hydrology.	15	10 (professional experience Hydrologic studies on major streams)
3.	Principal Hydraulic Structure Specialist /Engineer [*Key Staff*]	Graduate Civil Engineer. Master's Degree or PhD in Water Resources/Hydraulic Engineering-preferable.	15	10 (Specific experience in design of hydraulic structures)
4.	Principle Engineer. (Dam Design / Structural Engineer) [*Key Staff*]	Degree in Civil Engineering and preferably have an additional Masters Degree in Civil Engineering.	15	10 (professional experience in structural design of the hydraulic aspects of civil works related to dams systems, head-works, bridges and other hydraulic structures on streams in Pakistan/Region)
5.	Senior Structural Design Engineer) [*Key Staff*]	Degree in Civil Engineering and preferably have an additional Masters Degree in Civil Engineering.	15	10 (professional experience in structural design of the hydraulic aspects of civil works structures on streams in Pakistan/Region)
6.	Senior Geotechnical Engineer /Senior Geologist [*Key Staff*]	Degree in Civil Engineering. An additional Masters Degree in Civil Engineering with a major in soil mechanics and foundations is preferable or Master Degree in geology	15	10 (professional experience related to sub-surface investigation for hydraulic structures on or adjacent to major streams in the Indus Basin)

7.	Junior Geotechnical Engineer /Junior Geologist [*Key Staff*]	Degree in Civil Engineering or Master Degree in geology	10	3 (professional experience related to sub-surface investigation for hydraulic structures on or adjacent to major streams in the Indus Basin)
8.	Irrigation Specialist	Degree in Civil Engineering and preferably have an additional Masters Degree in Civil Engineering.	15	10 (professional experience in structural design of irrigation network, canal structures on streams in Pakistan/Region)
9.	Economist / Financial Specialist	Master's degree in Economics or Project Economics.	15	7 professional experience in costing and analyzing the economics of major irrigation investment projects)
10.	Sociologist / Resettlement Specialist [*Key Staff*]	Master's degree or PhD in social sciences, engineering, management or agricultural sciences.	15	7 (professional experience in social organizations, and preparation of Resettlement Action Plan with hands-on experience of major irrigation investment projects)
11.	Environmental Specialist [*Key Staff*]	Master's degree or PhD in Environment, social sciences	15	7 (professional experience in Environment Action Plan, Environmental Impact Assessment (EIAs) documents with hands-on experience of major irrigation investment projects)
12.	Agricultural Agronomist [*Key Staff*]	Master's Degree in Agricultural with specialization in Agronomy and water management	10	3 (specific experience in Agronomy / High Efficiency Irrigation system management)
13.	Agricultural Engineer / Water Management Specialist	Master's Degree in Agricultural Engineering with specialization in Irrigation / water management	10	5 (specific experience in on-farm water management particularly high efficiency irrigation system and water course designing)
14.	Horticulturist	Master's Degree in Agriculture with specialization in Horticulture	10	7 (specific experience in Horticulture development under high efficiency irrigation system)
15.	Public Health Specialist (s)	Degree in Civil Engineering. Preference will be given to Master's Degree in Civil Engineering with a major in public health engineering.	15	7 (professional experience in public health engineering preferably in water supply schemes design &operation)

16.	Contract / Procurement Specialist [*Key Staff*]	At least a Degree in Civil Engineering or equivalent.	10	5 (professional experience in preparing procurement documents of civil works and other engineering works under donor agencies guidelines)
17.	GIS Specialist / Data Analyst	Degree in in GIS & remote sensing.	10	5 (professional experience in GIS, remote sensing operations and data analysis)
18.	Junior Engineer	At least a Degree in Civil Engineering or equivalent.	05	3 (specific experience in construction of dams and irrigation infrastructure)

Indicative Job Description and Qualifications of Consultants' Key Staff required for Completion of Study / Report & detailed design:

Project Manager/Team Leader: The Project Manager/Team Leader will be a graduate Civil Engineer. A masters degree or PhD in Water Resources/Hydraulic Engineering is preferable and would be scored higher, and have at least twenty five years experience in design of major water control structures on major rivers in developing countries and a minimum of fifteen years experience job specific or as the team leader for similar design undertakings. His duties will include but not limited to the following:

(i) Review all relevant documents previously prepared on the Pothohar region;

(ii) Assume overall responsibility for management and supervision of the team for data collection / preparing inventory, identifying the needs, ranking and grouping to form projects, preparing feasibility reports for construction of water storage dam along their water supply systems, detailed design & tender documents and timely consultation on design considerations with IA;

(iii) Provide technical support and guidance in all aspects of the design effort including hydrology, flood routing, physical and mathematical hydraulic modeling, hydraulic design, sediment studies, mechanical considerations, environmental and resettlement plan etc;

(iv) Coordinate and supervise the preparation of tender documents for project;

(v) Take overall responsibility for preparation of the feasibility study and after the finalization of feasibility study report till the start of the project;

(vi) Report on a regular basis on studies being under taken, design and/or tendering progress to IA;

Principal Hydrologist: The Principal Hydrologist will have a degree in Civil/Agri Engineering. Preference will be given to Master's Degree in Civil/Agri Engineering with a major in hydrology and a minimum of 15 years professional experience, including a minimum of 10 years in hydrologic studies on major streams in the Indus Basin. Total period of hiring is 8 months, hiring will be intermittent basis during 12 months. His duties will include but not limited to the following:

(i) Take the leadership in collecting and organizing all hydrological data and records required for updating the flood frequency analysis of the selected streams;

(ii) Update the flood frequency analysis of streams;

(iii) Evaluate the effect of the increased extent of flood levels and embankments along the river and the resulting confinement of flow area on the historic flood of record and the flood distribution regime at sites of small dams;

(iv) Delineate the catchment area of each dam site;

(v) Determine the catchment area characteristics;

(vi) Determine water availability, flood frequency, peak flood discharges, etc;

(vii) Using all available data, simulations and comparisons with like situations in other river basins, update and/or prepare a detailed and refined flood frequency analysis at the streams and comprehensive hydrographs of flood events for all return frequencies required by the principal hydraulic engineer and both the physical and mathematical modellers; and

(viii) Carryout mathematical modeler in assessing water levels upstream, downstream and at the site corresponding to floods of various return intervals.

Principal Hydraulic Structure Specialist / Engineer: The Principal Hydraulic Structure Specialist / Engineer will be a graduate Civil Engineer. A masters degree or PhD in Water Resources/Hydraulic Engineering is preferable and would be scored higher and have at least 15 years of professional experience in design of civil works for major hydraulic structures and a minimum of 10 years specific experience in design/rehabilitation of barrages/head-works and canal head regulators. Total period of hiring is 8 months, hiring will be intermittent basis during 12 months. His duties will include but not limited to the following:

(i) Organize and supervise topographic surveys and any other investigations required to provide necessary input data for both physical and mathematical modeling exercises and design preparation proper;

(ii) Supervision of follow-up physical model tests to ensure reliable output;

(iii) Coordinate and supervise the work and develop a mathematical model of the small dams to predict likely water levels at all critical points and flows at the locations of dams;

(iv) Use both physical and mathematical modeling results to refine both design proposals and operating rules;

(v) Analyze hydraulic design options dam body, intake structure, spillway and downstream scour protection with a view to cost effective project, including but not limited to hydraulic optimization of intake structure, spillway parameters and ensuring adequate sediment transport during flushing operations employing the protection works;

(vi) Coordinate and supervise detailed design of all hydraulic aspects of the rehabilitation works including preparation of relevant construction drawings and specifications as well as contributing as required to the preparation of the final tender documents.

Principle Engineer (Dam Design / Structural Engineer): The Senior Engineer (Dam Design / Structural Engineer) shall have a degree in Civil Engineering and have a minimum of 15 years of

professional experience. A minimum of 10 years of that experience will have been in the structural design of head-works, bridges and other hydraulic structures on streams in Pakistan/Photohar Region. Total period of hiring is 8 months, hiring will be intermittent basis during 12 months. His duties will include but not limited to the following:

(i) Organize and undertake a critical examination targeted to establishing the overall structural and geotechnical (foundation) integrity of the small dams confirming remedial works earlier recommended and identifying additional needs if any;

(ii) Organize, supervise and carry-out any additional investigations deemed necessary for structural aspects of all features to be included in the design;

(iii) Analyze structural design options for, dams, spillways, intake chambers, water supply channel related works with a view to carry out cost-effective but sustainable construction;

(iv) Coordinate, supervise and undertake preparation of detailed structural design, bills of quantities and technical specifications for the hydraulic structures as well as any other components identified requiring structural input and treatment and contribute as required to preparation of the final tender documents of sub-projects;

Senior Structural Engineer: The Senior Structural Engineer shall have a degree in Civil Engineering and have a minimum of 15 years of professional experience. A minimum of 10 years of that experience will have been in the structural design of hydraulic structures on streams in Pakistan / Photohar Region. Total period of hiring is 8 months, hiring will be intermittent basis during 12 months. His duties will include but not limited to the following:

(i) Design structural components for large-scale projects, including analyzing survey reports, topographical maps, zoning restrictions and client requirements to ensure specifications meet project goals

(ii) Perform structural design and analysis calculations using governing codes and standards, engineering formulas, skills, and experience.

(iii) Make calculations about pressures, loads and stresses.

(iv) Consider the strength of construction materials and select appropriately.

(v) Provide technical advice on safe designs and construction.

(vi) Analyze configurations of the basic components of a structure.

(vii) Inspect properties to evaluate the conditions and foundations.

(viii) Use computer aided design technology for simulation purposes.

(ix) Analyze structural design options for, dams, spillways, intake chambers, water supply channel related works with a view to carry out cost-effective but sustainable construction;

(x) Supervise and undertake preparation of detailed structural design, bills of quantities and technical specifications for the hydraulic structures as well as any other components identified requiring structural input and treatment and contribute as required to preparation of the final tender documents of sub-projects;

Senior Geotechnical Engineer / Senior Geologist: The Senior Geotechnical Engineer / Senior Geologist will be a graduate civil engineer or masters in geology. A masters degree in Civil Engineering with a major in soil mechanics and foundations is preferable and would be scored higher and a minimum of 15 years professional experience including at least 10 of which were related to sub-surface investigation for hydraulic structures on or adjacent to major streams in the Indus Basin. Total period of hiring is 8 months, hiring will be intermittent basis during 12 months. His duties will include but not limited to the following:

(i) To select the best suitable site between the different alternative;

(ii) Monitor the subsurface geological investigation and provide necessary guidance in field data collection;

(iii) Carry out (organize and oversee) a comprehensive review of foundation conditions at each of the existing features and ensure conditions are such to ensure the long-term integrity water storage structure;

(iv) Identify any remedial foundation stabilization work to be included in the package of works for the construction of water storage structure;

(v) Formulate plans for and carry out detailed foundation investigations for each of the new works;

(vi) Supervise the work of the sub-contracted drilling, sampling and testing services to ensure compliance with best geotechnical practice;

(vii) Subsequent to the required sub-surface investigations and required laboratory testing, work with the Senior Structural Engineer in preparing detailed designs and specifications for the foundation treatment/features of the new small dams works and any identified remedial work if required;

(viii) Assist in the preparation of the tender documents as required;

Junior Geotechnical Engineer / Junior Geologist: The Junior Geotechnical Engineer / Junior Geologist will be a graduate civil engineer or masters in geology. A masters degree in Civil Engineering with a major in soil mechanics and foundations is preferable and would be scored higher and a minimum of 10 years professional experience including at 3 year of which were related to sub-surface investigation for hydraulic structures on or adjacent to major streams in the Indus Basin. His duties will include assisting the Senior Geotechnical Engineer / Senior Geologist in each activity and assignment carried out. Total period of hiring is 8 months, hiring will be intermittent basis during 12 months.

Irrigation Specialist Engineer: The Irrigation Specialist Engineer will be a graduate Civil Engineer. A masters degree or PhD in civil engineering (irrigation) is preferable and would be scored higher and have at least 15 years of professional experience in design of civil works for major irrigation system network and a minimum of ten years specific experience in design/rehabilitation of irrigation system network, canal structures. Total period of hiring is 10 months, hiring will be intermittent basis during 12 months. His duties will include but not limited to the following:

(i) Undertake the necessary technical surveys to allow the preparation of layout and technical design of proposed irrigation network.

(ii) Recommend improvements in the design of irrigation network / structures in irrigation related projects to improve efficiency of water utilization and facilitate efficient water management during the operational phase.

(iii) Appropriate canal design related to the characteristics of the command area and cropping alternatives.

(iv) Prepare technical designs of the projects to feasibility study level and canal structure design

Environmental Specialist: The Environmental Specialist will have a Master's degree or PhD in Environmental Science with at least 15 years experience in conducting environmental screening/assessment and in social organizations, and preparation of Environmental Impact Assessment (EIAs) documents of major water resources projects in accordance with GoP and WB's Environmental Guidelines. Total period of hiring is 4 months, hiring will be intermittent basis during 12 months. His duties will include but not limited to the following:

(i) Review all relevant documents including those prepared previously, particularly relating to the environmental;

(ii) Work with IA to prepare/update a cost effective environmental management and monitoring plan for the rehabilitation and upgrading of the works which is in line with EIA recommendations so as to ensure minimal environmental effects both during and following the construction period;

(iii) Prepare and execute required appropriate actions to mitigate any negative environmental impacts associated with construction activities in collaboration with IA and all concerned stakeholders;

(iv) Prepare a detailed reforestation plan at the work sites and following-up construction oversee its implementation; and

(v) Formulation of EMP

(vi) Preparation of documents of agreements and other necessary instruments to help in negotiations with the beneficiaries and in obtaining of local permits, etc

(vii) Assess and calculate the cost of environmental impact and mitigation related activities.

Sociologist/Resettlement Specialist: The sociologist / resettlement Specialist will have a Master's degree or PhD in Social Science /sociology with at least 15 years experience in conducting screening/assessment and in social organizations, and preparation of resettlement Action Plan, documents of major water resources projects in accordance with GoP and WB's Guidelines. Total period of hiring is 8 months, hiring will be intermittent basis during 12 months. His duties will include but not limited to the following:

(i) Review all relevant documents including those prepared previously, particularly relating to social aspects;

(ii) Develop methodology and instruments for social assessment for the potentially affected people and areas.

(iii) Review all national and provincial statutory, customary and administrative framework (of Punjab Province) relevant to the project interventions in the resettlement context (categories land ownership, yardstick for inventories of different type of structures, trees, construction quality and categorization of built-up priorities, land acquisition procedures, provisions for public notification regarding cut-off-date for compensation etc.).

(iv) Based on the comprehensive review of country legal framework and guidelines of donor agencies identify the resettlement principles for all types of affected peoples.

(viii) Carry out a full-scale field assessment and develop definitions for entitlements for compensation for the properties of potentially affected people (houses, lands, crops, trees, lost income, relocation allowance and entitlement for support business activities) including squatters and encroachers. Develop an entitlement matrix;

(ix) Assess the direct Impacts on people and properties

(x) Assess the indirect impacts of project operations on people such as loss of temporary or permanent access to markets, services and social relations.

(xi) Organize series of consultations meetings with communities to create awareness about the project activities, and to ensure public participation.

(xii) Develop a monitoring and evaluation program (in a logical framework) for implementation of resettlement-related activities.

(xiii) Preparation of documents of agreements and other necessary instruments to help in negotiations with the beneficiaries and in obtaining of local permits, etc

(xiv) Identification of alternative sites for resettling people and related assets

(xv) Development of Plan including identification of sites for resettlement, planning, infrastructure, utilities, and replacement houses etc.

(xvi) Assess the staffing need of Resettlement and Compensation Centre propose a mechanism for feedback from the affectees.

(xvii) Develop and establish the framework for grievance redresses mechanism and propose the composition of Grievance Redressal committee for of potentially affected people.

(xviii) Assess the staffing need of Resettlement Information Centre and provide support in implementation, implementation of communication plan, development of information base, messages, information to users, delivery of messages etc.

(xix) Assess and calculate the cost of resettlement and compensation related activities.

(xx) Settlement Action Plan
(xxi) Plan for management of physical relocation and disbursement of actual compensation
(xxii) M&E Plan for implementation of resettlement Activities.

Public Health Engineering Specialist Engineer: The Public Health Specialist Engineer will be a graduate Civil Engineer. A masters degree or PhD in Public Health Engineering is preferable and

would be scored higher and have at least 15 years of professional experience in design of civil works for major water supply systems and a minimum of seven years specific experience in design/rehabilitation of city / town water supply schemes, water treatment plant and storage tanks. Total period of hiring is 4 months, hiring will be intermittent basis during 12 months. His duties will include but not limited to the following:

(i) Utilize the source raw water sampling and analysis records available from the water storage reservoir;

(ii) Based on the raw water characterization, determine raw water quality conformance to the World and national standards;

(iii) Identify parameters that may impact treatment of the water, and influence operation of the system;

(iv) Evaluate the potential for formation of trihalomethanes (THMs) based on levels of organic precursors in the raw water;

(v) Identify any emerging issues that may impact the water source;

(vi) Identify treatment options that may be necessary to assure conformance to the World and national standards;

(vii) The assessment of the physical works shall include a review of all on-line instrumentation in regards to their installation and operation;

(viii) Make recommendations as necessary for operational and physical improvements that should be implemented to mitigate against the potential for contamination;

(ix) Design of treatment plant, cost effectiveness and operation

(x) Review the existing Water System with particular attention to works necessary to ensure the robustness of the system utilizing the multiple barrier concepts and capacities with respect to needs;

(xi) Make recommendations as necessary for operational and physical improvements that should be implemented to achieve compliance with regulations;

Economist/Financial Specialist: The Economist/Financial Specialist will have a Master's degree in Finance or Project Economics and at least 15 years relevant professional experience in costing and analyzing the economics of major irrigation investment projects. Total period of hiring is 4 months, hiring will be intermittent basis during 12 months. His duties will include but not limited to the following:

(i) Using input from various specialists on the team develop detailed feasibility level cost estimate for the different alternatives using different analysis techniques ensuring that all input and output can be used by government agencies in appraisal and by the Government of Punjab in PCI preparation;

(ii) From the detailed cost tables identify all costs directly related to generating "with-project" benefits;

(iii) Working with the costing engineer, identify and quantify the estimated benefits resulting from the investments including the benefits associated with reduced risk of infrastructure failure and the associated interruptions in domestic water supply as well as the raw water and treated water supply to the city area, within the relevant effective water supplies to city area and effect of population with improved, more efficient, dependable and equitable delivery of water;

(iv) Undertake detailed economic analysis of the project for Economic Analysis ensuring that it meets the viability requirements of both donor agencies and the Government of Punjab;

Contract / Procurement Specialist: The Procurement Specialist will have at least a BS Degree in Civil Engineering with 10 years professional experience in procurement of civil works and contract administration including procurement under World Bank / Asian Development Bank guidelines using international competitive bidding. Total period of hiring is 4 months, hiring will be intermittent basis during 12 months. His duties will include but not limited to the following:

(i) In consultation with IA, develop the prequalification criteria, prepare notices of pre-qualification and prequalification documents in accordance with both PPRA procedures and WB / ADB guidelines;

(ii) Under the direction of the Project Manager/Team Leader and using input from various specialists on the team prepare the international / national bidding documents for the project, and in a format agreeable to both IA;

(iii) Advise on the conducting of required pre-bid consultations;

GIS Specialist / Data Analyst: The GIS Specialist / Data Analyst will have a BS Degree in Civil Engineering with master degree in GIS & remote sensing, 10 years professional experience in Perform data capture and analysis for GIS product. Oversee data flow, management and distribution activities to support GIS. Manage geospatial database and develop maps and aerial photography. Work in compliance with GIS standards and quality policies. Total period of hiring is 3 months, hiring will be intermittent basis during 12 months.

(iv) To propose new concept based on combination of GIS and statistical methods as a decision support tools for estimation of dam dimensions, reservoir volume and area.

(v) GIS store data in database and then represent it visually in a mapped format.

(vi) Evaluates user requirements for GIS; identifies and implements applications.

(vii) Writes and maintains reports; programs database reports, forms and queries.

(viii) Prepares GIS databases, maps, database reports and specialized queries in support of various projects.

(ix) Performs GIS analysis, modeling and reporting to support decision making.

(x) Generates, maintains and disseminates GIS layers.

(xi) Operates and maintains GIS software and web-based applications.

(xii) Designs GIS enterprise database and enforces data standards.

(i) Produces complex maps for user departments and outside agencies.

(xiii) Methods/Statistical analysis: To accomplish goal, firstly spatial data analysis on GIS was used to select the best location along the river for construction of the dam that has enough capacity for storage of required volume of water.

(xiv) Peaks Over a Threshold (POT) techniques was utilized to estimate 1000-year flood discharge using daily discharge data of 30 years;

(xv) Application/Improvements: combination of GIS and statistical analysis is a powerful tool for finding the most appropriate situation for dam construction compared with reservoir surveys method.

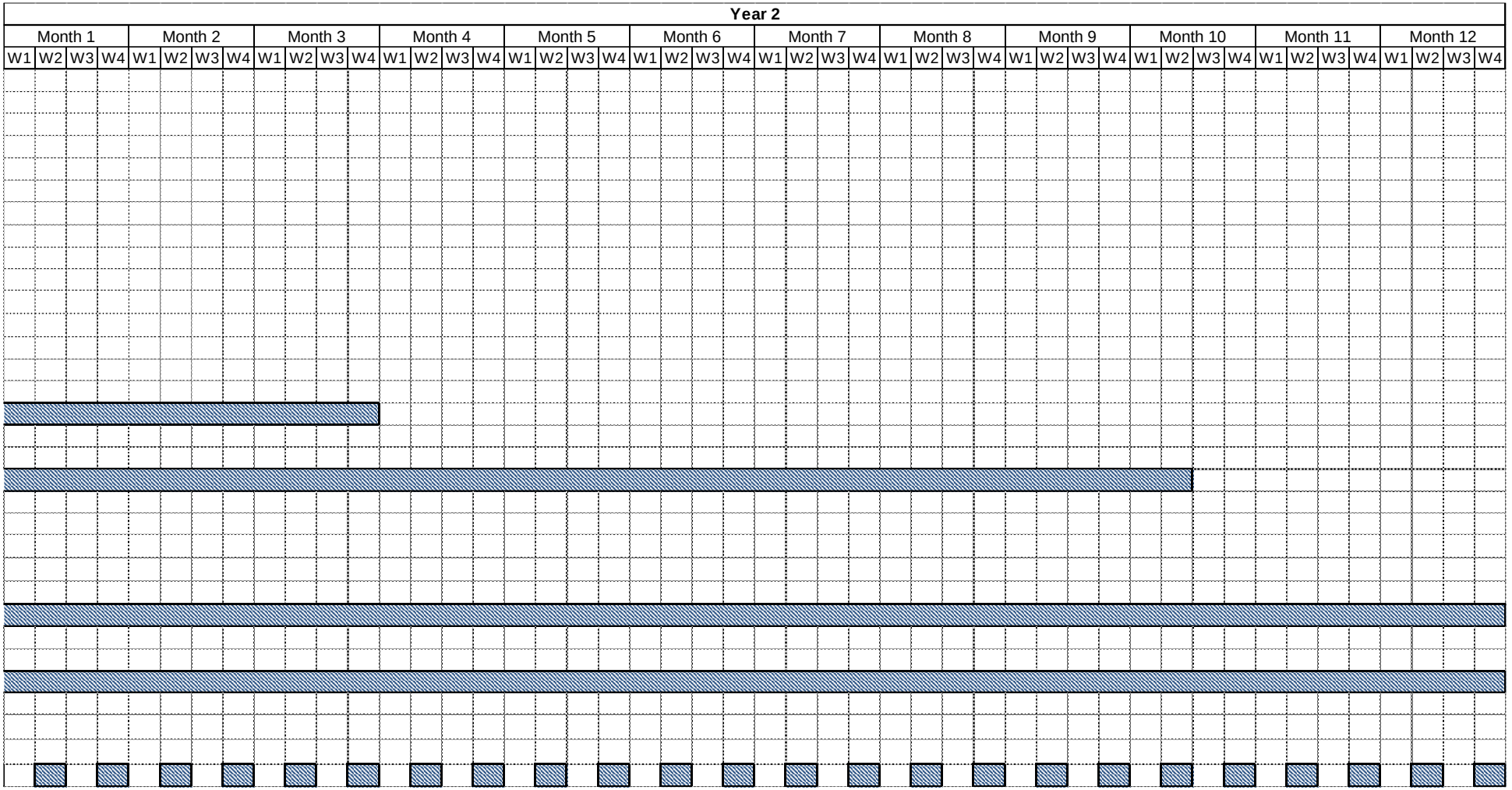
SECTION - 5

ANNEXURES

FEASIBILITY STUDY AND PROPOSING SOLUTIONS OF PROBLEMATIC SMALL DAMS IN DEVELOPMENT ZONE

SCHEDULE OF WORK

S.#	Interim Progress / Reports	Duration (after award of study)	Year 1																																													
			Month 1				Month 2				Month 3				Month 4				Month 5				Month 6				Month 7				Month 8				Month 9				Month 10				Month 11				Month 12			
			W1	W2	W3	W4	W1	W2	W3	W4	W1	W2	W3	W4	W1	W2	W3	W4	W1	W2	W3	W4	W1	W2	W3	W4	W1	W2	W3	W4	W1	W2	W3	W4	W1	W2	W3	W4	W1	W2	W3	W4	W1	W2	W3	W4	W1	W2	W3	W4
1	Inception Report	1.5 Months	X	X	X	X	X	X																																								
2	Report on collection of additional primary and secondary data	03 Months							X	X	X	X	X	X	X	X	X	X	X																													
3	Report on identification of problem areas after detailed analysis of data, design parameters and site conditions	05 Months									X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X																		
4	Report on comparative analysis of various available technical solutions / alternatives for further detailed deliberations in order to evolve most economical and viable solution	08 Months											X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X						
5	Preparation of detailed feasibility studies including conceptual design and estimates	12 Months													X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
6	Preparation of detailed design and drawings with design calculations	18 Months															X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
7	Preparation of cost estimate, PC-I, BOQ and tender documents, pre-qualification criteria of contractors etc, as per requirements of IAs in the light of PPRA Rules	20 Months																	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
8	Preparation of contractor's pre-qualification criteria, etc.	20 Months																	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
9	Monthly & fortnightly progress reports & monthly presentations	Within 1st & 3rd week of every month		X		X		X		X		X		X		X		X		X		X		X		X		X		X		X		X		X		X		X		X		X		X		X


Year 2
Month 1
Month 2
Month 3
Month 4
Month 5
Month 6
Month 7
Month 8
Month 9
Month 10
Month 11
Month 12
W1 W2 W3 W4 W1 W2 W3 W4 W1 W2 W3 W4 W1 W2 W3 W4 W1 W2 W3 W4 W1 W2 W3 W4 W1 W2 W3 W4 W1 W2 W3 W4 W1 W2 W3 W4 W1 W2 W3 W4 W1 W2 W3 W4 W1 W2 W3 W4