SURFACE WATER INVESTIGATIONS IN AFGHANISTAN

Prepared by
the United States Geological Survey in cooperation with the
Water and Soil Survey Department
Ministry of Agriculture and Irrigation
Royal Government of Afghanistan
under the auspices of the
United States Agency for International Development

REPORT DOCUMENTATION PAGE	*Form Approved* *OMB No. 0704-0188*

1. REPORT DATE *(DD-MM-YYYY)*	2. REPORT TYPE	3. DATES COVERED *(From - To)*
01-03-1969	Administrative Report; Open File Report	1952-1969

4. TITLE AND SUBTITLE Surface water investigations in Afghanistan: a summary of activities from 1952 to 1969	**5a. CONTRACT NUMBER**
	5b. GRANT NUMBER
	5c. PROGRAM ELEMENT NUMBER
6. AUTHOR(S) Westfall, Arthur O., 1918-,	**5d. PROJECT NUMBER**
	5e. TASK NUMBER
	5f. WORK UNIT NUMBER
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) US Geological Survey (USGS) 12201 Sunrise Valley Drive Reston, VA 20192, USA	**8. PERFORMING ORGANIZATION REPORT NUMBER**
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)	**10. SPONSOR/MONITOR'S ACRONYM(S)** HVA; USGS; USAID
	11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION/AVAILABILITY STATEMENT

Unclassified/Unlimited

13. SUPPLEMENTARY NOTES

14. ABSTRACT

The purpose of this report is to summarize briefly the history of the Surface Water Research project since its inception in 1952, the work accomplished, and the problems encountered. In general, each topic is discussed under two periods of time: 1952-1963, when projects were confined to the Helmand River Valley and was entitled "Helmand Surface Water Investigations (306-12-021, 306-M-12-AD and 306-AC-12-AD5)," and 1963-1969 when activities were expanded to cover most of Afghanistan and title was changed to "Surface Water Research (306-11-190-002)".

Prepared by the United States Geological Survey in cooperation with the Water and Soil Survey Department, Ministry of Agriculture and Irrigation, Royal Government of Afghanistan under the auspices of the United States Agency for International Development. 18 appendices.

15. SUBJECT TERMS

Afghanistan. Drainage. Flood control. Helmand River Project. HVA. Helmand Valley Authority. Hydrology. Hydropower. Irrigation. Rainfall Runoff Calculations. Stream-flow Data. Stream gaging stations. Stream measurements. Surface Water. Water supply.

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT	b. ABSTRACT	c. THIS PAGE			19b. TELEPHONE NUMBER *(Include area code)*
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Surface Water Investigations in Afghanistan

A Summary of Activities from 1952 to 1969

by

Arthur O. Westfall, 1918 -

U. S. Geological Survey

[Open file]
~~Administrative Report~~

Washington, D. C.

March 1969

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Introduction

The purpose of this report is to summarize briefly the history of the Surface Water Research project since its inception in 1952, the work accomplished, and the problems encountered. In general, each topic is discussed under two periods of time: 1952-63, when project activities were confined to the Helmand River Valley and was titled "Helmand Surface Water Investigations (306-12-021, 306-M-12-AD, and 306-AC-12-AD5)," and 1963-69 when activities were expanded to cover most of Afghanistan and title was changed to "Surface Water Research (306-11-190-002)" (see map, figure 1).

Surface-water resources investigations in Afghanistan have been conducted with the guidance of American engineers since 1946 when feasibility studies were undertaken by Morrison-Knudsen-Afghanistan Company (MKA) and its affiliates in the Helmand Valley development. Since 1952 the U. S. Geological Survey (USGS) has provided advisors in surface-water investigations to the Royal Government of Afghanistan (RGA) under the auspices of the U. S. Agency for International Development (USAID) and its predecessor agencies.

All reports prepared during the life of the project including end of tour, programming, administrative, basic data, and training manuals have been listed as appendixes to this report

Figure 1.--Map of Afghanistan showing location of project activities. (in pocket)

but because of their great bulk are not attached. Copies of the appendixes are on file at the Office of International Activities, Water Resources Division, U. S. Geological Survey, Washington, D. C. 20242, and the library of the National Agricultural Development Division, U. S. Agency for International Development, American Embassy, Kabul, Afghanistan.

The selected references (see page 38) were taken from the files of the Office of International Activities, Water Resources Division, U. S. Geological Survey and represent most of the literature readily available in the U. S. on surface-water hydrology and climatology of Afghanistan. Lustig (1967) gives a comprehensive bibliography of geomorphology and surface hydrology of Afghanistan and most of the works he mentions are available at the University of Kabul library or in the files of agencies of the Royal Government of Afghanistan.

Objectives

1952-63: Snell (app.1) and Heckmiller (app.2) quote the objectives contained in the Helmand Surface Water Investigations (HSWI) program agreements as follows:

"The primary objective in the hydrologic program is the surface-water investigation to obtain data that will permit a sound determination of the hydrologic regimen of the Helmand River system; the secondary, long-term objective, is to prepare Afghan personnel to carry on the investigation so as to assume ultimate responsibility. Specifically the services consist of assisting the Helmand Valley Authority (HVA) to:

a. Supervise and operate existing network of stream-gaging stations.

b. Establish and operate additional stream-flow stations; rate canals and other miscellaneous channels as required for canal operation.

c. Review, compile, and analyze stream-flow records for current and future technical use.

d. Establish climatological stations as required in the Helmand Valley.

e. Study rainfall-runoff correlations, canal losses, etc., forecasts; make analyses and corrective or supplemental recommendations.

f. Train Afghan personnel in both field and office functions.

g. Furnish advisory service to the HVA.

h. Aid in the development of an Afghan organization for the collection and analysis of hydrologic data and reports; ultimately, to work on a national scale."

Brigham (app.3) states that, "the objectives have remained the same, being basically two-fold, that is (1) to collect the basic hydrologic data, stream-flow records, and weather data necessary to intelligent operation and planning of water use, and (2) to develop a staff of Afghan personnel competent to carry on the work of the unit."

The program document, "Development Grant Program Evaluation (app.8)," states essentially the same thing as Brigham but relates it to the reason for establishing the project. It lists the following as specific targets and results desired:

a. To collect basic hydrological data needed to effectively develop irrigation, drainage, land use, flood control and hydro-power projects in the Helmand Valley.

b. To develop within HVA by mid-1965 a competent organization for the collection and analysis of such hydrological data and the preparation of related reports. Through these reports it is believed maximum efficiency can be obtained in the use of available water, resulting in maximum agricultural production. The reports will also provide necessary data for planning drainage, hydro-power development, flood control measures, and further irrigation development.

c. In the process of developing this hydrological organization, to train Afghans (both in field and office procedures) to adequately operate and supervise a network of 16 discharge and/or stage stations and 4 evaporation and weather stations so that further U. S. technical or supervisory assistance is no longer needed; and to give training in the compilation of hydrological and weather data including stream flow, rainfall run-off correlations, canal and evaporation losses, and watershed snowfall data so that accurate forecasts and intelligent management can be made of water supplies. While the project is presently limited to the Helmand Valley project, Afghan technicians so trained will be capable of planning, developing and carrying out similar activities in other areas of the country.

The program document goes on to say that "While these are specific objectives of the hydrological project, this project cannot be easily divorced from that of the overall parent project with its objective of ultimately adding large areas to the productive lands of Afghanistan. As such, then, the hydrological project plays an important part in increasing the probability of success of the HVA itself."

1963-69: Brigham (app.4) reports that the newly-established Water and Soil Survey Authority (WSSA) of the Royal Government of Afghanistan (RGA) requested the U.S. Agency for International

Development (USAID) to furnish the services of two technical advisors to "advise the WSSA . . . in the development of a national agency for the collection, interpretation, and publication of surface water information in the country."

Westfall and Latkovich (app.10) report that ". . . the objectives of the Surface Water Research (SWR) project are to advise the RGA, through the Ministry of Agriculture (MAI), on procedures and practices in surface-water investigations that will permit the most rational use of the water resources of the country, and further, the ProAg requires the development of a water-resources investigation plan to coordinate the collection of data from drainage basins in all parts of the country."

To summarize, the general objectives of the project have been to furnish the necessary hydrologic data to the parent projects (1952-63) the HVA and (1963-69), the National Agricultural Development Project (NAD) to assist them to increase food production by increasing irrigated acreage and more efficiently use the water on already-irrigated lands. To accomplish the general objectives it has been necessary to (1) build gaging stations to collect basic streamflow data, (2) establish and staff an organization capable of collecting, interpreting, and publishing the data, (3) train Afghan nationals to successfully do the above steps, and (4) supply scientific instruments and equipment to measure and record the data.

Pre-Project Streamgaging Activities

Streamgaging in Afghanistan was not done on an organized basis until Morrison-Knudsen-Afghanistan (MKA) began work on the Helmand Valley project in 1946. Prior to that time occasional estimates and measurements of flow have been made by various groups or individuals as a matter of professional curiosity or in relation to international partition of waters of the Helmand River.

In 1885 the Goldschmid Commission determined the flow of the Helmand River at a point near Chahar Burjak. In 1902-05 the Persian-Afghan Arbitration Commission reported on low flows of the Helmand River resulting from the 1902 drought. In an unpublished paper, L. E. Stenz reports the following:

"RIVER DISCHARGE. The first measurements of river discharge in Afghanistan begin in 1939, but they were not systematically executed till now. The few occasional data, which have been collected here and there, show great variations of the water quantity.

"The most abundant river is the Amu Daria, whose average discharge at the place where it leaves Afghanistan, is estimated as 1740 to 2000 c. m/s. which corresponds to 55-63 c. km of water per year. The corresponding quantity of gravel and silt, which it carries, is estimated to be about 1/4 milliard cub. m. per year. The water discharge of this river was measured in Afghanistan only once and only at its left elbow embracing the Darkat Island; the result was 970 c. m/s (the middle of Sept. 1939);

the entire discharge of the river was probably more than twice of this amount.

"The discharges of the present and former affluents of the Amu Daria show great differences. The Kokcha is well watered and had in the middle of Sept. 1939, below its normal stage, a discharge of 163 c. m/s., and the Kunduz r., as its low stage (on 10th Nov. 1940) 108 c. m/s. On the other hand the other rivers of the Afghan Turkestan, i.e. the former Amu's tributaries, are very poor in water (Khulm resp. Khaibak - 3 c. m/s at the beginning of October 1940, Balkh r. - 29 c. m/s on 7th Nov. 1940 and Ab-i-Safed, at Sar-i-Pul, on 28th Nov. 1940, estimated 4 c. m/s; all these data correspond to a low stage). This scarcity of water, compared with its need in the region, was the reason that still before the Timur invasion (14th century) a big canal has been built from the Kunduz r. westwards in order to irrigate the fields of Bactriana, the Mazar-i-Sharif province of today.

"As to the Murghab r., its highest discharge of 367 c. m/s took place during its flood in 1886 on the Turkoman S.S.R. territory. Its minimum is 8, the average - 41,3 c. m/s. Only 20% of its water resources is consumed in Afghanistan.

"The Hari Rud carries much more water. During the spring flood of 1939 its water was so high that it carried away nearly all bridges. Its discharge was then estimated by L. Malinowski as 1090 c. m/s at Herat. The water quantity, determined in August of the same year at Shirkatch (near the 64° meridian), for a low water, was 46 c. m/s. Surely, on the Turkoman S.S.R. territory the Tedjen's (Hari) discharge is less because of losses which it suffers by conducting water to irrigation canals at the Sarakhs oasis. So its water amount at a high stage in spring is only 60 to 70 c. m/s, in 1923 it was even only 30 c. m/s; the average is about 25 c. m/s. Losses by evaporation are caused by the desiccating action of the "wind of 120 days," a hot and dry gale which is blowing in the Herat province from June to September.

"The water supply of the Helmand r. is now being thoroughly investigated in connection with the planned irrigation scheme. This river is well watered indeed, and in 1885 (the "Year of Noah") its discharge near its mouth was estimated to be about 5700 c. m/s. In the spring of 1903 it was only 1980 c. m/s. On the contrary, the low mark falls sometimes to zero, and Tate writes that the Helmand's bed "below Chaharburjak was dry for 42 days from the end of July till the second week in September 1902."

"During the spring flood 1939, when the new bridge was destroyed at Girishk, Helmand's discharge was estimated as 4000 c. m/s. But at the end of October 1939 the amount was only 90 c. m/s. The same value of 91 c. m/s has been measured by the author on 10th February 1944 near Girishk. In April 1945 the discharge on a high stage was 737 c. m/s. In 1946 begin more frequent determinations executed by the hydrographer of the Morrison-Knudsen Co; the highest discharge found was that of 215 c. m/s on 16th April 1947; but this was an exceptionally dry year. In any case the Helmand r. exhibits the same great fluctuations of its water amount as the Hari Rud.

"The discharge of the Kabul r. was determined for the first time by the author on 29th March 1942 during a high water at Kabul; 50 c. m/s was found then. On 6th April 1946 Keesee observed only 33,3 c. m/s. In the Middle course of the Kabul r., at the Darunta bridge 73,4 c. m/s was found on 20th Jan. 1946, 131,6 c. m/s on 18th March and 425 to 460 c. m/s (high water) on 8th April of the same year."

Starting in 1946, MKA established the following gaging stations in the Helmand River drainage:

Station	Date established
Helmand River near Dehraout	Oct. 1952 -
Tirin River at Dehraout	Mar. 1952 -
Kajakai Reservoir	Jan. 1953 -
Helmand River below Kajakai dam	Oct. 1946 -
Musa Qala River at Musa Qala	Apr. 1952 -
Seraj Canal at Sangin	Oct. 1952 -
Helmand River at Girishk	July 1946 -
Arghandab River above Arghandab Reservoir	Oct. 1951 -
Arghandab Reservoir	Feb. 1952 -
Arghandab River below Arghandab dam	Oct. 1947 -
Arghastan River near Kandahar	Oct. 1952 -
Arghandab River near Qala Bist	Oct. 1947 -
Helmand River near Chahar Burjak	Oct. 1946 -
Khash River near Dilaram	Oct. 1952

(Listing is in downstream order and indentations indicate intervening tributaries.)

MKA also established gaging stations on the Ghazni, Paltu, Sardeh, and Kabul Rivers. The responsibility for operating these stations was transferred directly to the Ministry of Public Works in 1952 but the program was continued by MKA.

In addition, MKA had established meteorological stations at Kandahar, Chahanjirs, Kajakai Dam, and Arghandab Dam.

Project Accomplishments

1952-63.--USGS participation in the HSWI began in mid-1952 with the arrival of Mr. Leonard J. Snell on post. For at least the first year of his tour, because of staffing and organizational problems in the Helmand Valley Project, Mr. Snell assumed the duties of Operations and Administrative Officer in addition to his responsibilities as technical advisor. In May 1953 the MKA gaging and meteorological stations were transferred to the HSWI project.

Mr. I. A. Heckmiller arrived in June 1954 to assist Mr. Snell. Mr. Snell's tour of duty was completed in early 1956. Mr. Heckmiller continued the project until June 1959. He was replaced by Mr. Robert H. Brigham in November 1959 who served until April 1964.

During the period 1952-63 the following was accomplished:

1. Continued operation of the streamflow stations established by MKA in the Helmand Valley.
2. Improved the physical structures of the gaging stations to acceptable standards.

3. Established additional gaging stations at the following sites:

Boghra Canal above Girishk	Oct. 1954
Shamalan Canal near Chahanjir	Oct. 1954
Helmand River at Darweshan	Oct. 1956
Helmand River at Shela Charkh	Aug. 1955
Farah River near Farah	Apr. 1953

4. Prepared discharge ratings for all canal turnouts and laterals in the HVA system.

5. Made over 100 measurements of flow in old existing canals in the Arghandab and Shamalan areas for planning purposes.

6. Reviewed, corrected, and brought up to acceptable standards all records compiled prior to 1952.

7. Analyzed, computed, and edited all streamflow and reservoir records for the entire period.

8. Compiled and published all streamflow, reservoir, and climatological records through September 1960 (see appendixes 17 and 18.

9. Published and distributed to interested parties a monthly hydrologic summary during the entire period. This summary contained comments on weather conditions and tables of temperatures, precipitation, evaporation, humidity, and wind data.

10. Published and distributed the operation records for Kajakai and Arghandab Reservoirs during the entire period. These records included daily inflow and outflow, reservoir elevation and contents, change in contents, evaporation.

11. Continued to operate the climatological stations established by MKA.

12. Constructed new climatological stations at Nadiali, Kalakang, Panjao, Orosgan, Mukur, Marja, Lashkar Gah, Dehraout, and Darweshan. The station at Bakwa near Farah operated by the Meteorological Service from February 1944 to September 1946 was reactivated by MKA in February 1950 and continued by this project until March 1954. Because of difficulty in finding competent resident observers, the stations at Panjao, Orosgan, Mukur, and Dehraout were discontinued after short periods of operation.

13. Established staff gages in Nawar Lake for rainfall-runoff correlation purposes.

14. Furnished advisory services to the HVA in the form of forecasts of seasonal runoff, reservoir operation, and canal losses.

15. Established four snow-survey courses in the Ghazni-Mukur area.

16. Established sediment data collection stations on the Helmand and Tirin Rivers above Kajakai Reservoir and on the Arghandab River above Arghandab Reservoir in October 1955.

17. Obtained over 1,200 sediment samples during the 1956 water year and had them analyzed for concentration and sediment size distribution.

18. Established a hydrology section within the HVA. This included planning the physical structure, position classifications, staffing pattern, procedures and standards of technical work, acquisition and use of scientific instruments and equipment, and transportation and warehousing needs.

19. Trained, to varying degrees of competency during the 11-year period, 15 Afghan technicans in all phases of the work. This included construction and maintenance; use, care, and servicing of scientific intruments and equipment; procedures and standard methods of streamflow measuring; office computation and compilation of basic data; determination of drainage areas by use of a planimeter; elementary surveying and differential leveling; and drafting techniques.

20. Gave additional training to Afghan engineers on indirect methods of measuring river discharge, transit-stadia surveying, reservoir sedimentation surveys, and planning and programing project activities.

21. Prepared and sent five technicans for participant training at the American University of Beirut or to U.S. universities.

1963-69.--Brigham (app.4) reports that in March of 1963 the RGA created an independent agency, the Water and Soil Survey Authority (WSSA), with authority to ". . . assume responsibility for the investigations into Afghanistan water resources and all activities in this field were folded into it." Mr. Brigham spent the remainder of his tour working between the HSWI office and the new WSSA headquarters in Kabul.

The WSSA requested additional technical assistance from USAID to assist in streamflow investigations in the Ghazni, Tarnak, Helmand, Arghandab, Khash, Farah, Adraskand, and Hari River drainages. As a result, the project was reorganized into the SWR Project and the author arrived in Kabul in March 1964 to assume leadership. In July 1964, Mr. V. J. Latkovich arrived in Lashkar Gah to continue supervision of the activities done under the old HSWI project and to assist the author in the organization and field work connected with the new WSSA.

A planned expansion of the gaging station network resulted in the addition of two USGS engineering technicians early in 1967: Mr. Vincent Piro arrived in March and Mr. Dallas Childers in April.

Short-term consultants were used to assist in sediment studies: Mr. George Porterfield from March through May 1967, Mr. Don Perkins and Mr. James K. Culbertson from August to December 1968.

As the result of a planned phase-out, Mr. Latkovich departed post in September 1968, the author in December 1968, and Messrs. Piro and Childers will depart in June 1969. It is not planned to replace these advisors. Continuing supervision of the project will be done through the office of the USAID/NESA Water Resources Engineer in New Delhi.

During the period 1963-69 the following was accomplished:

1. Continuation of the work done in the HSWI project 1952-63.
2. Advised on the establishment of standards and procedures to be adopted nationwide and held many conferences with WSSA officials and representatives of other country aid missions concerning these standards.
3. Prepared a comprehensive surface water investigation plan (see appendix 10) that gives recommendations for an expanded gaging station network, procedures and standards for field and office work, organization of the Hydrology Section in the WSSA, staffing pattern, participant training, equipment, publication of data, and a technical library.
4. Prepared three formal training manuals (see appendixes 14, 15, and 16) that have been adopted as the standard training manuals by the WSSA.
5. Conducted on-the-job training in field and office work for Kabul University students on vacation by formal classroom lectures and practical field demonstrations (see fig.2).

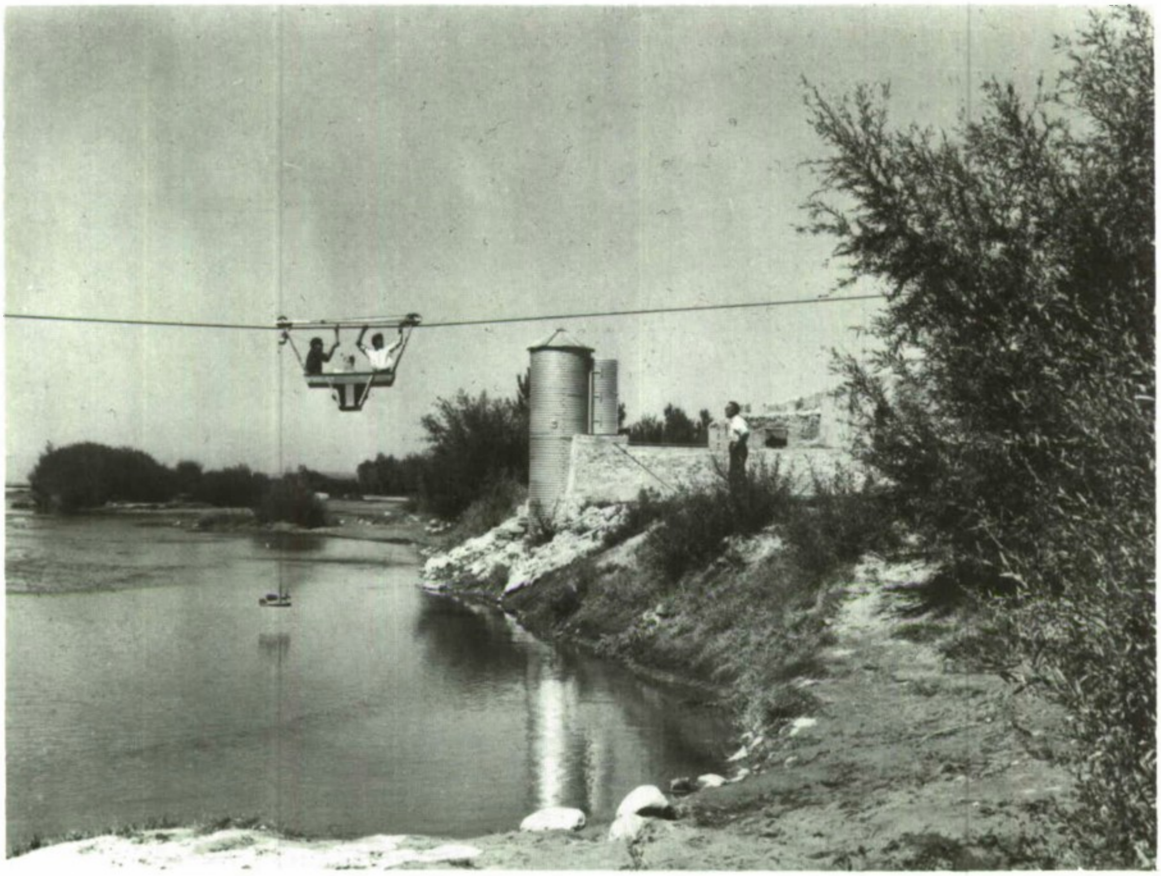

Figure 2.--Afghan counterparts receiving instruction on use of cableway river discharge measuring equipment from A. O. Westfall, U. S. Geological Survey advisor.

6. Assumed operation of 10 additional gaging stations established by the UNSF (United Nations Special Fund) in 1961-63 and 4 stations established by the USSR (Union of Socialist Soviet Republics):

UNSF:	Hari River at Chekcheran	1961
	Hari River at Tagaw Gaza	1961
	Hari River at Pulipushtun	1963
	Kowgon River at Tangi Azo	1963
	Kowgon River at Langar	1962
	Adraskand River at Adraskand	1963
	Gaz River near Adraskand	1963
	Farah River at Petchi Tangi	1961
	Farah River at Daulatabad	1963
	Malman River near Shawalat	1961

(Listing is in downstream order and indentations indicate intervening tributaries)

USSR: Kholem River near Siad
Balkh River at Chismashafa
Sarepul River near Sarepul
Shirin Tagao River near Daulatabad

(Dates of establishment and data collected are not available)

7. Reviewed and reworked all records of the 10 UNSF stations to USGS standards.

8. Conducted a course on hydrology for junior year engineering students at Kabul University during the fall of 1964.

9. Made field reconnaissance surveys of about 80 gaging station sites.

10. Planned, designed and constructed 63 new gaging stations (see fig. 3).

11. Revuilt 13 existing gaging stations.

12. Reestablished 3 former gaging stations.

Figure 3.--One of 63 new streamgaging and weather stations built by Surface Water Research project. Automatic water stage recorders are installed in structure on right; weather observation instruments will be installed in enclosure on left.

13. Prefabricated 75 instrument shelters, 65 sets of inspection doors, 59 cable cars, 64 cableway column supports (ranging in height from 4 feet to 45 feet), and 70 landing hooks for cable cars.

14. Built 59 new cableways (ranging in length from 150 feet to 755 feet).

15. Established 43 sediment data collection stations and started systematic collection.

16. Established and equipped a sediment laboratory for analyses of sediment samples.

17. Planned and executed a comprehensive hydrographic and sedimentation study of Kajakai Reservoir (see appendix 13).

18. Trained five Afghan technicians in the techniques of reservoir hydrographic and sedimentation surveys to the point where they are capable of making futures surveys without technical assistance.

19. Prepared and sent for participant training six technicians to the American University of Beirut or U. S. universities

20. Sent two Afghan technicians to the University of Minnesota for a special 10-week course in ground-water hydrology and well drilling.

21. As principal advisors to the USAID Mission on water problems, attended numerous meetings and conferences and were consulted frequently by officials and members of private groups.

22. Trained, to varying degrees of competency, about 20 Afghan technicians in all phases of the work (see figs. 4 and 5).

23. Trained six Peace Corps Volunteeers in all phases of the work and an additional five in construction practices.

24. Established and operated four additional snow-survey courses in Shoshgow, Salang, and Shibar passes.

Figure 4.--Afghan counterparts learning stilling well installation from A. O. Westfall.

Figure 5.--Afghan counterpart receiving instruction on design of streamgaging station installation from A. O. Westfall

Accelerating and Inhibiting Factors

Afghanistan is an extremely remote and under-developed country and the services, communications, and supplies taken so much for granted in most other countries are not always obtainable there. This makes it necessary to cut every corner possible and to take full advantage of what services and commodities are in the country so as to avoid as much as possible the high cost and lengthy time involved to acquire these things from outside. Many innovations were made or introduced by project technicians to facilitate travel or to avoid expenses and costly delays.

Heckmiller and Snell had experienced much difficulty traveling in the southwestern part of the country because of the many jueys (canals) that blocked progress in the almost roadless Chakansur area. Many hours were lost in laboriously hand-filling the juey or in extricating a stuck vehicle. To overcome this problem, Mr. Heckmiller (app. 2) designed and built a portable bridge (fig. 6) that could be carried in the back of a pickup truck but which was large enough to carry the weight of any project vehicle and to span any size juey up to 15 feet in width. Although cumbersome to handle and set up, it was a big improvement on the alternatives and added greatly to the efficiency of operations in that area.

When the Boghra and Shamalan canals were built in the Helmand Valley, no provision was made for measuring the canal discharge. To avoid costly cableway installations, Mr. Heckmiller (app. 2) devised a truck-winch cableway (fig. 7) that could be

Figure 6.--Portable bridge over canal in Chakansur area designed and built by I. A. Heckmiller, Hydrologic Advisor.

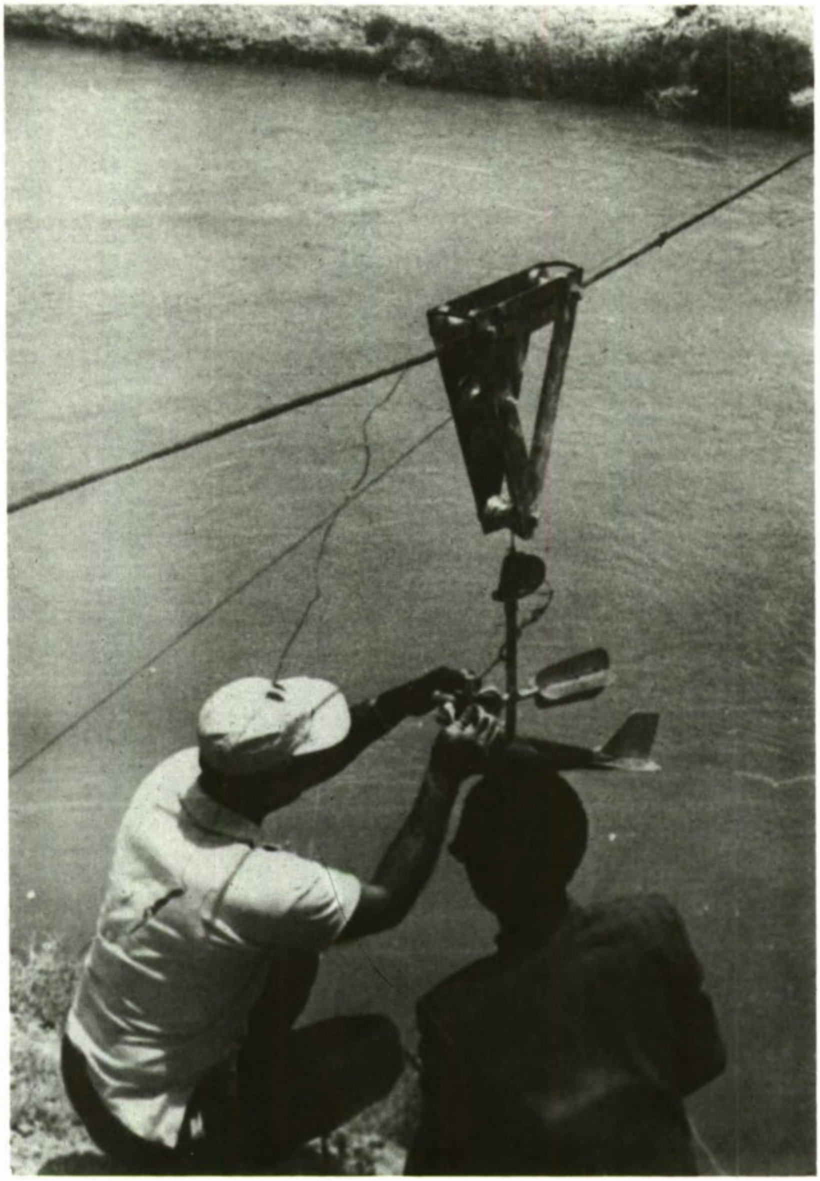

Figure 7.--Truck-winch cableway in use on Boghra Canal. Designed and built by I. A. Heckmiller.

used in place of the conventional cableway or bridge. This worked successfully because of the relatively high banks of the canal. It consisted of a carriage that traveled on a truck-winch cable suspended between trucks parked on opposite sides of the canal. The standard sounding reel was mounted on the bumper of the truck and the sounding cable reaved through special sheaves on the carriage. This provided an accurate and easy way to make canal discharge measurements until a small boat was brought into the country for this purpose.

With the planned expansion of the gaging station network in 1966 by the addition of about 85 stations, many problems arose but satisfactory solutions were found for most of them. Every attempt was made to use locally available materials or surplus items from other U.S.-supported projects. The cablecars used for transporting personnel and instruments on the cableway crossings would have cost about $350 each if shipped from the U.S. By modification of the standard USGS design, these cars were built by project personnel for a local materials cost of $12. The only part not locally available were the roller sheaves the car rides on. These were purchased from the U.S. at a cost of $20 per car.

Modification of design allowed use of surplus pipe piling for cableway supports (fig. 8) rather than relatively expensive and scarce structural steel; and the use of surplus culvert pipe for the stilling wells avoided the rather expensive and

Figure 8.--Transporting specially-designed telescoping column support across Dasht-i-Margo desert. The transport length of 27 feet extended to 45 feet when erected.

time-consuming masonry construction previously used by the WSSA. It was estimated that about $20,000 was saved in the cost of materials by the above means.

The fabrication of cablecars, instrument shelters, well inspection doors, and cableway supports was done at the Afghan Institute of Technology in Kabul. This institute is another USAID-supported project and the author was able to work out an agreement with the school authorities for use of their shops and equipment. This was of benefit to both the project and the school: costs of about $5,000 for tools and equipment plus rental of shop space for two years was avoided; students worked on project items and received valuable practical experience.

The magnitude of trying to build so many gaging stations at such widespread sites in the country would have required the services of many more U.S. engineers and thereby become prohibitively expensive. This was solved by requesting six Peace Corps Volunteer engineers for project work (fig. 9). During late 1966 and early 1967, five Peace Corps Volunteers acted as work crew foremen alongside their Afghan counterparts. These were replaced by six volunteers in September 1967. These latter six have been given training in all project work and will continue to assist the WSSA after our project phases out in June 1969.

Probably the most persistent and troublesome problem encountered during the life of the project was the continual shortage of Afghan engineers and technicians and the poor

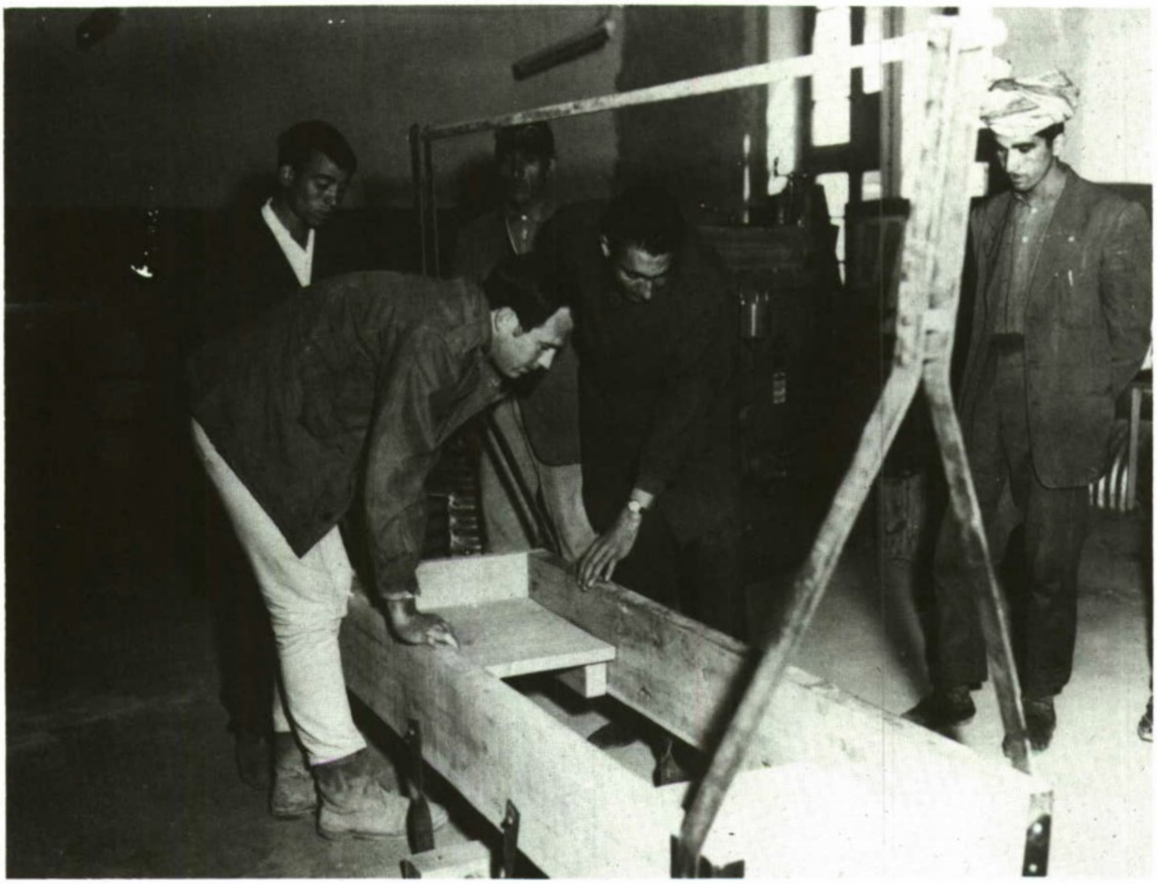

Figure 9.--Afghan counterparts discussing assembly of cable cars with Wayne Woolvard, Peace Corps Volunteer engineer.

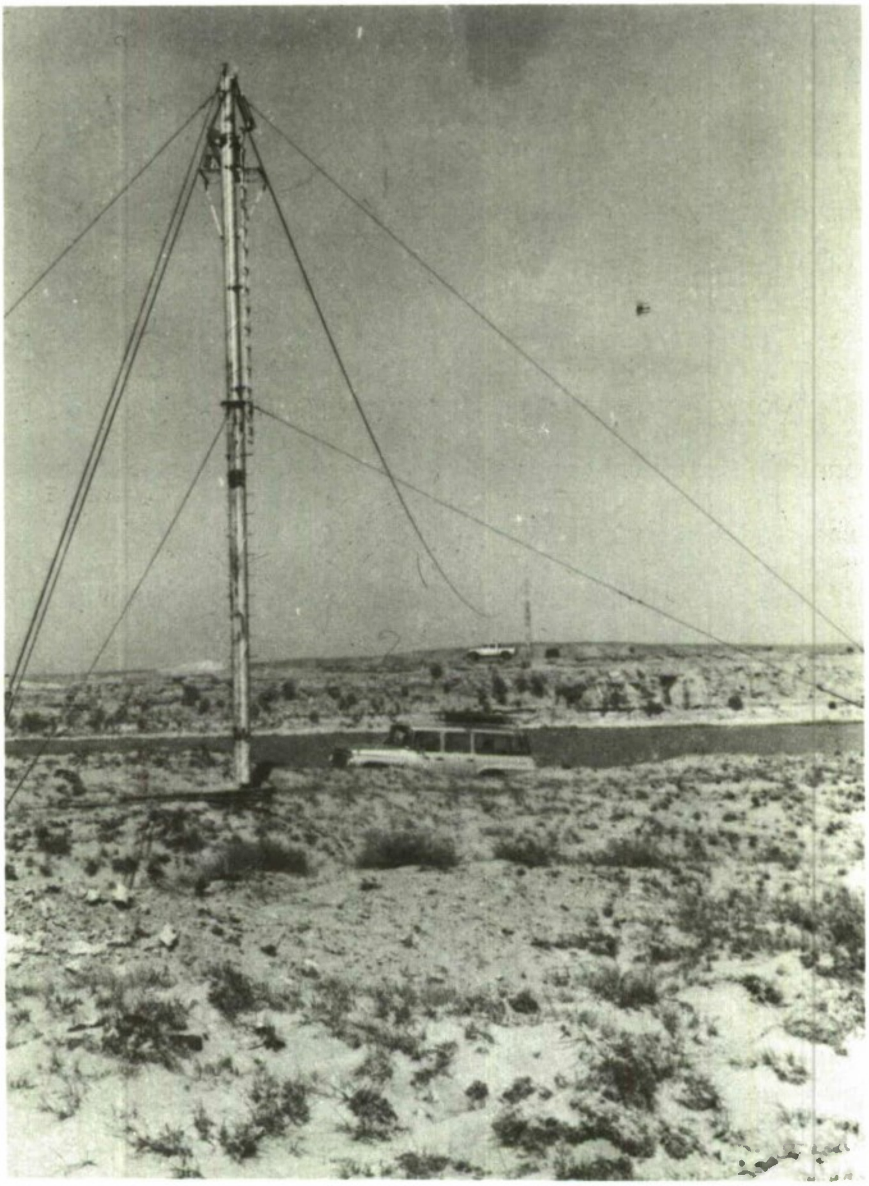

Figure 10.--Afghanistan's largest cableway is located on the Helmand River at Khaubgah. Length 755 feet, column supports: right bank 45 feet, left bank 30 feet.

quality in academic training, general intelligence level, and attitude of those who were on the project. Snell (app. 1) states that, "Difficulty in finding qualified Afghan employees... was met with immediately and continued to be one of the major problems..." Heckmiller (app.2) said, "The most difficult problem is the training of Afghan personnel...(and) the problem of instilling work pride and responsibility has been and is a difficult one." Brigham (app.3) recommends the encouragement of work pride and responsibility, and the stimulation of an awareness of the importance of the work. In 1963, Brigham acknowledges that some progress has been made in developing a competent staff and that the Afghan technicians can learn to work effectively, but often they are frustrated by restrictive or interfering activities of their own government agencies.

In 1966, the author found that after 14 years of training some of the HSWI technicians had become quite adept in the basic work, but at the Kabul office continual personnel problems in the form of transfers and induction into the army plagued efforts to get the newly-established WSSA off to a good start. Because of these transfers and inductions, the Kabul office was left with only two technicians trained to do acceptable field work by mid-1966.

The development of the two training manuals (see appendixes 14 and 15) gave direction to the training effort and allowed self-study by the Afghan technicians. About 20 more technicians were trained in some degree during the next two years but this was hampered to some extent by the use of these technicians on construction work when the gaging station network was expanded. The original intent was to use only one Afghan engineer as supervisor on each work crew (there were eight crews) and to hire skilled laborers for the work. But a continual shortage of funds forced the use of project technicians as carpenters and masons thus limiting their availability for training.

One experience showed that given a selection of personnel and the right atmosphere to work in, that Afghan technicians can be trained to do a job with an acceptable degree of accuracy and completeness and in a reasonable length of time. This occurred during the sedimentation survey of Kajakai Reservoir. This 4-month project was conducted in the fall of 1968 and the work site, both field and office, was far removed from the influence of any of the administering offices. During the first month of the project, 12 technicians were used and rotated from job to job during the period. At the end of this time, the five technicians who had shown most aptitude were assigned to specific jobs for the duration of the project and the rest sent back to Kabul. At the end of the remaining three months, it was the opinion of Mr. Perkins and Mr. Culbertson that these five technicians were capable of making all future reservoir hydrographic and sedimentation surveys without outside technical assistance.

Admittedly, this training was done under conditions rarely available: away from outside influence, making a good salary (their per diem in affect doubled their income), a high advisor-counterpart ratio (there was always two and most of the time three advisors on the survey), and a job that was not repetitious and monotonous and in which they could see and understand the need for doing.

Staffing and organizational recommendations were presented in the overall plan for surface-water investigations (app. 10, p.46-48) but repeated efforts to carry out these recommendations have failed. In most part, this was due to the lack of men to put in the recommended positions but also was due to the reluctance of the administrators to violate the traditional structure within the civil service system of the RGA. Several efforts were made to correlate the recommended structure and staffing pattern with those acceptable to the RGA but this was never successfully concluded.

Other problems of a more minor nature affected the project from time to time. Probably the most important one (and it is becoming more so as activities expand) is the problem of adequate transportation to reach the field installations. When activities were confined to the Helmand River basin and the number of installations was small, this was not too great a problem although breakdowns were frequent because of bad roads and poor maintenance. With the expansion of the gaging station network it is now necessary to make periodic trips to all parts of the country. The business of this project is to collect data; without dependable transportation the quantity and timeliness of the data is inadequate. Without exception, all WSSA vehicles are old and wornout; long past the stage of economical repair. All have been acquired by grant-in-aid from USAID which had declared them unfit for continued Mission use. No spare parts are available other than carburetor and ingnition maintenance parts. As time goes on, these vehicles will become increasingly difficult to maintain and operate and project work will suffer accordingly.

Difficulties in commodity procurement, warehousing, and funding were met with at times but a slow and continual improvement is being made along these lines.

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Appendices
1-18

Copies of the listed appendixes are on file in the Office of International Activities, Water Resources Division, U. S. Geological Survey, Washington, D. C. 20242, and in the library of the National Agricultural Development Division, U. S. Agency for International Development, American Embassy, Kabul, Afghanistan.

Appendix 1. Termination of assignment report, Leonard J. Snell, 1957.

2. Termination of assignment report, I. A. Heckmiller, 1959.

3. Two year tour report, Robert H. Brigham, 1961

4. End of tour report, Robert H. Brigham, 1964

5. End of tour report, Arthur O. Westfall, 1966

6. End of tour report, Arthur O. Westfall, 1969

7. Activities of the senior field engineer, Surface Water Research Project, Afghanistan, Vito J. Latkovich, 1969

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9. Summary report of project: Helmand Surface Water Investigations, Robert H. Brigham, 1963

10. Surface-water resources investigation plan for Afghanistan, A. O. Westfall and V. J. Latkovich, 1966

11. Reconnaissance sediment survey of Kajakai and Arghandab Reservoirs, George Porterfield and A. O. Westfall, 1967

12. A proposed sediment data collection program for Afghanistan, George Porterfield, 1967

13. Hydrographic and sedimentation survey of Kajakai Reservoir, Don Perkins and James K. Culbertson, 1968

14. Hydrology training manual No. 1, Basic streamgaging, A. O. Westfall, 1966

Appendix 15. Hydrology training manual No. 2, Computation of basic streamflow records A. O. Westfall, 1967.

16. Hydrology training manual No. 3, Sediment data collection and laboratory analyses, Dallas Childers, 1969.

17. Streamflow records, Helmand River Valley, Afghanistan, 1947-54, L. J. Snell, 1954

18. Compilation of hydrologic data, Helmand River Valley, Afghanistan, through September 1960, Robert H. Brigham, 1964.

Glossary of Geographic Names Used in Report

Names used in this report conform to the Board on Geographic Names (BGN) approved standard name where possible to verify.

Where no standard name islisted, this is not verified.

Where part of a name is underlined, the use of the part not underlined is optional.

A name followed by a parenthesis ending (generic ending) describes a feature and may be part of the map name, where difficult to describe the feature cartographically.

A name with parenthesis ending not adjacent to name ending indicates that country's spelling or conventional, popular, or well-known spelling.

A name with no parenthesis ending is populated (city, town, etc.). It may be a feature as noted in the report name column. The difference may be described cartographically.

Report Names

Report Names	Board on Geographic Names	
Helmand Valley		
Helmand River	Daryā-ye Hīrmand	(Afghan)
	Rūd-e Hīrmand	(Iran)
Amu Darya	Amu Darya	(Conventional)
	Āmū Daryā	(Afghan)
	Amudar' ya	(U.S.S.R)
Kokcha River	Darya-ye Kowkcheh	
Kunduz River	Daryā-ye Qondūz	
Khulm	Khulm	
Girishk	Gereshk	
Hari River	Harī Rūd	(Afghan)
	Harīrūd	(Iran)
	Tedzhen	(U.S.S.R)
Kabul River	Daryā-ye Kābul	(Afghan)
	Kābul River	(Pak)
Ghazni River	Daryā-ye Ghaznī	
Paltu River	Paltū' ī Rūd	
Sardeh River		
Kandahar	Qandahār	
Chahanjirs	Chāh-e Anjīr	
Kajakai Dam	Band-e Kajakai(dam)	
Arghandab Dam	Band-e Arghandab(dam)	
Arghandab River	Daryā-ye Arghandāb	
Shamalan	Shamālān(area)	

Tagaw Gaza	Tagāb Ghazeh
Pulipushtun	
Tangi Azo	Robāṭ-e Tangī Azow
Langar	Langar
Siad	Ṣayyād
Barak	
Zebak	Zībāk
Aq Kupruk	Āq Koprūk
Bubulai	Bābulā'ī
Daulat Yar	Dowlat Yār
Anardarra	Anār Darreh
Lukhi	Lowkhī
Gardeni Wal	Gardan Dīvāl
Maidan	Meydān Kalay
Kalat	
Marana	
Zarghun	Zarghūn Shahr
Bactriana (area)	Bactria (region) (conventional)
	Baktriya (U.S.S.R.)
Sangin	Sangīn
Marana	
Anardarra	Anār Darreh

Nadiali	Nād-e ʻAlī
Kalakang	Zaranj
Panjao	Panjāb
Orusgan	Orozgān
Mukur	Moqor
Marja	Mārjeh
Lashkar Gah	Lashkar Gāh
Dehraout	
Darweshan	Darvīshān
Bakwa	Solṭān-e Bakvā
Farah	Farāh
Nawar Lake	Dasht-e Nāvar(depression)
Tirin River	Rūd-e Terī
Shoshgow	Shesh Gāv
Salang	Kowtal-e Sālang(pass)
Shibar	Kowtal-e Shebar(pass)
Chakansur	Chakhānsūr
Boghra Canal	Nahr-e Boghrā(canal)
Shamalan Canal	Nahr-e Shamālān(canal)
Khuabgah	Tahāneh-ye Khvābgāh
Musa Qala	Mūsá Qalʻeh
Seraj Canal	Nahr-e Sarāj
Sangin	Sangīn
Qala Bist	Qalʻeh-ye Best

Base Map Names

Report Names	Board on Geographic Names
Aq Chah	Aqcheh
Balkh	Balkh
Taliqan	Tāloqān
Haibak	Āybak
Zebak	Zībāk
Islan Qala	Eslām Qal ʿeh
Bala Murghab	Bālā Morghāb
Kushka	Kushka (U.S.S.R.)
Qala Nau	Qal ʿeh-ye Now
Obeh	Owbeh
Khwaja Chisht	Chest-e Sharīf
Belchirag	Belcherāgh
Daulat Yar	Dowlat Yār
Qala Shaharak	Shahrak
Salang Tunnel	Tūnel-e Sālang (tunnel)
Jabal us Siraj	Jabal os Sarāj
Gulbarhar	Golbahār
Paghman	Paghmān
Sorubi	Sorūbī
Shaikhabad	Shēkhābād
Darreh ye Pich	Darrah-ye Pīch
Chigha	Chagasarāy
Tor Kham	Towr Kham
Farsi	Fārsī

Qala Adraskan	Adraskan
Shindand	Shīndand
Kajkai	Kajakī (32°16-65°03)
	Kakakī Soflá (32°17-65°03)
	Kakakī ʿOlyā (32°18-65°05)
Kalat-i-Ghilzai	Qalāt
Ali Khel	ʿAlī Khēl
Matun	Khowst
Urgun	Orgūn
Gowmal	Gowmal
Zaranj	Zaranj
Zabol	Zābol (Iran)
Khash Desert	Dasht-e Khāsh(desert)
Chakhansur	Chakhānsūr
Registan	Rīgestān(region)
Spin Baldak	Spīn Būldak
Chaman	Chaman (Pak)
Zahedran	Zāhedān (Iran)
Gizab	Gīzāb
Qala-Hazar Qadam	Hazār Qadam
Qala Ahangaran	Āhangarān
Deshu	Deh Shū
Sistan Basin	
"	Seistan(region) (conventional)
	Sīstān (Persian)

Dak Lake	Dak(lake)
Ab-i-Istade	Āb-e Īstadeh-ye Moqor(lake)
Jammu and Kashmir	Jammu and Kashmir (disputed terr)
Dasht-i-Margo	Dasht-e Margow(desert)
Quetta	Quetta (Pak)
Peshawar	Peshāwar (Pak)
Shibarghan	Sheberghan
Gardez	Gardēz
Sang-i-Masha	Sang-e Māsheh
Sar-i-Pul	Sar-e Pol
Andkhoi	Andkhvoy
Daulatabad	Dowlatābād
Gaud-i-Zirreh	Gowd-e Zereh(salt)
Hindu Kush	Hindu Kush (conventional, Jammu and Kashmir, Pakistan)
	Hendū Kosh(mtn) (conventional)
Khash River	Khāsh Rūd
Farah River	Farāh Rūd
Malman River	Mālman Rūd
Adraskand River	Daryā-ye Adraskan
Murghab River	Daryā-ye Morghāb
	Murghab (U.S.S.R)

Kowgon River	Rūd-e Kowghān
Shirin Tagao	Shīrīn Tagāb
Sar-i-Pul	Daryā-ye Sar-e Pol
Balkh River	Balkh(river)
Kholem River	Darya-ye Kholm

PREPARED

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COOPERATIVELY BY THE UNITED STATES GEOLOGICAL SURVEY AND THE WATER AND SOIL SURVEY DEPAR
MINISTRY OF AGRICULTURE AND IRRIGATION, ROYAL GOVERNMENT OF AFGHANISTAN
UNDER THE AUSPICES OF THE
UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT

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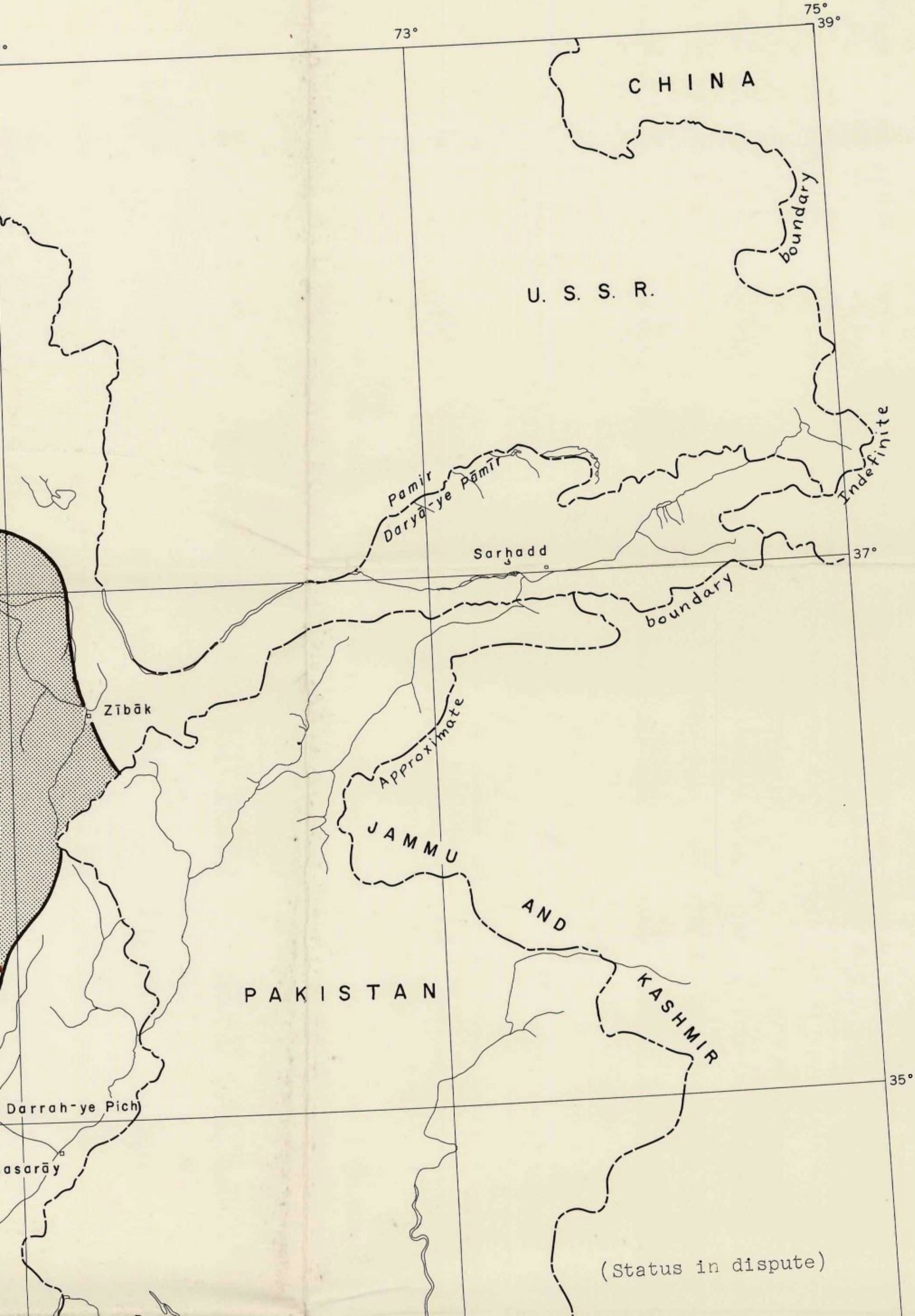
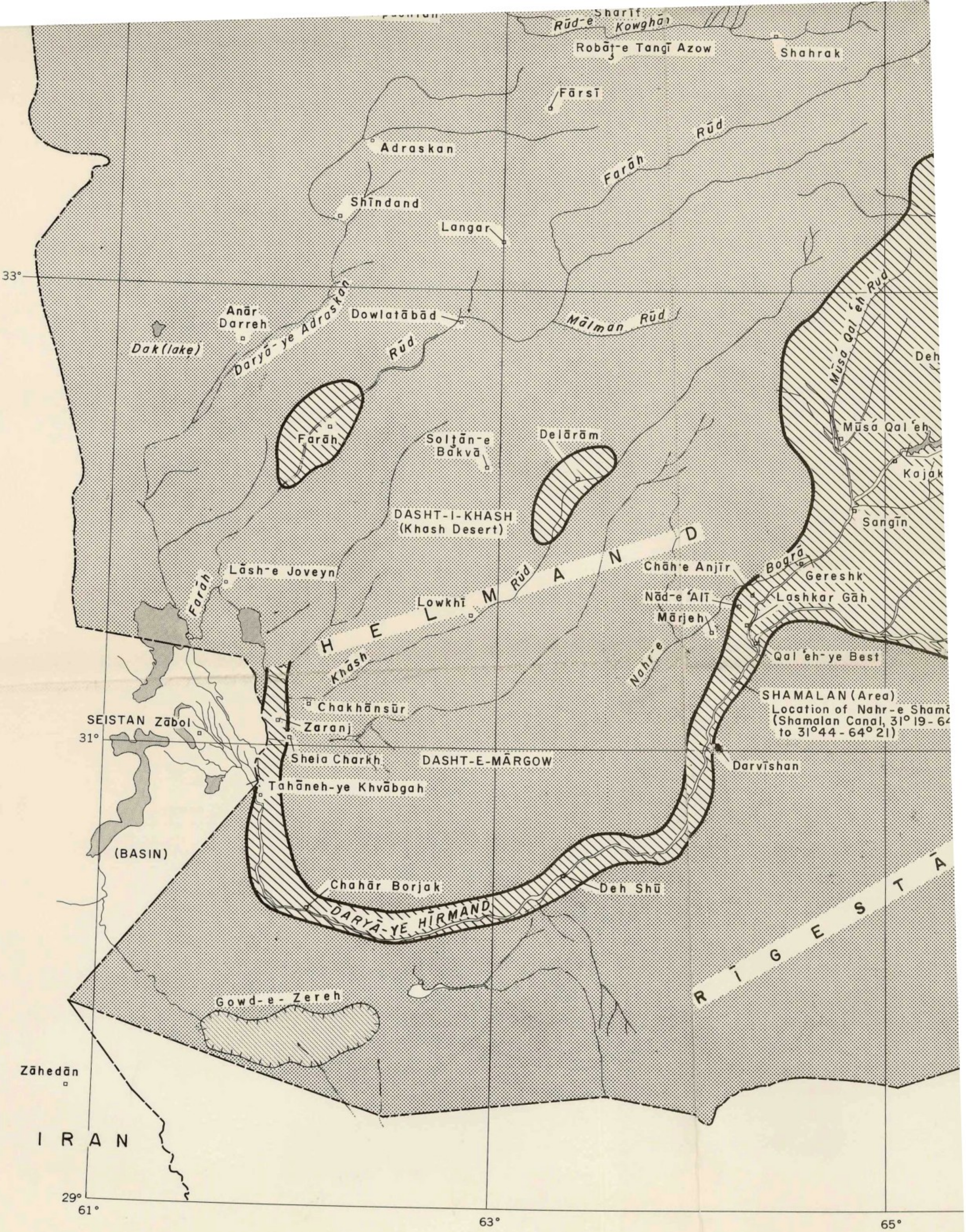
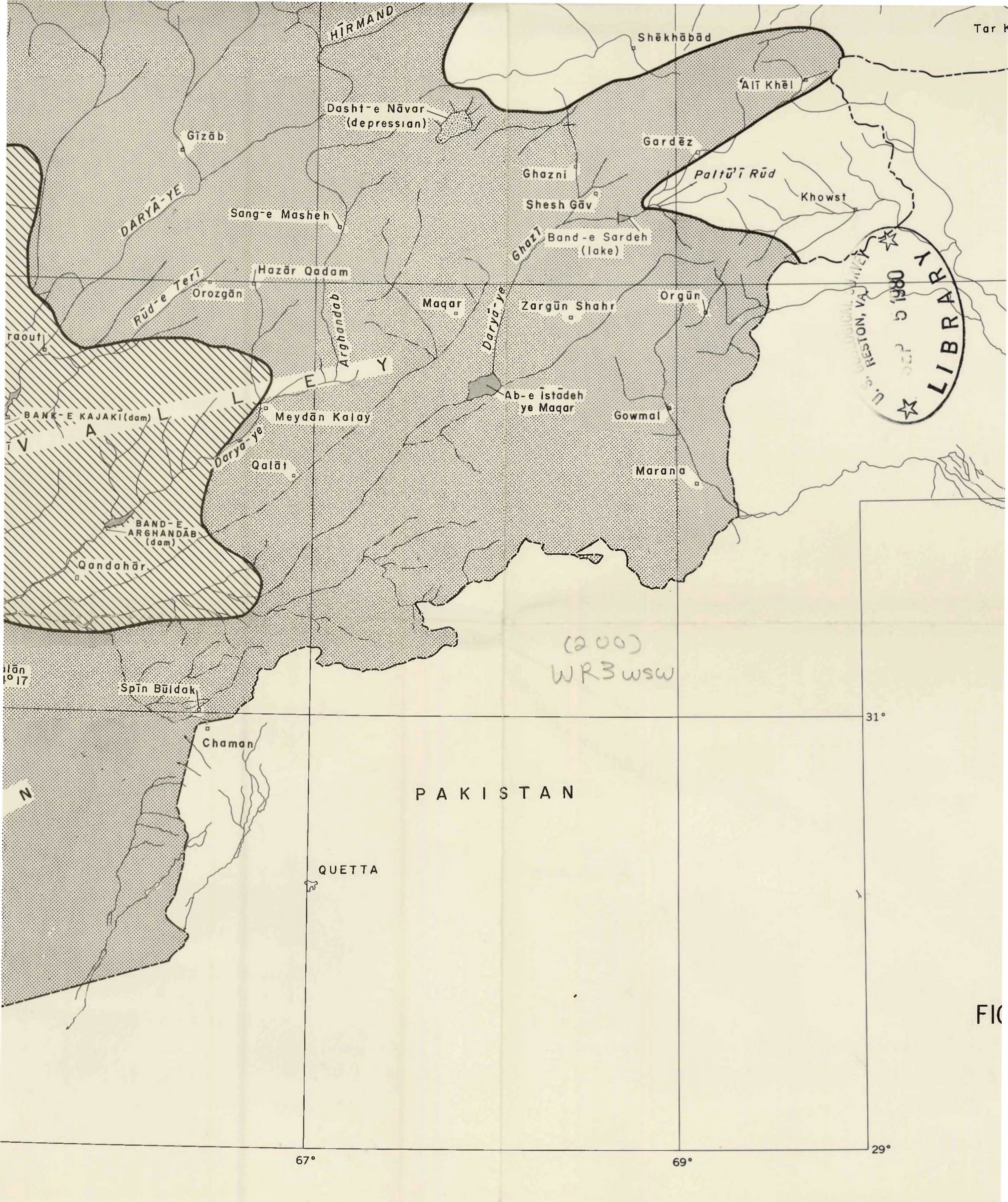


75°
39°
73°
CHINA
boundary
U. S. S. R.
Indefinite
Pamir
Daryā-ye Pāmīr
Sarhadd
37°
boundary
Zībāk
Approximate
JAMMU
AND
KASHMIR
PAKISTAN
35°
Darrah-ye Pich
asarāy
(Status in dispute)



Rūd-e Sharīf
Kowghān
Robāt-e Tangī Azow
Shahrak
Fārsī
Adraskan
Farāh Rūd
Shīndand
Langar
33°
Anār Darreh
Dowlatābād
Dak (lake)
Daryā-ye Adraskan
Rūd
Mālman Rūd
Mūsa Qal'eh Rud
Deh
Farāh
Soltān-e Bakvā
Delārām
Mūsā Qal'eh
Kajak
DASHT-I-KHASH
(Khash Desert)
Sangīn
H E L M A N D
Lāsh-e Joveyn
Farāh
Rūd
Chāh-e Anjīr
Bogra
Gereshk
Lowkhī
Nād-e 'Alī
Lashkar Gāh
Mārjeh
Khāsh
Nahr-e
Qal'eh-ye Best
SHAMALAN (Area)
Location of Nahr-e Shama
(Shamalan Canal, 31° 19-64
to 31° 44-64° 21)
Chakhānsūr
SEISTAN Zābol
Zaranj
31°
Sheia Charkh
DASHT-E-MĀRGOW
Darvīshan
Tahāneh-ye Khvābgah
(BASIN)
Chahār Borjak
Deh Shū
DARYĀ-YE HIRMAND
R I G E S T Ā
Gowd-e-Zereh
Zāhedān
IRAN
29°
61°
63°
65°



HĪRMAND
Shēkhābād
Tar K
ʿAlī Khēl
Dasht-e Nāvar (depression)
Gīzāb
Gardēz
Ghazni
Paltū'ī Rūd
Khowst
Shesh Gāv
DARYĀ-YE
Sang-e Masheh
Band-e Sardeh (lake)
Ghazī
Hazār Qadam
Rūd-e Terī
Orozgān
Orgūn
Maqar
Zargūn Shahr
Arghandab
Daryā-ye
raout
V A L L E Y
BANK-E KAJAKĪ (dam)
Meydān Kalay
Ab-e Istādeh ye Maqar
Gowmal
Daryā-ye
Qalāt
Marana
BAND-E ARGHANDĀB (dam)
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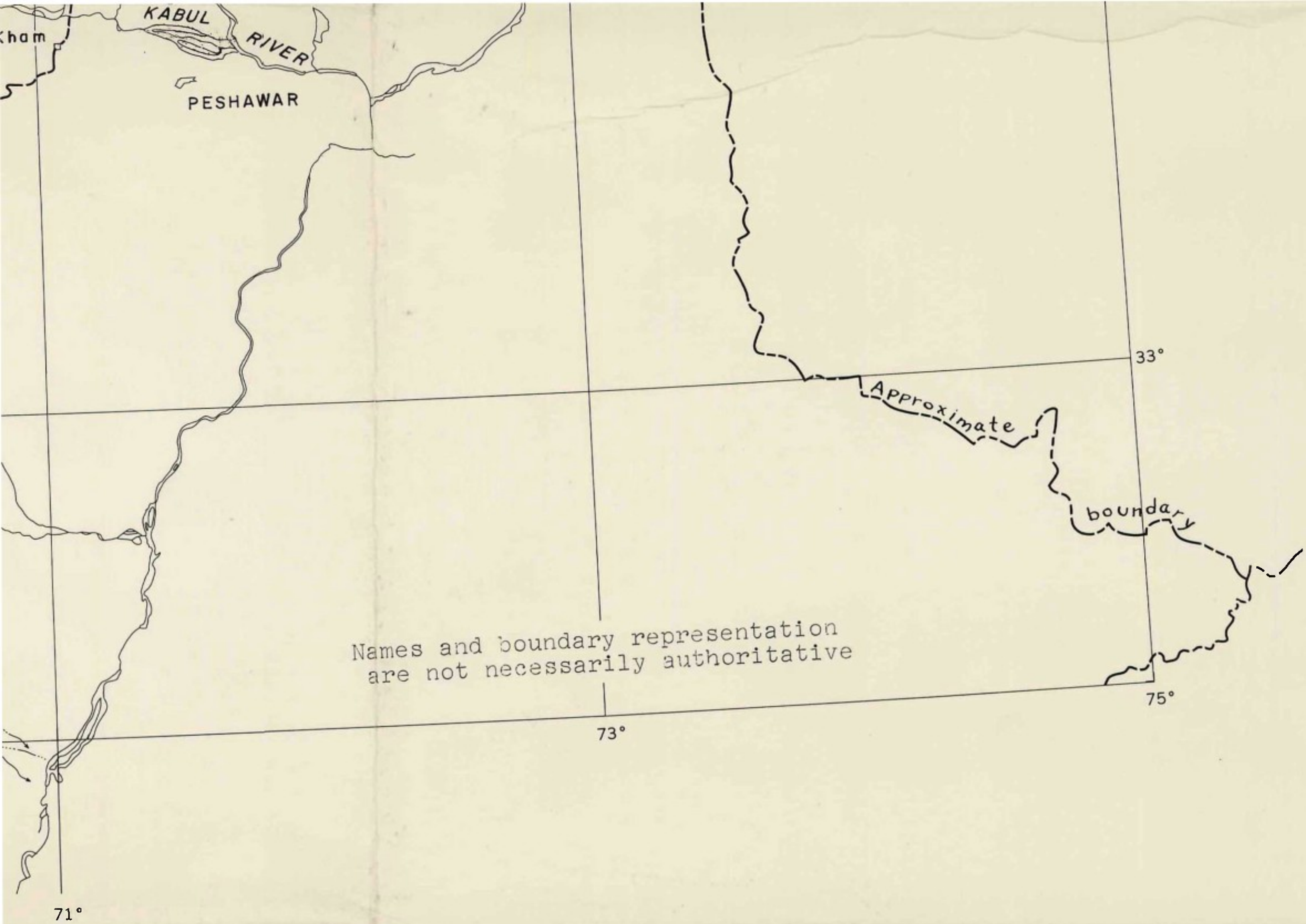

EXPLANATION

Area of project activity,
1952 to 1963

Area of additional project activity,
1963 to 1969

GURE 1 —— MAP OF AFGHANISTAN SHOWING LOCATION OF
SURFACE—WATER PROJECT ACTIVITIES, 1952 TO 1969