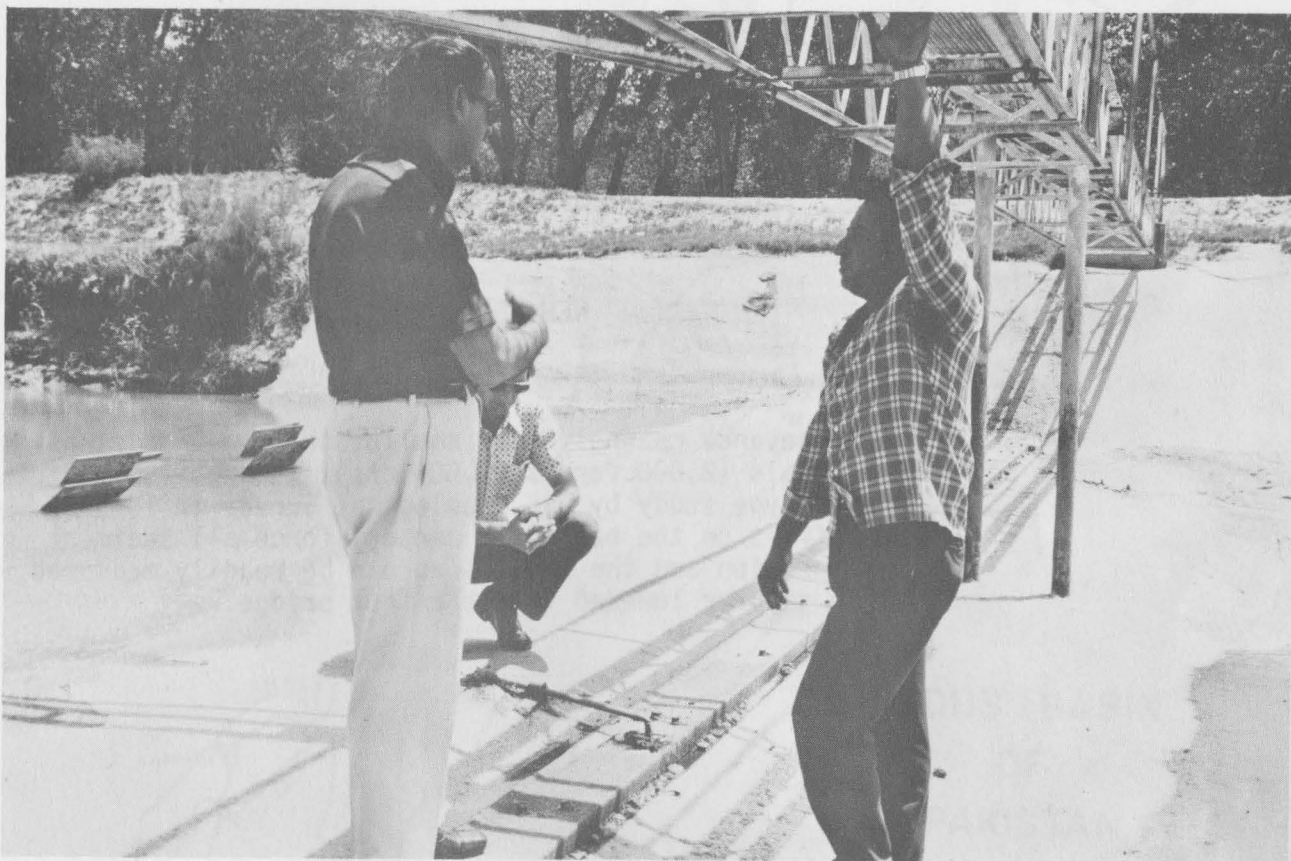


Final Report
FIRST REVIEW MEETING
ALLUVIAL CHANNEL OBSERVATION PROJECT (ACOP)

Submitted by
Khalid Mahmood



to
Office of International Programs
National Science Foundation

for
Colorado State University

in fulfillment of
NSF Grant OIP74-08440 A01

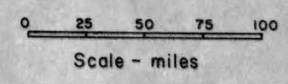
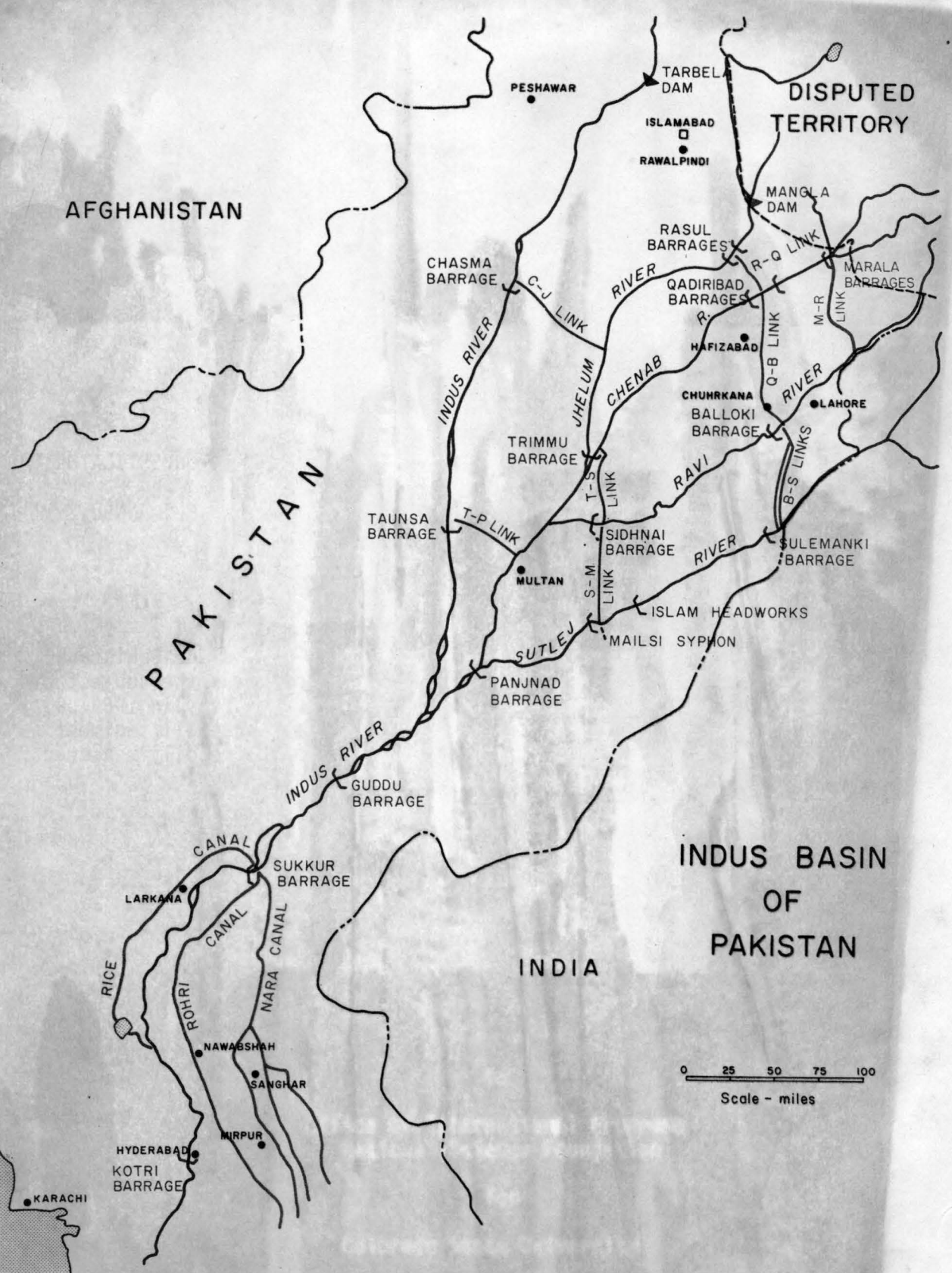
September 1974

CER74-75KM7

COVER PHOTO

VISITING PAKISTANI SCIENTIST R.N. TARAR, PRINCIPAL INVESTIGATOR, ACOP
AT THE SAMPLING WEIR OF RIO GRANDE CONVEYANCE CHANNEL,
NEW MEXICO

The conveyance channel, much smaller than the Pakistani Link Canals (2,000 versus 22,000 cfs), was the subject of an ACOP type study by U.S. Geological Survey in 1965-69. The baffles on the bed (left center) force all sediment in suspension and the total load can be readily measured with a sampler lowered from the foot bridge.



ABSTRACT

Alluvial Channel Observation Project, ACOP is a Special Foreign Currency Cooperative Research Project funded by NSF Grant GF-39653 to Water and Power Development Authority, Pakistan. The Project was inaugurated in Pakistan in January-February, 1974, and since then considerable progress has been made in the organization, staffing and field work. A review meeting was held at Colorado State University from August 8 to August 11, 1974. This was attended by Mr. R.A. Qureshi, General Manager, Water, WAPDA and Project Manager, ACOP, and Mr. Riaz N. Tarar, Project Director and Principal Investigator, ACOP from Pakistan. The review meeting was followed by a visitation of the Pakistani scientists and the U.S. Cooperating Scientist to various Federal Agencies interested in the mechanics of alluvial channels. The review meeting and the following visitation was sponsored by the supplementary NSF Grant OIP-74-08440 A01 to Colorado State University.

This completion report narrates the discussions and the decisions of the review meeting. It also covers the visit of the Pakistani scientists to U.S. Federal Agencies.

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FIRST REVIEW MEETING ON ALLUVIAL CHANNEL OBSERVATION PROJECT

I. INTRODUCTION

This completion report covers the activities and accomplishments of the program conducted under the supplementary NSF Grant OIP-74-08440 A01. The purpose of the grant was to sponsor the first review meeting of the Alluvial Channel Observation Project (ACOP) at Colorado State University and to sponsor meetings of the Pakistani Principal Investigator Mr. Riaz N. Tarar with U.S. Federal Agencies involved in similar investigations.

The Alluvial Channel Observation Project (ACOP) is a special Foreign Currency Cooperative Research Project funded by NSF Grant GF-39653 to the Water and Power Development Authority, Pakistan. The Government of Pakistan approved the project in November, 1973. The project was inaugurated during January-February, 1974 in Pakistan and at that time the specific objectives and direction of research on this project were discussed with the Pakistani Principal Investigator Mr. Riaz N. Tarar (refer CSU Final Report No. CER-73-74 AGM-KM29 dated March 1974).

Since the inaugural meeting, work on ACOP has progressed in Pakistan. The field and office staff has been mobilized and levelling along the Link Canal has been carried out to establish bench marks. The field and office procedures have been set up and preliminary data collection activity has been started. A meeting was held at Colorado State University, Fort Collins from August 8 to August 11, 1974 to review the project. It covered the present and future technical and administrative aspects of the project as well as the research

equipment needs. The review meeting was followed by visitation of the Pakistani Principal Investigator, Mr. Riaz N. Tarar of different Federal Agencies, such as U.S. Geological Survey, U.S. Bureau of Reclamation, U.S. Agricultural Research Service and U.S. Army Corps of Engineers, working on similar projects. In the meantime, Mr. Rafique A. Qureshi travelled to Washington, D.C. to visit the Coastal Engineering Research Center and the National Science Foundation. These visits and meetings lasted from August 12 to August 23, 1974, and included meetings at NSF with Dr. Bodo Bartocha, head of Office of International Programs (OIP), Dr. R.R. Ronkin, Manager, Special Currency Section, OIP, Mr. Karl Olsoni, Program Manager, OIP, Dr. Michael P. Gaus, Head, Engineering Mechanics Section and Dr. Arthur A. Ezra, Program Director in Engineering Mechanics Section. The help of Drs. Bartocha, Ronkin, Gaus, Ezra and Mr. Olsoni in reviewing the scientific direction of the project with the visiting Pakistani scientists is greatly appreciated.

II. REVIEW MEETING

The review meeting was held at Colorado State University. It lasted from August 8 to August 11, 1974 and was attended by:

Mr. Rafiq A. Qureshi
General Manager, WAPDA
Project Manager, ACOP

Mr. Riaz N. Tarar
Project Director
Principal Investigator, ACOP

Dr. Khalid Mahmood
Associate Professor
Colorado State University
U.S. Cooperating Scientist, ACOP

Dr. A.G. Mercer
Northwest Hydraulic Consultants, Ltd.
Vancouver, B.C. Canada
as a consultant

At the planning stage of the meeting Mr. Nissar Ahmad, General Manager (Water), WAPDA, was also expected to attend the review meeting. However, he has since been transferred from WAPDA and being no longer associated with the project, did not come. Dr. Mercer arrived on the 9th of August and attended the meetings on the 9th and 10th.

The agenda of the meeting was planned and the following major decisions were made:

A. Review of the Progress on ACOP

The progress on the activities in Pakistan was reviewed. The study reaches on canals have been selected and collection of equilibrium data has been started. Considering that the project has been inaugurated in February, 1974, the progress was considered highly satisfactory.

B. Design of Experiments and Transmittal of Data

The orientation of the project was reviewed. ACOP as a cooperative research project has two objectives:

1. The research results will be of importance to Pakistan in research content, development of personnel expertise, solving operational problems, and in developing scientific contacts with the United States.
2. The results will be of importance to the U.S. and to the World at large in scientific content, availability of reliable data on large sand bed canals and in fostering cooperative research with Pakistan.

It was agreed that the design of experiments and collection, dissemination and analysis of data be governed by these considerations. Several graduate students will be working at CSU under the guidance of the U.S. Cooperating Scientist on research projects related to large sand bed channels. These students will be using ACOP data for their research theses. To make the data as useful as possible, it is necessary that all data collecting activity be regulated by delineating specific experiments and the data be transmitted to CSU as soon as possible after the date of collection. Also, to avoid errors in transmittal, it is necessary that as much of the data be transmitted in "raw state" (i.e. without transcription or reduction) and as soon as possible. It was specifically agreed that:

1. Before collecting data in the field, specific experiments will be delineated with objectives, procedure, and data requirements. The experiments will be mutually reviewed by ACOP and CSU so their scope can be improved and difficulties resolved.

2. All field data will be transmitted to the U.S. Cooperating Scientist during the ensuing month. The schedule will be worked out by the Principal Investigator in Pakistan.

3. About five percent of data will be transmitted in reduced as well as in raw state (i.e. in basic measurements and records as actually made in the field) and the remaining in reduced form alone.

4. The research workers may need additional data in raw state. They can obtain it by requesting specific items.

5. The format for reduced data will be finalized with each experiment and will be specific to the objectives of that experiment.

6. The format for reduced data to be subsequently published as the Project Data Reports will be decided in the future.

7. In most cases, the raw data should be put on punched computer cards for help in future retrieval, reduction and analysis.

This involves:

- a. adopting a format
- b. key punching the data
- c. verifying the punched data

The format in each case will be developed and supplied from CSU. The key punching and verification will be done by ACOP and for this purpose, they will develop necessary manpower in the project office.

8. ACOP personnel will be encouraged to use the data for their academic purposes. CSU will provide the maximum cooperation needed to develop an academic liaison between ACOP and the Engineering University at Lahore.

9. The results of research conducted at CSU on sand bed channels will be made available to ACOP on a continuing basis. It is understood that most thesis research can be relevantly transmitted only at the completion of each particular thesis.

C. Supply and Need of Research Equipment

The equipment arranged for the project from NSF Grant GK-42921 was reviewed. It appears that bottlenecks exist in the following areas:

1. Some older sonic sounders were being repaired in Pakistan. It is not yet certain if any of these can be made operational. It was decided that at least one fathometer with accessories will be sent by air freight so the work on the project does not suffer.

2. Some difficulty is being experienced with the use of BM 54 bed material samplers from the smaller fiber glass boats available to the project. It was agreed that sediment load observation mostly needs simultaneous bed material samples at sites away from bridges. This may be done by modifying the existing small boats or using the larger flat bottom boats or by developing a two boat raft system. The Pakistani Project Director is investigating these alternatives.

3. It is believed that with the current meters being manufactured in Pakistan and the Price meters being supplied from CSU, there will be an adequate supply of current meters in the long run. In the near future, there may be some deficiency on this account but will not be serious.

4. A large number of sonic sounders and accessories will be used in the project. It was agreed that the Project Director will establish an operation and maintenance facility for the sounders by recruiting a qualified person on his staff.

5. Equipment needs of the project were estimated for the future when the work will be extended to the Lower Indus Canals and as more sophisticated observations will be undertaken. It was agreed that CSU will approach NSF for funds for the additional equipment.

6. The problem of import of the research equipment into Pakistan was also considered. It was agreed that the arrangement already worked out between ACOP and CSU will be followed. Under this arrangement, ACOP will obtain import permits and pay the necessary import duties for each shipment. On their part, CSU will supply to ACOP documents related to all items sent to Pakistan.

7. No other bottleneck due to materials and equipment is presently apparent in the near term research plan.

D. Participation of CSU Students in the Field Research in Pakistan

It was agreed that two or three CSU graduate students working on their advanced degrees will do their field research on the Link Canals for about six months each. These students will have completed their coursework and will come back to the university to analyze the data and complete their theses. The research theses, in general, represent the most advanced state of knowledge in any discipline. If students developing these theses work on the field research in Pakistan, the scientific content of the total research program will be greatly enhanced. The objectives of student participation are:

1. To impart a high level scientific content to the project,
2. To fulfill the academic requirements of the students' work at CSU under the Link Canal Project,
3. To impart current theoretical concepts to the Pakistani co-workers,
4. To develop international scientific cooperation

It was explained that the scope of field research to be done by these students will have been finalized by the students and their academic committees beforehand. This scope is quite specific in its objectives,

but the details are worked out by the student and he has, as a rule, a great flexibility, so the administrative set up in which the students are placed should keep this factor in view. It was agreed that for purely administrative matters, the students will be under the supervision of Project Director, ACOP. It was also agreed that the students will spend ten to fifteen percent of their time on activity immediately beneficial to the Project. This will include developing computer programs, data reduction and theoretical developments.

It was agreed that the Office of International Programs be approached by CSU to cover the salaries and travel costs of these students. It was also agreed that the revised ACOP project under preparation with the Project Director will incorporate the preceding provisions, so that approval of the Government of Pakistan for CSU student participation is obtained in conjunction with the project's sanction.

E. Training Course in Pakistan for ACOP Personnel

It was agreed to hold a training course for ACOP personnel on the fundamentals of sedimentation and measurements in alluvial channels in Pakistan. The objectives of such a course are:

1. To provide a basic theoretical understanding of the mechanics of alluvial channels and related measurements,
2. To provide practical training in field data collection,
3. To provide training in the use of specialized measuring equipment supplied to the project.

The following specific decisions were made in this context:

1. The course will be held in Pakistan for two to three weeks' duration. There will be three instructors from the U.S., two

senior professionals from U.S. Geological Survey besides the U.S. Cooperating Scientist.

2. The course will be organized to handle up to 30 students. Primarily these students will be degreed engineers from ACOP. However, in the interest of harmony with other departments, a limited number of persons from other government agencies in Pakistan will be invited to attend.

3. The training course will be administratively organized by the Pakistani Principal Investigator and the technical content will be designed by the U.S. Cooperating Scientist.

4. The cost of the course will be included in the revised ACOP project.

5. The U.S. Cooperating Scientist will approach NSF and USGS for related support and personnel.

6. The course should coincide with the annual visit of the U.S. Cooperating Scientist in March - July, 1975.

An outline of the course was drawn, see Appendix B.

F. Long Range Goals of ACOP

A phased program of research under ACOP was developed during the inaugural meeting in Pakistan (refer Final Report on Inaugural Meeting, ACOP, CSU Report No. CER 73-74 AGM-KM 29, March 1974). This phased program was reviewed. The Pakistani scientists suggested that they can move into C-J and T-P Link Canals (refer Map, page iii) during Phase I. This was agreed to. Also, they proposed the inclusion of Marala-Ravi (M-R) Link Canal in the Phase II study. This Link Canal is an important canal in the recent alluvial channel history. It was

designed for a discharge of 22,000 cfs but within a few years, it silted up to a fraction of that capacity. Presently, the canal can only be used for flows up to about 9,000 cfs. The inclusion of some studies on M-R Link Canal during the second phase (July, 1975 to June, 1976) was agreed to. The Pakistani Project Director agreed to prepare a background report on this canal narrating the history of silting up, record of past observations, water and sediment entry data, etc. The U.S. Cooperating Scientist will design a study based on this report. The revised phased program is as follows:

Phase	Period		Activity
	From	To	
I	Start	June 1975	Initial mobilization. Training course for personnel, Baseline data, Equilibrium and special observations on R-Q-B-S, T-P and C-J Link Canals. Selection of Sukkur Barrage (S.B.) Canals in Lower Indus. Baseline data on M-R Link Canal. Mobilization into Phase II. Report on Phase I.
II	July 1975	June 1976	Baseline data on S.B. Canals, Equilibrium and special observations on Phase I Canals, M-R Link and S.B. Canals. Introduction and use of turbulence and diffusion equipment. Mobilization into Phase III. Report on Phase II.
III	July 1976	June 1977	Selection and baseline data collection for some unlined irrigation canals in Panjab and Sind for specific problems. Equilibrium and special observations on Phase II canals and on newly selected canals. Mobilization into Phase IV. Report on Phase III.
IV	July 1977	June 1978 or conclusion of the Project	Review of the overall data/information collected during the first three phases of the Project. Identification of the gaps in data. Extension of the study to some representative river reaches in the Indus plain. Final data and research reports on Project.

The long range goals of ACOP have been twice revised and enlarged since the project was first written and approved in 1973. In the meantime there also has been an increase in the project cost due to inflation. The broadened scope of the project as well as the inflation requires a revision of the project cost. A draft revised project has been prepared by the Project Director, ACOP. This was reviewed and endorsed in principle. It was agreed that Project Director, ACOP, will finalize the revised project, conjunctively incorporating the CSU student participation, training courses in Pakistan and the future participation of the Pakistani Universities. The Project Director will then submit it to the Government of Pakistan for approval.

An abstract of the revised draft budget as discussed at the meeting is given in Appendix C.

G. Visit of Senior ACOP Professionals

It was moved by the Project Director, ACOP that some senior personnel from ACOP will need to visit CSU for three to six months assignment to undertake advanced theoretical work, participate in the analysis of data at CSU and to see first hand the field and laboratory work with various U.S. Federal Agencies. These visits will amount to about one half professional man-year annually. It was agreed that NSF be approached for policy decision and funding of these visits.

H. Administrative Problems of ACOP

The ACOP monthly progress reports had indicated a continued problem on the appointments, promotions and amenities to the staff employed on the project. ACOP is a research project and encouragement

of research can be achieved by giving proper support to the personnel employed on the project. The Project Director and the General Manager indicated that major hurdles in the solution of administrative problems have been cleared and the matter will be handled within WAPDA.

Considering the long range goals of ACOP, some areas of weakness are apparent in the staff at the headquarters of the project. It was agreed that separate sections will be established at the project headquarters in the following areas:

1. Data Compilation and Transmission
2. Computer Programming
3. Data Analysis and Reduction
4. Report Publication

In addition, the project headquarters will now be responsible for sediment sample analyses (IRI has finally refused to undertake this work), and an operation and maintenance section for the sonic sounding equipment will be added besides the current organization (see Supply and Need of Research Equipment, Para. 4, page 7).

It was agreed that the Project revision will reflect these additions and the Project Director will establish the new positions.

I. Visit of U.S. Cooperating Scientist

It was agreed that the U.S. Scientist should make his annual visit from March to July, 1975, and the training course in Pakistan should coincide with this visit. Also at least one CSU student should arrive at the same time. The objectives of this visit will be:

1. To review the progress
2. To review the field work
3. To conduct the training course
4. To conduct field investigation and some specialized experiments in the field.

III. VISITATION OF U.S. FEDERAL AGENCIES

The review meeting at CSU was followed by visitation of various Federal agencies in the U.S. working in river mechanics, and by meetings with research workers at these sites. The purpose was to acquaint the Pakistani Principal Investigator with the ongoing research in the field of alluvial channels and the instrumentation used. Another object was to introduce ACOP to the U.S. research groups engaged in similar work and to familiarize them with its scope and objective. The list of persons and agencies visited by the General Manager and the Project Director are given in Appendix A. A summary of some major meetings and discussions follows:

- A. U.S. Geological Survey, Water Resources Division
Denver Federal Center
Denver, Colorado 80225

R.A. Qureshi, R.N. Tarar, and K. Mahmood met with Mr. David Hubbell and Mr. Herbert Stein.

Tarar explained the scope of the ACOP project. The instrumentation used by Hubbell in the Columbia river estuary work was discussed. Some of these are adaptable to the Link Canal studies.

- B. U.S. Bureau of Reclamation, Sedimentation Branch
Denver Federal Center
Denver, Colorado 80225

R.N. Tarar and K. Mahmood met with Mr. E.L. Pemberton, Head.

Tarar introduced the scope of ACOP. Pemberton explained the Bureau's sedimentation work and their interest in the outcome of ACOP studies.

- C. U.S. Geological Survey, New Mexico District Office
University of New Mexico
Albuquerque, New Mexico 87106

R.N. Tarar and K. Mahmood met with Mr. William Hale, District Chief.

Discussion of ACOP and USGS activities in New Mexico district. Visitation of sedimentation and water quality laboratory. Field visit to Rio Grande and Rio Grande conveyance channel. This channel is extremely similar to the smaller canals in Pakistan (the Link Canals are, however, and order of magnitude larger). It has been the subject of an ACOP-type study by J.K. Culbertson and Carl Nordin of USGS. The metering section on the conveyance as well as the head regulator were visited.

The visit to the sedimentation lab with David Funderburg was particularly useful. It is a typical U.S. sediment data analysis lab handling a large number of samples. The procedures from this lab can be adapted for ACOP.

- D. U.S. Department of Agriculture, Agriculture Research Service
Sedimentation Laboratory
Oxford, Mississippi 38655

R.N. Tarar and K. Mahmood had separate and joint meetings with Drs. J.R. McHenry (acting Director), Neil Coleman (hydrologist), Frank Shiebe (instrumentation), Carl Murphee (agriculture engineer), and J.D. Schreiber (soil scientist).

Tarar presented a seminar on the Link Canals and ACOP Project, which was attended by the Laboratory Director, and staff. Discussions with Coleman and Shiebe on the ARS interests in sedimentation studies and the instrumentation used. The indoor lab, outdoor flume and the sediment monitoring site on the nearby stream were visited. ACOP generated effusive professional interest in this laboratory.

- E. U.S. Army Corps of Engineers, Vicksburg District
Potamology Section,
Vicksburg, Mississippi 39180

R.N. Tarar and K. Mahmood met with Mr. Brian R. Winkley, Head, and Mr. W.H. Walters, Engineer.

The potamology section at Vicksburg is one of four sections in different U.S. Army Corps districts engaged on an extensive program of hydraulic, morphologic and sedimentation data collection on the Mississippi River. ACOP compliments the potamology work on the Mississippi in the type of equilibrium state data. The difference is that ACOP deals essentially with straight canals and the Mississippi is a largely stabilized river with meandering and braided planform geometry.

Tarar explained the objectives and scope of ACOP to this potamology group. Winkley presented a slide show on the procedures of data observation used on the Mississippi. The form of data reduction and reporting were discussed. Mahmood had helped this potamology section in the past, in organizing their computer record of data. This was discussed further and its implications for ACOP were noted.

A single engine Cessna was rented and Winkley, Tarar and Mahmood flew over the Mississippi. The river has been extensively trained and stabilized for flood control and navigation. The morphological aspects of bank protection and river training measures are a common factor in Tarar's and Winkley's professional background. Views were exchanged on the differences in the U.S. and Pakistan practice on river training.

Tarar, Winkley, Walters and Mahmood also visited the Waterways Experiment Station at Vicksburg and the headquarters of the Mississippi River Commission.

F. U.S. Army Corps of Engineers
Coastal Engineering Research Center
Fort Belvoir, Virginia 22060

R.N. Tarar and K. Mahmood met with Col. James Trayers, head of the Center, and with Dr. Galvin, Mr. Chesnutt and Mr. Judge.

This Center has recently shifted to Fort Belvoir, Virginia and is presently not very active. Tarar explained the objective and scope of the Project to various program leaders. Of special interest to ACOP is the Rapid Size Analyzer (RSA) being developed at this lab for sediment size analysis.

G. U.S. Geological Survey
National Center
Reston, Virginia 22092

R.N. Tarar and K. Mahmood met with hydrologists J.K. Culbertson, Thomas Maddock, Jr., Harold P. Guy, and Mr. George C. Taylor, Chief, Office of International Activities, Water Resources Division.

Tarar explained the objectives and scope of ACOP to the meeting. This USGS group has long been involved with water quantity, water quality and sedimentation data collection in the U.S. Tarar explained to the group that the data collection in ACOP will be closely regulated by research objectives and for this reason, every bit of data will be observed under experimental conditions. These experiments will be designed for definite objectives and the observations and procedures will be specified in advance. Generally from start to the end of analysis the experiments will cover about six months. In many instances different experiments will have similar objectives but will be carried out under different conditions or at different locations. Tarar explained that this approach is necessary to optimize the field effort. The group fully endorsed this approach. Tarar and Mahmood also explained the need for USGS help in organizing a training course in Pakistan (see Review Meeting item E, page 9 and Appendix B, Training Course in Pakistan for ACOP Personnel). They also narrated the proposed scope and duration of the course and

the type of students that will be involved. George C. Taylor, Jr. indicated that an arrangement can be made to release two USGS professional people in this case. The exact details of the travel and per diem support to the Survey's professionals will be worked out later.

H. National Science Foundation
Engineering Mechanics Division
Washington, D.C. 20550

R.A Qureshi visited Drs. M.P. Gaus and A.A. Ezra on August 14, 1974. R.N. Tarar and K. Mahmood met with Drs. Gaus and Ezra on August 20 and 22, 1974.

Tarar narrated the progress on the project and the future program as developed over the last year and finalized in the review meeting. Tarar explained the future equipment and dollar needs of the project. He also explained the proposal to have the CSU students do their field research on the Link Canals for their research theses (see Participation of CSU Students in Field Research in Pakistan, Page 8). It was agreed that at the conclusion of renewal research grant for calendar year 1975 (presently under review with NSF), a three years project will be drawn up by Mahmood to insure a continuity of research in the U.S. and to provide necessary equipment support to the field project. The proposed CSU student participation was also endorsed.

I. National Science Foundation
Office of International Programs
Washington, D.C. 20550

R.A. Qureshi met with Dr. R.R. Ronkin, Manager, Special Foreign Currency Section, Dr. Bodo Bartocha, Head, Office of International Programs (OIP) and Dr. T.O. Jones, Acting Assistant Director, National and International Programs.

Qureshi discussed the general direction of ACOP and the overall problems of land and water resource utilization in Pakistan.

R.N. Tarar and K. Mahmood met with Mr. Karl Olsoni, Program Manager on August 22, 1974.

Tarar discussed the progress on ACOP and the proposed revised project. Olsoni informed that the budget for next year will soon be released and WAPDA will be informed of that.

R.N. Tarar and K. Mahmood met with Dr. R.R. Ronkin and Mr. Karl Olsoni on August 22, 1974.

Tarar explained two recently introduced concepts for field work; one, the participation of CSU students (see Review Meeting, item D, page 8) and two, the training course for ACOP personnel in Pakistan (see Review Meeting, item E, page 9). It was agreed that the revised project will incorporate these concepts and the corresponding budget requirements. It was also agreed that Mahmood will make necessary references to the Office of International Programs for monetary support sufficiently in advance.

R.N. Tarar and K. Mahmood met with Dr. Bodo Bartocha, Head, Office of International Programs and R.R. Ronkin on August 22, 1974.

Bartocha welcomed Tarar and discussed general direction of the project. Tarar invited Bartocha to visit the project in Pakistan.

IV. CONCLUSION

The Alluvial Channel Observation Project (ACOP) was reviewed in a meeting held at Colorado State University from August 8 to August 11, 1974. The progress on the project was reviewed and found to be highly satisfactory. The long range goals of the project were discussed and a number of specific decisions were made regarding the administrative problems and technical direction of the project (see Review Meeting, pages 3 to 13). It was decided that the project report, currently under review with the Project Director, ACOP, be finalized reflecting the decisions made in the review meeting.

It was agreed that the U.S. Cooperating Scientist should visit Pakistan during March through July, 1975 to organize and conduct a training program for the ACOP personnel in Pakistan and to conduct some field research. He will be assisted in the training program by two senior professionals from U.S. Geological Survey that will be requested from the Survey. During this visit, at least one CSU graduate student will start field work on the project for his graduate research.

The review meeting was followed by a visit of R.A. Qureshi, Project Manager, ACOP to the U.S. Army Corps of Engineers, Coastal Engineering Research Center and to the National Science Foundation. The Project Director, R.N. Tarar and the U.S. Cooperating Scientist visited U.S. Geological Survey, U.S. Bureau of Reclamation, U.S. Department of Agriculture, Agricultural Research Service and U.S. Army Corps of Engineers at various locations in the country. They also visited the Engineering Mechanics Division and Office of International Programs in the National Science Foundation. R.A. Qureshi left New York for

Pakistan on August 17, 1974 by P.I.A.C. flight no. 712 and R.N. Tarar
on August 24 by P.I.A.C. flight no. 712.

APPENDICES

APPENDIX A

LIST OF PERSONS (BY INSTITUTIONS) CONTACTED BY
THE VISITING PAKISTANI SCIENTISTS

- A. Colorado State University
Fort Collins, Colorado 80523
1. Khalid Mahmood
Associate Professor
Civil Engineering
 2. A.G. Mercer
Former Associate Professor
Civil Engineering
 3. E.V. Richardson
Professor
Civil Engineering
 4. Fuat Senturk
Visiting Professor of
Civil Engineering
 5. D.B. Simons
Associate Dean for
Engineering Research
- B. National Science Foundation
Washington, D.C. 20550
- 1B. Engineering Mechanics Section
1. Arthur A. Ezra
Program Director
 2. Michael P. Gaus, Head,
Engineering Mechanics Section
- 2B. Office of International Programs
1. Bodo Bartocha, Head,
Office of International Programs
 2. Karl Olsoni
Program Manager
 3. R.R. Ronkin, Manager
Special Foreign Currency Section

C. U.S. Army Corps of Engineers

1C. Coastal Engineering Research Center
Fort Belvoir, Virginia 22060

1. Charles Chesnutt
Coastal Processes Branch
2. C.J. Galvin, Jr., Chief
Coastal Processes Branch
3. Charles Judge, Chief
Petrology Laboratory
4. Colonel James Trayers, Head
Coastal Engineering Research Center

2C. Vicksburg District, Potamology Section
Vicksburg, Mississippi 39180

1. Lamont Robbins
Engineer
2. W.H. Walters
Engineer
3. Brian R. Winkley, Head
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1. Merl Howard, Head,
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2. E.L. Pemberton, Head,
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Sedimentation Laboratory
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1. N.L. Coleman
Hydrologist
2. J.R. McHenry
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3. C.E. Murphee
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4. J.D. Schreiber
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5. F.R. Shiebe
Instrumentation Engineer

F. U.S. Geological Survey in Colorado, New Mexico and Virginia

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2. Carl Nordin
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3. Herbert Stein
Hydrologist

2F. University of New Mexico
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1. David Funderburg
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2. William Hale
District Chief
3. Francis C. Koopman
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4. Robert M. McBreen
Chemist, Water Quality Section

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Reston, Virginia 22092

1. J.K. Culbertson
Hydrologist
2. Harold P. Guy
Hydrologist
3. Thomas Maddock, Jr.
Hydrologist
4. George C. Taylor, Jr., Head,
Office of International Activities
Water Resources Division

APPENDIX B

SEDIMENTATION COURSE OUTLINE

Location: Lahore, Pakistan

Duration: two weeks lectures
one week field work

Students: About thirty with Engineering degree or equivalent training in the mechanics of alluvial channels.

Timing: April, 1975

Course Outline:

1. Theory:
Hydraulic, morphologic and sediment transport concepts for sand bed channels, computational methods and field measurements to evaluate resistance and transport in sand bed channels; errors in measurements and analysis of errors.
2. General field training:
Measurements in sand bed channels of water level, bed level, longitudinal distance, velocity, velocity profile, bed forms, bed material, suspended load, temperature and water quality parameters.
3. Training in the use and operation of specific measurement and analysis equipment: current meters, sonic sounders, point and depth integrating sediment samplers, bed material samplers, visual accumulation tube sediment size analyzer, bottom withdrawal tube, sieves and tracer particles preparation, detection and analysis equipment.

APPENDIX C

SUMMARY OF INCREASE IN COSTS, ACOP

A STUDY OF ALLUVIAL RIVER MECHANICS
USING THE CANALS OF PAKISTAN
REVISED-AUGUST 1974

in 1,000 Rupees

A. Revised Cost	11,729
B. Original Cost	5,280
C. Increase (A-B)	6,449
D. Categorization of Increase	

<u>No.</u>	<u>Category</u>	<u>Inflation</u>	<u>Increased Scope</u>	<u>Total</u>
1.	Direct Costs:			
	a. Staff salaries and benefits, etc.	430	265	695
	b. Travel/air fare, etc	250	102	352
	c. Administrative expenses	210	59	269
	d. Operation and Maintenance	487	456	943
	Subtotal (a thru d)	<u>1,377</u>	<u>882</u>	<u>2,259</u>
2.	Permanent Equipment:			
	a. Local	970	742	1,712
	b. Imported (duties & taxes only)	---	1,700	1,700
	Subtotal (a+b)	<u>970</u>	<u>2,442</u>	<u>3,412</u>
3.	Expendable Equipment and Supplies	74	244	318
4.	Omission in the original project	---	<u>460</u>	<u>460</u>
5.	Total (1 thru 4):			
	i) in 1,000 Rs.	2,421	4,028	6,449
	ii) Percent	38	62	100

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