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THE WORLD BANK

UZBEKISTAN: WATER SUPPLY, SANITATION AND HEALTH PROJECT

SUMMARY AIDE MEMOIRE

At the request of the Uzbekistan Government a World Bank mission visited Uzbekistan from September 23 to October 15 1994 to identify a Water Supply, Sanitation, and Health Project for the Republic of Karakalpakstan and the Khorezm Oblast. The Heads of the Governments of the five Aral Sea states agreed to include this project in the Aral Sea Program presented to an international donors conference held in Paris from June 23-24, 1994. It is identified as Program 5.1 in the documents presented to this conference. At this meeting it was decided that the World Bank would take the lead in identifying and preparing this project with financial support of the Kuwait Fund, the Swiss Government, and the Dutch Consultant Trust Fund in the World Bank. International donors have also expressed strong interest in cofinancing the implementation of this project with the World Bank, the details of which will be worked out during preparation of the project.

MAJOR FINDINGS AND RECOMMENDATIONS

Since 1990 the Government of Uzbekistan has launched an ambitious program to provide social and physical infrastructure for rural communities, which constitute 60% of the population. Provision of safe piped drinking water has been a major focus of this program. Because of the greater need for these public services and more adverse effects of the Aral Sea disaster in the Republic of Karakalpakstan and Khorezm Oblast, the Government is allocated some 30% of its piped water program budget to this region, amounting to approximately $130 million over four years. Good progress has been made in achieving the Government's goals and construction of Phase I of the program is almost complete. The Government is keen to speed up the completion of the piped water program with World Bank and donor support, and has requested that the proposed project includes funding for the second and third phases of this program. In addition it is proposed to speed up funding for sewage treatment systems in Nukus, Urgench and 4-6 towns in Khorezm Oblast, as well as low cost water supply and sanitation in rural areas not serviced by the main water pipeline distribution system. A health and hygiene education program will be integrated into the above to achieve maximum benefit from the infrastructure investment program.

The mission has reviewed the Government's proposals for the piped water distribution program, as well as its sewage treatment and health education programs and has the following observations:

- The use of Tuyamuyun reservoir as the principal water source for the piped water system in Karakalpakstan and Khorezm appears to be the best option for Phase II and III in Khorezm Oblast with possibly some minor changes. However, for Phase III expansion in Karakalpakstan, other local water supply options, such as artificial groundwater recharge schemes may prove a lower cost option than constructing a parallel large diameter pipeline from Tuyamuyun to Nukus, a distance of some 240 km.

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- The program needs to be expanded to include other safe low cost water supply options for villages that will not be served by the main pipeline system;

- Because of extensive rural poverty in the project area the program should provide maximum employment opportunities for local people. In order to further boost rural incomes and willingness to pay for rural infrastructure, small scale village credit schemes to encourage household investment in productive activities should be considered;

- There is excessive wastage of piped water which is reflected in high per capita water consumptions in urban areas. A program to reduce this wastage could be a very cost effective way of providing extra piped water to rural communities;

- The current program design is based on a very strict national drinking water norm of 1 g/l for salinity. Since this norm is not based on health impacts, but mainly on taste considerations, a temporary norm of 1.5 g/l for people living in irrigated areas and 2.0 g/l for people living in non-irrigated areas of the region would be an acceptable design basis for the program and could lead to considerable cost savings for the program;

- From this perspective it would be premature to consider developing the costly Kaparas water storage reservoir scheme as the Tuyamuyun reservoir can meet the above temporary salinity norm;

- An integrated program of safe water supply, improved sanitation and health/hygiene education is needed to achieve the maximum benefits of a piped water program;

- The current program needs to be supplemented with installation of sewage treatment systems in areas where houses have internal piped water connections and with improved low cost sanitation facilities in homes and public facilities where there are yard connections, standposts and handpumps.

- The main causes of child mortality and morbidity from drinking water in rural areas of the region is contamination by bacteria and viruses from humans and domestic animals and not from agrochemicals;

- Improved service levels of piped water supplies will also benefit rural populations, which now receive piped water for only 1-2 hrs in the morning and evening. At other times they are forced to use other possibly unsafe local sources, with the children being at most risk;

- The Government's incremental approach to achieve full recovery of O & M costs for piped water supply and sewage treatment is considered to be appropriate, taking into account the extremely low income levels in rural communities;

- The program of installing desalination units in Karakalpakstan to treat saline deep well water for public supply has run into many operational and maintenance difficulties and needs to be reevaluated. Ad hoc installation of expensive complex reverse osmosis units should not be encouraged in the future, even if it is provided "free of charge".

NEXT STEPS

During the mission supplemental terms of reference were prepared with the assistance of local experts for the project feasibility study to be funded by the Kuwait Fund, which is expected to take approximately 9 months to complete. It is hoped to start this feasibility study by early February 1995, when it is expected that a team of foreign and local experts will begin the work.

In addition to the feasibility study it is proposed to carry out several pilot demonstration projects during the preparation phase to test new low cost integrated approaches to rural water supply, sanitation and health and to obtain more systematic field data to improve project design. Funding will be provided by the Swiss Government and Dutch Consultant Trust Fund at the World Bank. These projects will include:

- An integrated community based water supply, sanitation and health pilot demonstration project in two rural communities in Karakalpakstan and Khorezm;
- A rural community needs assessment survey;
- A survey to improve the design, operation and maintenance of hand pumps;
- A test program to improve the operation and maintenance of small scale desalination units in Karakalpakastan; and
- A sampling and analysis program to evaluate the quality of water sources proposed for the project area.

To support this program and the development of the feasibility study it is proposed to set up two project preparation and implementation units (PPIUs) in Nukus and Urgench under the Ministry and Committee of Water Management respectively. These units would also support other Aral Sea programs in the region.

The Government needs to take a decision on the composition of a high level Project Steering Committee and to set up a Project Office in Tashkent for the preparation of the feasibility study. It is expected that the Project Office and the PPIUs would be supplied with office equipment under the project preparation funding.

and to supervise implementation of the project.

In order for the project to be successful it will involve working across several sector ministries (Goscomprognostat, Ministry of Finance and Regional agencies. This will require effective coordination and strong leadership. Therefore,

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THE WORLD BANK

UZBEKISTAN WATER SUPPLY, SANITATION AND HEALTH PROJECT

AIDE MEMOIRE

1. At the request of the Uzbekistan Government a World Bank mission visited Uzbekistan from September 23 to October 15, 1994 to identify a Water Supply, Sanitation and Health Project for the Republic of Karakalpakstan and the Khorezm Oblast. The mission was led by Roger Batstone and consisted of Ayse Kudat, Tony Garvey, Mike Blackburn, Bert Schuchmann, Jan Schippers, Jan van Rijckevorsel, Vsevolod Shakin, Rita Klees and Nezahat Ozmen.

2. The Heads of the Governments of the five Aral Sea states agreed to include this project in the Aral Sea Program presented to an international donors conference held in Paris from June 23-24, 1994. It is identified as Program 5.1 in the documents presented to this conference. At this meeting it was decided that the World Bank would take the lead in identifying and preparing this project with financial support of the Kuwait Fund, the Swiss Government, and the Dutch Consultant Trust Fund in the World Bank. International donors have also expressed strong interest in cofinancing the implementation of this project with the World Bank, the details of which will be worked out during preparation of the project. The Executive Committee of the Aral Sea Program and the associated Working Group for Program 5.1 have played a very important role in facilitating the work of this mission and their support and advise is gratefully acknowledged.

3. The mission met with a large number of government officials, experts from Institutes and Universities, local NGO's, and local communities during its stay in Uzbekistan, both at national level and in the Republic of Karakalpakstan and the Khorezm Oblast. A partial list of persons met is given in Attachment I. Because of time constraints most of the field work was carried out in the Republic of Karakalpakstan. The most adverse and widespread impacts of the Aral Sea disaster in Uzbekistan are found in this Republic and the more difficult economic and logistical problems are faced by this region. A meeting was held in Urgench on October 10 to discuss the findings of the mission and to identify the Khorezm Oblast authority's priorities for water supply, sanitation and health in rural communities. Similar needs and approaches to solving these problems were identified in this Oblast as in Karakalpakstan, although on a more easily manageable scale. However, the mission findings and preparation activities proposed in this Aide Memoire apply equally to both regions. The mission gratefully acknowledges the enthusiastic support and assistance that it received during its stay in Uzbekistan. This draft aide memoire represents the findings of the mission but has not yet been cleared by Bank Management.

A. OBJECTIVES OF THE MISSION

4. The objectives of the mission were to identify the potential components of a rural water supply, sanitation and health project in the Republic of Karakalpakstan and the

Khorezm Oblast to be financed by the World Bank and other international donors, and to agree on a work program and schedule for preparation of the project for Bank appraisal.

5. The terms of reference for program 5.1 of the Aral Sea Program is the basis for the preparation of the project, but supplemental terms of reference had to be prepared to provide more detailed and specific instructions to the foreign and local experts who will be working on project preparation. These supplemental terms of reference are provided in Attachments II, III and IV of this Aide Memoire. Tentatively it is proposed that the Kuwait Fund finance the supplemental terms of reference in Attachment II, the Swiss Government finance the demonstration pilot projects outlined in Attachment III, and the Dutch Trust Fund support the Needs assessment outlined in the TOR in Attachment IV. Attachment V contains the cost estimates for setting up a Project Preparation and Implementation Unit (PPIU) in Karakalpakstan and Khorezm.

B. SUMMARY OF FINDINGS AND RECOMMENDATIONS

Socio-economic Conditions In The Project Area

6. The area hardest hit by the conditions that have accompanied the Aral Sea crisis is Karakalpakstan, a de-jure autonomous republic with an area of 165,000 km2 and a population of 1.38 million. While officially only 51% of the population is rural, agricultural activity provides the basic income for a much larger share of the population. Even in the major cities of Nukus and Takhiatash, garden agriculture provides a major sources of livelihood to many households. A large proportion of the water consumed by households connected to the piped water supply system that serves 50% of the urban and 29% of the rural households is used to irrigate these gardens. Based on an estimated average of 7 persons per rural household there are about 100,000 rural households in Karakalpakstan. If those in small towns of less than 20,000 population are included, there is a total of about 120,000 rural households; of these the great majority have poor access to clean and adequate water supplies and no sanitation infrastructure. The situation in Khorezm is similar.

7. Despite the recent high rate of in-migration to the capital city of Nukus, indicative of the rapidly deteriorating living conditions in the countryside, the total population of the region is relatively stable. Especially in poverty stricken traditional rural communities there is very little tendency for out-migration as a possible solution to the acute problems encountered[1]. Studies have shown, however, that a close positive relationship exists between Russification and small family size on the one hand, and migration on the other hand. These effects would appear to be small in the Project area. Hence, development efforts aimed at the rural populations will have sustained impact for the current populations.

8. Karakalpakstan is one of the poorest regions in Uzbekistan, with a birth rate well above the average, and a very high infant mortality rate (ranging from 51.4 per 1000 according to official figures, to about 92 per 1000 according to studies undertaken by other demographers). Khorezm Oblast is located south of Karakalpakstan and to the west of the Amu Darya. This Oblast has a smaller rural population living under relatively better

[1] There are also many other constraints to migration, including the rigidities in the housing structure.

conditions, yet burdened by high population densities. In contrast to Karakalpakstan, the piped water coverage in rural Khorezm is relatively high, (54%)[2] although use of surface sources and shallow wells in close proximity to irrigation canals and other unsafe practices are equally evident.

9. ***Overall Findings Of The Rapid Needs Assessment.*** A rapid rural assessment based on about 29 community visits, including eleven small towns of 10-15,000 population, and discussions with many households and neighborhood groups, revealed large scale poverty, especially in areas to the north and northeast of Nukus in Karakalpakstan. There are also marked differences in poverty levels within each community, and households headed by widowed women with large numbers of children particularly suffer from poverty and inadequate access to safe, reliable water and sanitation infrastructure.

10. The single most important problem faced by the majority of the rural households is the lack of food. With practically no income received for their labor from the state sector for the past many months, most households are in need of flour[3]. Since few have cash, farmer's ability to sell small quantities of vegetables and animal products is also hindered. Lack of capital, even small amounts to allow purchase of tools for repair jobs, or a few meters of plastic sheeting to build a greenhouse, make it impossible for the rural poor to create alternative income earning opportunities. There is, therefore, a high demand for small scale credit for home based income generating activities.

11. Following the high demand for income and food, the next most articulated demand of rural households is for natural gas[4]. Good quality water is also among the highest priority needs. Indeed, frequent mention of infrastructure needs such as energy and water is surprising in view of the extremely low levels of income. The perceived need for improved sanitation is notably lacking, even though sanitation conditions are extremely poor.

12. ***Key Observations and Recommendations From the Rapid Assessment Concerning Water Supply and Sanitation.*** Any attempt to improve rural infrastructure, be it water or another, has to go hand in hand with income and employment generating efforts, and ought to be based on a model that generates maximum local employment. While expanding piped water coverage for safe drinking water, efforts should be made to increase handpump, well or canal water use for home based agricultural production. Piped water cannot reach all communities in need and those who are more vulnerable may be left outside the coverage. Therefore, low cost solutions to safe drinking water should be sought for the small and scattered rural communities, focusing primarily on ground water utilization through community managed piped systems and privately owned handpumps.

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[2] These kinds of figures can be misleading as they give no indication of the quality of service. For instance, in Urgench the water pressure is so low that no floor in buildings above the second can be served. In Karakalpakstan, most rural areas served by piped water have few if any house connections, and are supplied for only a few hours a day and at highly variable pressure.

[3] Consumers with an average pension salary of 140 soms or wage of 220 have to pay 2 soms for a loaf of bread or pay 170 soms for a sack of 50 kg of flour, hardly enough for a family of 8 persons for one week.

[4] With winter approaching and with coal and wood in short supply, this need is particularly acute. Households without gas connection have a high demand and others want system improvements so that they can have gas in winter as well.

13. Given the widespread poverty in the region, any attempt for full cost recovery of capital costs ought to be delayed until such time as rural incomes substantially increase; however, there appears to be potential for gradually increasing recovery of operation and maintenance costs provided these costs can be minimized and controlled, water quality and reliability increased, and supply systems efficiently managed[5]. Investments in water supply should be accompanied by innovative experimental programs for small scale business. Sanitation improvements can only be achieved on a pilot basis, starting from relatively better-off rural communities, school and rural clinic water and sanitation programs, and public bath improvement initiatives. Also, a technical assistance program should be added in order to prepare a pipeline of investments on rural infrastructure with a focus on energy.

14. *Observation No. 1:* A great majority of rural households suffer from inadequate access to water. Rural water supply coverage is about 29%[6]; larger state farms and collectives in closer proximity to cities are more likely beneficiaries of the current and future piped water. Smaller and scattered communities have no coverage and some rely primarily on surface waters.

15. All households have access to multiple sources: hand dug wells, handpumps, irrigation canals, lakes and ponds, vendors as well as to public piped water; depending upon their safety some are used for drinking and others for other purposes[7]. The intermittency of available tap water also induces use of unsafe sources of water. This multiple access to unsafe or uncontrolled water, complemented by inadequate knowledge of water quality often hinder demand for safe water. Those who are most vulnerable, the children, carry the greatest risk and drink contaminated water directly from polluted sources.

16. Fetching and transportation of water is nearly universal. Although the distances are not large, several trips have to be made to meet the most basic needs. The transportation and storage of water discourages its utilization for hygienic purposes and many households with a population of ten report using no more than 40-80 litres daily for human consumption. The burden of fetching falls exclusively on women and children.

17. *Recommendation No. 1:* Monitoring of informal sources of water and communication of relevant information to the rural populations is important and can easily be done given the highly hierarchical and structured nature of rural communities.

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[5] The opportunities for cost recovery could substantially increase if the installation of yard connections were to be highly subsidized. At public standpipes, flat rate charges are presently used but could be more closely linked to usage after discounting for inconvenience. These and other cost recovery issues including the willingness-to-pay will be explored in the context of a socio-economic study which is being designed.

[6] There are several estimates for rural water coverage, putting it as high as over 40%. However, what is meant by "coverage" is somewhat unclear. In many rural areas including small towns served by piped water, yard connections are relatively limited and house connections are an exception. Whether potential access to piped water through relatives, neighbors or public stand posts is considered as "coverage" needs to be established.

[7] Some households have access to several handpumps or even yard-taps. They would use one handpump for fetching drinking water and another for watering livestock.

18. *Observation No. 2:* Many households within the piped water areas have no connection and those who do only enjoy yard connections. There are four reasons for this:

(i) Water is perceived to be more important for income generation (livestock production and garden agriculture) than for convenience of drinking and sanitation;

(ii) Houses are made of stabilized mud without sewerage or drainage and thus waste water handling causes inconvenience if connections are made to the homes;

(iii) Perceived cost of house connection is much higher than for yard connection; and

(iv) Water pressure is too low to allow its use within the household; yard connections are often made in the lower parts of the yard to allow access during hours when water is available.

19. *Recommendation No. 2:* The use of piped water in the yards often results in high levels of wastage, with water running freely for as long as it is available sometimes but not always irrigating gardens at the same time. Measures need to be adopted to minimize this wastage. Given that poorer households are also more crowded and have a high dependency on home-based agricultural production, a new tariff structure should be identified through community participation. Again, the role of an informed public in water management should not be underestimated.

20. *Observation No. 3:* Demand for new household connections, especially in areas where piped water is already available, appear to be low for the following reasons:

(i) Cost of new connection is perceived to be high and affordability is extremely low especially in an economic environment where a majority of the people have not been paid wages for many months;

(ii) Since the bulk of the water is needed for livestock and garden watering, handpumps appear to be more cost effective solutions. To many households without a connection multiple sources of water are available, including use of tap water from neighbors or public standposts;

(iii) There is sharing of water among relatives and neighbors; water is almost never denied to anyone especially since it is practically free without restrictions to quantity used and the habit of fetching water for one reason or another is widespread and culturally accepted.

21. *Recommendation No. 3:* To avoid excessive use of piped water for agricultural production, it is important to improve the management and cost recovery of the public standpipe system. For those homes with a yard connection, metering may be introduced over-time. It is also important to complement piped water expansion with an accelerated handpump program, provided that environmental and health factors are taken into account, so as to prevent waste of piped water while protecting incomes from home based agricultural

activities.

22. *Observation No. 4:* Most communities are state controlled and belong to the state farm or collective system. Water improvements, especially piped water expansion will be based on the decisions of the state enterprises. Should there be an intention of expanding existing systems or building new ones with cost recovery, it is essential that households are informed and involved in the decisions. A large portion of the houses in the state farms belong to the state and making households pay for connections for homes that do not belong to them would raise issues of equitability. Likewise, making connections for households that have other priorities would not be desirable.

23. *Recommendation No. 4:* Any attempt for cost recovery should be carefully designed with full and true participation of the household involved whether they are within the state sector or not.

24. *Observation No. 5:* Communities without piped water substantially differ in their demand for connections depending upon their income levels and the perceived quality of the existing sources of supply. On the whole, they perceive it to be a "dream difficult to come true"; when questioned concerning their willingness to participate in the provision of such connections. Those with access to usable quality of ground water often have low demand for connections if they were to pay for the connection. A few mentioned that they would be willing to pay about 25% of their official wage income for one-time connection fees[8] and 3-8%[9] of such income as monthly user charges. Thus, when households realize the low quality of water the demand for safe water is high, despite acute poverty. The socio-economic study (Attachment V) will attempt to establish these trends more precisely.

25. The overall household sanitation conditions are extremely poor: latrines are badly constructed and maintained and are hardly used by the children; children play in yards full of animal excreta, waste water and other waste; water is rarely boiled or filtered and little care is devoted to ensuring that children do not drink directly from unsafe sources; and personal hygiene does not appear to be high in the agenda with relatively low attendance at public bathing facilities and use of soap. The closing of most public baths in cotton growing areas for nearly two months of the year attests to this. The lack of cleanliness in school latrines is yet another indication.

26. *Recommendation No. 5:* Enhanced information communication on unsafe water, especially once rural incomes improve would substantially enhance demand for safe water. Pilot sanitation programs may be feasible in relatively better off communities near urban centers. Indeed the demand for a latrine improvement program was identified in several rural communities. The feasibility of improving the public baths in pilot communities should also be investigated [10]. Similarly, a water and sanitation program for the school system and

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[8] Between 100-500 sum for connections, and 20-50 sum for monthly user charges.

[9] However, these high figures are based on the understanding of multiple use of water: human consumption and agricultural production purposes. For drinking alone, an average of about 10-20 soms appear to be comfortable to those interested in connections.

[10] Many of the public baths are in the process of being privatized and could be supported as part of the demonstration for the project.

for rural hospitals/clinics may be considered.

Impacts of Aral Sea Crisis on Cultural Heritage

27. One of the world's most valuable and unique treasures is under attack by the excessive salinization and rising ground water tables due to the Aral Sea ecological crisis. The State Museum of Karakalpakstan contains a priceless collection of avant-garde Russian paintings as well as an invaluable collection of Uzbek art. The Museum is under immediate and grave danger and some 8,000 pieces of art face the risk of being irreparably damaged. Construction of a new museum would attract tourism to the region and have a positive rate of return. It would also provide a focus for local culture that the people of Karakalpakstan could justifiably be proud of.

28. The State Museum of Karakalpakstan was originally established as a museum of natural history and ethnography. It still contains a modest collection in these areas. However, the well known Russian painter Igor V. Savitski has turned it into one of the world's most important centers of art after his long stay in Uzbekistan. Having worked in Karakalpakstan for many years as a painter himself, he was given the opportunity to establish a museum of art and in 1970 he managed to collect 8,000 pieces from artists who were trained in Moscow, St. Petersburg and other art centers of Europe prior to the 1917 Revolution. These were Russian artists who escaped the influence of communist ideology and some died in Stalin's prisons of hunger. The collection includes the paintings of such great artists as Kuzetsov, Kurzin, Volkov, Nikolayev (Usta-Mumin) as well as Chagal and Kandinsky.

29. The Museum provided inspiration to many great Uzbek and Central Asian artists whose great works are stored in the cellar of the Museum building, which is at risk of flooding with saline groundwater. The building itself has been damaged by salt attack and is far too small to allow the display of the total collection.

Water and Sanitation Related Health Impacts and Sanitation

30. Water related health problems are primarily caused by insufficient water supply, poor sanitation, poor personal hygiene, and little hygienic awareness. The officially reported infant mortality rate in Uzbekistan was 45 in 1992 and 51.4 in Karakalpakstan. These figures are approximately 20% higher than in similar countries. The mortality rate for the whole population in Uzbekistan and in Karakalpakstan does not differ greatly when compared to similar countries. However, life expectancy after the first year may be better than in similar countries when one compensates for the large infant death rate. These facts indicate that primary attention should be focused on mother and child health particularly on health hazards during the first year after birth.

31. *Health Surveillance and Reporting Structure.* The republic and rayon sanitary and epidemiological stations (Sanepid) are responsible for the surveillance of the health of the population. Their main task is to fight epidemics by preventive measures, early warning, vaccination, curation, and extensive reporting. They also survey the main causes or conditions for epidemics such as the hygienic quality of water and food. Child and maternal

health are under surveillance by the rayon health centers of the Ministry of Health. Sanepid belongs officially to the Ministry of Health, but is financially independent of the Ministry.

32. ***Data Quality.*** There exists a serious bias caused by vertical dilution of health information from settlement level up to national level through selection and aggregation mechanisms. The data quality is uneven between rayons, and between settlements. The data are not computerized. The way the data are defined, and the standards and regulations used, are based on the former soviet system of information coverage and the definition of information is, therefore, uniform over all oblasts adjoining the Aral Sea and republics regardless of which country they belong. The data are centrally kept at the republican health center, at the republican Sanepid center and the Ministry of Health. There is virtually no cross referencing or matching between data sources. Mortality tables compiled by Goskomprognostat use different definitions for combining rayons and cities than Sanepid, or the Ministry of Health. Health data are not matched with information of water quality and water supply. There is no health information available on a monthly basis or on a seasonal basis. Water management authorities such as the Agrovodakanals and the Vodokanals are generally not informed of health or water quality data or issues, and so do not commonly receive or use data on these issues.

33. ***Infant Mortality Rate (IMR)*** The infant mortality rate in Karakalpakstan equals 43.5 per 1000 in 1993 and 33.2 per 1000 in 1994 based on the first eight months in each year. It is likely that infant mortality figures do not always include those who died within 6 days of birth, in which case the IMR is underestimated by 21%[11] compared to international methods of measurement. In the Chimbay rayon IMR in the first nine months of 1993 and 1994 decreased from 45.1 to 29.3 per 1000 and, if restricted to the rural areas of this rayon, from 41.4 to 28.2 per 1000. However, within the rayon the IMR varied between settlements from 9.2 to 65.9 per 1000. Reported diarrheal IMR of children up to one year old in rural areas, decreased from 6.36 per 1000 in 1991 to 5.69 promille in 1992 and to 5 per 1000 in 1993. However, other sources suggest diarrheal IMR twice as high. Although exact numbers are not known all signs indicate that the actual diarrheal IMR is expected to be 30% higher than reported. This is partly based on the estimate of the extent of systematic underreporting. Foreign investigators report infant mortality rates up to 90 per 1000.

34. ***Water Borne Diseases.*** OKZ is the acronym for various acute identified and unidentified diarrheal diseases[12]. Insufficient water supply, bad sanitation and lack of personal hygiene are the major contributors to diarrhoeal diseases (OKZ) and hepatitis-A. OKZ and Hepatitis-A are the first causes for both infant mortality and infant morbidity in Karakalpakstan. Infant morbidity and infant mortality due to OKZ and hepatitis-A has decreased uniformly over all rayons in 1994 compared to 1993 on basis of the first eight months of each year. The morbidity rate in Karakalpakstan due to OKZ was 28.25 per 10,000 in 1993 and 20.64 per 10,000 in 1994. The same figures for hepatitis A are 11.74

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[11] Riazantseo, A., Sipos S., and Labetsky O., 1993: Child Welfare and the Socialist Experiment: Social and Economic Trends in the USSR, 1960-90. Economic Policy Series Nr 24, Unicef International Child Development Center, Florence, February 1992

[12] Acute enteritis, colitis, gastro-enteritis caused by identified factors coded in the ICD-IX by 008;005.0 and 2-4,8. Also included are rotavirus infections belonging to ICD-IX 008. Unidentified OKZ is defined by unidentified gastro intestinal infections and unidentified toxical food infections. (ICD-IX 009 and 005.9).

per 10,000 in 1993 and 9.7 per 10,000 in 1994. The total infant morbidity equals 40 in 1993 and 30.34 in 1994. This exceeds by far the infant morbidity due to diarrhoeal diseases and hepatitis in Uzbekistan: 16.5 in 1989, 14.2 in 1990, 15.1 in 1991 and 17.1 in 1992. The diarrheal morbidity rate in the north of the republic sank dramatically from 35.8 in 1993 to 18.93 in 1994; in the south it sank from 25.12 to 17.59 in the center, however, it decreased marginally from 25.41 to 23.95.

35. The reasons for this decrease are not clear. There were no significant changes in the health care system, nor in the budget spent on health care or health education. However, 1994 was an exceptionally wet year and therefore there was an abundant natural water supply. Also in 1994 the water supply through the pipeline from Tuyamuyun Reservoir became available, but mainly to the Nukus region. In the north and the south consumers rely most on open water sources whilst the center is the best supplied with piped water. Overall it is considered that the availability and quality of rural raw water supplies has a significant impact on morbidity in general and on OKZ and hepatitis-A in particular.

36. ***Health Education and Awareness.*** Stimulating the awareness of personal hygiene and sanitation and health education is, after sufficient water supply, the most cost effective prophylactic against diarrheal diseases. Health education in Karakalpakstan is the responsibility of physicians regardless of their employment. Health education in the field of hygiene combined with diarrheal diseases takes place through posters and brochures and oral communication. Health education in rural areas is not accompanied by a set of other infrastructural measures and has little effect.

37. The educational program "Make mothers more healthy" of the Ministry of Health is more successful in this respect because the number of deliveries decreased by 10% from 27,615 to 25,120 and the number of abortions decreased by 20% from 3,153 to 2,559 in the period 1993-1994. This program apparently reaches the relevant group at risk in the population. This group of young women also has a key role in changing attitudes to sanitation in the household. School children and youths form a second target group since their acceptance may induce parental acceptance and therefore lead to improved household sanitation. At present, however, they receive no special attention.

38. *Sanitation.* There are no major sewerage systems in Karakalpakstan with the exception of Nukus, and small areas of Kungrad, where some sewerage has been installed by Gazprom. The Nukus sewerage system covers approx 25% of the town and comprises about 30 km of sewers. A total of 35 pump stations are planned to serve individual areas, but due to lack of finance only 12 have been constructed so far. Nukus sewage treatment works, with a capacity of 65,000 m^3/day has recently been completed and operation should commence shortly. Prior to this sewage was pumped from two pump stations to fields some 7 km to the northeast and used as fertiliser. The new treatment works is located 15 km further away and has primary settlement followed by waste stabilisation ponds.

39. A sewerage system is under construction in Urgench and is partially commissioned, covering 40% of the population. Sewerage systems are also under construction in Khiva and Druzhba, and are expected to be completed in 1995. The authorities in Khorezm also have plans for sewerage systems for 4 to 6 towns but lack of funds is preventing further progress. Urgench sewage treatment works is a standard aeration plant with a capacity of 80,000 m^3/day, but so far only the primary stage has been completed. Two other plants are under construction in Khorezm Oblast at Khiva and Druzhba with capacities of 15,000 m^3/day and 11,000 m^3/day respectively. These are expected to be completed in 1995 and will have

primary and secondary treatment.

40. For other areas the most common form of sanitation is the unlined, usually unventilated, pit latrine, located approximately 15 to 20 metres from the house. These latrines are not normally situated in the vicinity of a well but are often close to ditches which allows bacterial contamination to spread throughout the vicinity, including areas around standposts. The pit latrines are emptied only in a few communities that provide a central service for this purpose. The pits are emptied by vacuum truck and the waste transported by truck and used as fertilizer. If such service is not available a new pit is dug when the pit is full. In some areas flush toilets discharge into unlined pits, providing a serious risk of aquifer pollution.

41. There is seldom a water supply of any kind in the neighborhood of the latrine that can be used for washing hands, flushing or cleaning the latrine. Latrines in public buildings in rural areas are no different, only larger, poorly maintained, and extremely unhygienic. Most public buildings have simple hand washing basins near the entrance, but there is usually no soap available. The contamination of groundwater by human excreta is particularly of concern when there are high groundwater levels (less than one metre below ground) and a piped water system with low pressures and leaks. This situation is common in many rural areas with piped water.

42. *Sanitation Education.* The awareness of the importance of personal hygiene in sanitation is promoted in principle by the rayon health centers and by the rayon Sanepid stations. Each physician has the official task to participate in health education for four hours each month. Sanitation is seen as a health related topic but it is only indirectly dealt with. There exist no coordinated programs on sanitary education. Records of the educational activities are kept at the Republican Health Center in Nukus. The transfer mechanisms are lectures, public discussions, mass media, articles and epidemiological bulletins. The effect of this health education is bound to be limited, if the water supply is not sufficient. This education takes place independent of the local drinking water supply situation.

43. *Monitoring and Testing Water Quality.* Drinking water is either supplied through a piped system or from wells. When these facilities are not available (a frequent seasonal occurrence) water is obtained from the nearest source. A canal, a pond, river, or even and irrigation drainage collectors are used for drinking water. In areas with piped water, the pipes often break and are not repaired. This means the loss of pressure at the standpipes and a further possibility for contamination. The areas around standpipes are extremely muddy. Water availability is often restricted to a few hours per day.

44. The quality of the water in rural areas is tested by the rayon Sanepid stations for chemical and bacteriological contamination. The quality of tap and well water is tested at or near the point where they are consumed. For instance in the rayon of Chimbay (pop 84,000 of which 46,000 live in rural areas) Sanepid has 63 sample points: 15 at the pumping stations, 18 in the rural areas, 29 in the streets of the city and one at the drinking water reservoir at the pumping station. It is estimated that about 30% of these points are not used for various reasons. Samples are generally taken at a rate of 4 to 5 times per month, although the reservoir is sampled and tested daily. Canals are tested at two meters from the bank at a depth of 0.50 metres. It is not clear whether the testing program is actually carried out completely as prescribed.

45. *Laboratories.* There are three Sanepid laboratories for the analysis of water quality

in the Republic of Karalkalpakstan and one laboratory in Urgench in the Khorezm oblast. All water quality measurement devices are outdated, in poor shape, and ill used. The measurement technicians are not properly trained, nor aware of the relevance of their work. There is no portable equipment available. A quality control system such as alternating standard tests with extended tests is not used, and some of the analytical methods are outdated and inaccurate.

Drinking Water Quality

46. The full picture regarding water quality in the Amu Darya River, irrigation canals and drainage ditches, shallow groundwater, deeper aquifers, surface depressions, and lakes throughout the proposed project area has not yet emerged. It is very complicated geographically and hydrogeologically, and is changing due to drastically reduced pesticide, herbicide, and fertilizer use. From a health standpoint the most important water quality parameters to be considered in this region are pesticides, nitrates (from fertilizer use and livestock manures) and pathogenic contamination from humans and livestock. However, because it is easily monitored and strongly affects consumer perception of suitability, salinity tends to be the parameter that is of major focus to water system planners and designers, and to the regulatory authorities in Uzbekistan.

47. The Uzbekistan salinity standard (or norm) for drinking water is 1 g/l. All water supply schemes in the country are being designed to this standard regardless of the cost, even though there are no restrictions on selling bottled mineral waters which often greatly exceed this standard, even by as much a 4-5 times. The WHO guideline for salinity for drinking water is 1 g/l. This is not a health related guideline, but is principally based on taste considerations (particularly magnesium which gives an unpleasant taste), since people can drink water with a salinity up to 2 g/l or even higher without any adverse effect. There is no point during this period of extreme economic difficulty in the country of using limited investment capital to develop high cost schemes for supplying drinking water to the 1 g/l salinity standard.

48. Prior to 1989 Uzbekistan was one of the highest users of agrochemical and fertilizers in the world with average application ratios of 54 k/ha and 480 k/ha respectively. Since that time lack of funds for the purchase of chemical from foreign sources has reduced consumption of pesticides to about 4 k/ha although fertiliser use is still substantial.. Naturally the immediate impact on the environment and on the health of the population, especially in rural areas has also been dramatically reduced although there are long term effects which will take some years to reduce. Those who were most exposed were the workers in the field and residents of villages where aerial spraying was extensively practised. Local water resources and to a lesser extent those downstream receiving and using drainage water from such areas were also affected.

49. From data that the mission has received, as well as from its own observations, it does not believe that the major surface and groundwater resources being used and proposed for the Khorezm and Karakalpakstan areas are significantly contaminated by pesticides, herbicides, or nitrates. However, it recommends that under the pilot project demonstration activities, the quality of the water abstracted from the Tuyamuyun Reservoir, and any other major ground or surface water resource being considered for public water supply in the project area be monitored on an agreed schedule for these parameters especially, during the time of the year

when chemicals are applied or periods when canals are used directly for drinking water.

50. By far the most important drinking water quality parameter from a health perspective is bacteriological and virological contamination, which can be controlled in the water supply and distributions system through chlorination. In areas of low piped water pressure, however, it is possible that the water supply may become contaminated through infiltration of contaminated ground water, especially in areas using unlined pit latrines and where there are concentrations of livestock. Such conditions are found in many locations throughout Karakalpakstan.

51. Results of bacteriological analysis in the Tuyamuyun reservoir, and in ground water aquifers at depths of 30-40 m and in deeper wells of 300-400 m, show little contamination and are acceptable sources of water supply from this perspective. However, Sanepid have analysed shallow wells, surface irrigation canals, and other surface water sources in the project area that are used for drinking water in rural communities and settlements, and have found high levels of bacteriological contamination. Secure and reliable piped drinking water supplies will be an important factor in improving the heath of the population in Karakalpakstan and Khorezm oblast.

Surface Water Sources and Supplies

52. Very low water flows in the Amu Darya River in 1982, when the surface water supply in the river and irrigation canals of the Khorezm Oblast and the Republic of Karakalpakstan dried up even before reaching the Aral Sea, caused widespread concern at all levels of government in the former Soviet Union. As a result, after extensive investigations and debate a program for water supply and distribution for urban and rural communities in the two regions was initiated and good progress has already been made in its implementation, which began in 1988.

53. ***The Tuyamuyun Regional Supply System.*** The main component of the program is a large scale piped water scheme for both regions abstracting water directly from the 750 cubic km capacity Tuyamuyun reservoir located some 240 km upstream of Nukus and 90 km upstream of Urgench. In Karakalpakstan the primary trunk main from Tuyamuyun to Nukus, which was completed and brought into operation in December 1993 has a current design capacity of 200,000 m^3/day with an output capacity of 170,000 m^3/day. The treatment plant is located near the reservoir at the head of the primary trunk main serving the Project area. A second phase expansion of the water treatment plant to double its capacity to 340,000 m^3/day is under construction. Plans have also been drawn up to install three large pumping stations on the primary trunk main from Tuyamuyun to Nukus to increase its capacity to 340,000 m^3/day.

54. The Urgench treatment works has a gravity intake on the left bank of the Amu Darya and is some 9 km downstream of the Tuyamuyun Reservoir. The capacity, process and layout of the plant is the same as Nukus (although the authorities in Urgench quote an output of 180,000 m^3/day). There are plans to increase the capacity of the Urgench plant also to 570,000 m^3/day, which would provide the capacity to supply 90% of Khorezm with water. Water is pumped from the treatment works to Urgench, and this primary conveyor system is being extended to all large towns in Khorezm. The main conveyor to Urgench is 90 km long and 1000 mm diameter. The remainder of the system is almost complete, with only 50 km of

pipework (1000, 800 and 600 mm diameter) left to be laid. Secondary transmission systems similar to those in Karakalpakstan are under construction but lack of funding is holding up progress.

55. The Tuyamuyun - Nukus and Tuyamuyun - Urgench water supply companies operate the primary system and charge the Vodokanals and Agrovodakanal water distribution companies for bulk water supplies from this system. Both Vodakanal and Agrovodakanal also supply piped water from naturally recharged aquifers. Water is distributed from the primary trunk mains by Vodakanal and Agrovodakanal which are responsible for urban (population > 10,000) and rural areas respectively. Each organisation maintains separate pumping stations for each secondary system, often duplicating each other and chlorination facilities are also installed at each pumping station although they are often primitive and infrequently used.

56. Vodakanal supplies each city or town through a single secondary trunk main. The distribution systems do not have water storage apart from small tanks upstream of the pump stations acting as balancing tanks and header tanks downstream of the pump station to control pressures. The pumps are not reliable and supplies are therefore erratic. In general about 50% of the urban population obtain water either through house connections, yard-taps or standpipes.

57. Agrovodakanal supplies the collective and state farm centres within each rayon either from a single pump station supplied from the primary trunk mains, or from boreholes. The secondary trunk main systems from the pump stations to all state farms and collectives are under construction and are on average 80% complete. Once connections are completed it is intended to retain the boreholes either for non-potable use or as standby. Distribution networks within the farm centers are also under construction and are approximately 45% complete in Karakalpakstan. There are no plans to connect outlying settlements within the farm areas to this system.

58. *Recommendation.* A more rational system of water distribution should be investigated which would combine the Vodakanal and the Agrovodakanal into a single organisation. This should be considered during the preparation of the project preparation study.

59. ***Piped Water Use Characteristics,*** There is very large wastage of water from the piped water distribution systems as household taps and standpipes are commonly left running continually[13]. Moreover, highly fluctuating pressures were noted at these outlets even when the water supply was turned on. The water supply charge is based on a tariff of 2 kopeks/m^3 for rural areas and 6 kopeks/m^3 for urban areas and a consumption norm which is dependent on the facilities supplied by the connection. Since this charge is just a part of the total deducted from workers' salaries by collective or state farm managements before they receive their wages, families have no knowledge of the cost or appreciation for the value of piped water.

60. *Supply Restrictions.* These organizations reduce water consumption (in order to save

[13] This is often also due in part to the poor quality of fittings and fixtures.

costs) by supplying piped water to households for only 1-2 hours in the morning and evening[14]. Urban piped water systems are also shut down periodically during winter periods due to the lack of raw water supplies in the canals. Households respond to the lack of service by drawing water from other sources such as shallow wells, pools, lakes, and irrigation canals and ditches. Thus, even in the rural areas serviced by piped water, contaminated water can enter the piped system during periods of low pressure, and other possibly contaminated water sources are being used for drinking purposes when the piped water system is shut down.

61. Approximately 90% of the water supplied to the state and collective farms is for household use. The majority of the water for farm use (other than irrigation) is drawn from deep boreholes of which 700 are currently in use throughout Karakalpakstan for this purpose. The collectives do not pay any charge for this water which encourages its misuse and mor rapid depletion of this important resource.

62. In Nukus with a population of 170,000, piped water consumption is 100,000 m^3/day, or 600 l/person/day. This is an excessively high figure compared with other countries and will require further investigation during project preparation to identify the reasons and to determine practical ways of reducing the need to supply this volume of high quality water. Water metering should considered throughout the piped water network as a means of ensuring improved management of the system, to reduce wastage of water, and to increase cost recovery[15].

63. *Expansion Of The Regional Surface Water System.* A scheme has been proposed to store and draw water from the Kaparas reservoir for the Tuyamuyun-Nukus and Tuyamuyun-Urgench main pipelines. The objective of the scheme is to is to fill the Kaparas reservoir from excess water in the Tuyamuyun reservoir during periods of high summer flows and good water quality (salinity in the range of 0.5-0.8 g/l). The water will then be released from the Kaparas reservoir into the regional pipe system during the remainder of the year when salinity levels in the Tuyamuyun reservoir usually exceed the 1 g/l standard. It is estimated that this will provide Karakalpakstan and Khorezm with drinking water which will meet the 1 g/l salinity standard during the entire year, but will involve a large investment cost of more than $60 million to complete (some work on this scheme has already started), along with high pump operating and maintenance costs. However, under the existing arrangements water quality in the Tuyamuyun reservoir normally meets a 1.5 g/l salinity limit.

64. *Recommendation:* It is recommended that temporary or interim salinity norms be set as the design criteria for drinking water supplies to communities in Karakalpakstan and Khorezm. For communities living in the intensively irrigated areas and supplied either from the Tuyamuyun system or good quality well water, it is recommended that the temporary standard be set at 1.5 g/l. For communities outside this area where isolated supplies from wells are used, the temporary standard should be set at 2.0 g/l. In later years when the

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[14] It is unclear whether the agro-vodocanal or vodocanal pipe system could actually deliver continuous or longer period service at reasonable pressure.

[15] However, the impact of such a program on the poorer families who may not be able to afford sufficient water, and on the budget, manpower, and management capacity of the water management organizations which will have to install, read, and maintain the meters as well as collect billings and possibly disconnect defaulters should not be overlooked.

population can afford to pay for more expensive and less saline water more restrictive norms can be considered, which may lead to the development of some of the costly schemes currently being considered.

65. The investment and operating costs of increasing the capacity of the Tuyamuyun-Nukus and Tuyamuyun-Urgench main trunk pipelines and treatment plants as the piped distribution system expands are high by comparison with other sources, and any expansion must be carefully evaluated against competing resources. It is estimated that to complete the expansion of the Nukus water treatment plant from 170,000 m^3/day to 340,000 m^3/day and to install three large pumping stations on the main trunk line, the total investment cost will be approximately $26 million. A planned third phase expansion to 540,000 m^3/day would involve a total investment of some $ 250 million.

66. *Recommendation:* Despite the high cost of the Tuyamuyun system it should be recognised that the major investments have already been made, insofar as the 340,000 m^3/day scheme is concerned. The source has a proven reliability and problems of contamination are reasonably well defined. It will provide a major additional resource for the area and should therefore be considered seriously, particularly until the quality and quantity of groundwater resources are proven.

Groundwater Supplies and Sources

67. *Groundwater Sources.* Due to the extensive irrigation canal network there are ample shallow (ie, up to 40 m deep) groundwater resources in the project area. The main restriction to groundwater use is the salinity of the water. The superficial alluvium of the Amu Darya Delta consists of up to 40 m thickness of sands with clay lenses with transmissibilities varying from 300 to 1000 m^2/day, and water quality in the range of 0.5 to 2.0 g/l. Well discharges may reach 25 m^3/h. The water abstraction capacity of the alluvial deposits of acceptable salinity in the Amu Darya Delta is reported to be at least 175,000 m^3/d.

68. Of the rock strata underlying the delta alluvium, the Cretaceous sandstones have been extensively used for water supply. Nearly all wells in these aquifers are artesian, freely discharging water at the rate of a few litres per second up to 20 l/s with salinity in the range of 1.5 to 4 g/l, but reaching 35 g/l in some places. Though the artesian level has dropped from 60 to 20 m over the last 40 years the sustainable yield from the Cretaceous wells is estimated at 160,000 m^3/day.

69. *Recommendation:* On the basis of these preliminary findings, it is recommended that the groundwater resources in the area be further developed to improve clean drinking water supply to the population of Karakalpakstan and Khorezm.

70. ***Groundwater Supply by Handpumps.*** Throughout the irrigated areas of the project area the communities which no reliable piped water distribution system use water from nearby canals or ditches, shallow dug wells or drilled wells equipped with hand pumps. There is no inventory of existing handpumps, but the total number is said to be high since conditions are very favorable for this mode of water supply; ground water levels are generally very high, varying from 0.5 to 3.0 m depth; handpumps are of very simple design, locally produced, and are low cost. Such wells and handpumps can be and generally are installed at the people's own initiative and expense. Based on field visits it was found that the ground water

quality from handpumps is unlikely to meet quality guidelines principally due to inadequate design of the well and the handpump, and inadequate spillwater drainage infrastructure.

71. Currently, an international private voluntary organization with the assistance of the PreAralia Hydrogeological Expedition is implementing a shallow wells program. Since 1992 some 270 shallow wells have been drilled and equipped. The target for the 1994 programme was 60 wells. These numbers are likely to represent only a fraction of the total number of handpumps in use. The water obtained from the wells is tested after construction, and salinity is generally found to be in the range 0.5 to 1.5 g/l. However, nitrate, pesticide and bacteriological parameters are not measured in this program.

72. The demand for handpumps is likely to be high, but this remains to be determined. The PreAralia Hydrogeological Expedition has project proposals to install some 23,700 handpump wells, 14,400 in Karakalpakstan and 9,300 in Khorezm at an installed unit cost of US$35 and a total project cost of about US$830,000. This project needs to be examined carefully to ensure correct project design and that it is able to meet acceptable water quality standards but otherwise appears to be an appropriate proposal.

73. *Recommendation:* It is recommended that the interest of sector stakeholders, and in particular the beneficiaries in the introduction of improved of handpump water supply systems be confirmed. When this is confirmed, it is recommended that the project feasibility should formulate a handpump water supply component for rural communities, wherever it is cost effective. A sample survey of existing handpump operations should also be carried out to determine their reliability and maintenance requirements and to propose improvements for future installations proposed under the project.

74. ***Groundwater and Small Distribution Systems.*** An estimated 410 naturally recharged shallow wells exist in the project area, of which 220 are in operation in Karakalpakstan (150) and Khorezm (70). All were recently surveyed by the PreAralia Hydrogeological Expedition. These wholly or partly supply a large number of towns and villages from a 30 to m deep aquifer. All are situated in the more sandy alluvial deposits and in the vicinity of the Amu Darya river or irrigation canals to ensure groundwater replenishment with fresh water. Discharges from such wells are up to 25 m^3/hr.

75. Salinity in these wells varies from 0.5 to 1.5 g/l, but can be as high as 3 to 5 g/l if water is drawn from the less permeable alluvium (silts, clays), and at greater distances from the irrigation canals. The water then becomes more alkaline and contains higher levels of SO_4 and Cl. Salinity increases during November/December (flushing of agricultural land), and during March/April/May (low seasonal flow). Increased salinity values may then occur in well water but dilution in the groundwater regime reduces such values before abstraction from pumped wells. Prudent well siting and operation would suffice to maintain acceptable water quality throughout the year.

76. The possible presence of nitrates, bacterial contamination and pesticides in the water is of much greater concern. No data on these parameters in groundwater supplies are available. With prudent use of groundwater resources, i.e. using as a preliminary guideline a filtration period from source (e.g. canal) to well screen of 45 days, this problem should be minimized.

77. Appropriate sites where prudent groundwater development is possible can be found throughout the project area. The prerequisite is to have a sufficiently large aquifer connected

with a nearby irrigation canal. Information on sites is available from the PreAralia Hydrogeological Expedition. Obviously, the smaller the supply system, the more sites that may be available. Groundwater based supply systems discharging, say, 2 to 4 m^3/hr should be abundant.

78. The provision of small scale piped water supply systems based on groundwater from these medium depth aquifers is an interesting alternative to handpump schemes, as the service level is higher, permitting public taps and/or yard connections. Water consumption will be higher than for handpumps leading to improved domestic and personal hygiene, particularly when accompanied with health education.

79. *Recommendation:* It is recommended that the interest of sector stakeholders be determined, in particular the beneficiaries in the introduction of improved groundwater based water supply systems. When confirmed, it is recommended that the project feasibility studies should formulate this as a water supply component for rural water communities, wherever it is cost-effective.

80. ***Artificial Groundwater Recharge.*** A thorough study of freshwater resources of the Amu Darya delta was carried out in the 1960s. A number of the larger fresh water bearing aquifers, here referred to as the fresh water lenses, were hydrogeologically mapped and tested. Forty important lenses were identified. These will have undergone quality changes during the intervening period, particularly in the upper levels most affected by irrigation activities; these lenses have not been developed to full capacity.

81. In a pilot programme that was started in the 1960s several of number of these lenses were developed as river/canal bank infiltration sites. With the increase of salinity in the canals, the infiltration capacity around the wells was increased by construction of artificial recharge schemes involving additional rows of wells and infiltration canals. When properly operated such schemes provided discharges of up to 500 m^3/hr in the summer and 250 m^3/hr in winter.

82. Chimbay is one such town with an artificial recharge scheme. The town has recently been connected to the Tuyamuyun - Nukus pipeline system and consequently the scheme is in disuse. Out of the 26 wells constructed only 7 along the main irrigation channel are now operational and on an intermittent basis. The scheme only functioned as designed for three years (1981-1983): after this successful test period it was simply used as a naturally recharged ground water supply for the city. Vodakanal consider that it is now cheaper and more convenient to utilize the Tuyamuyun water, which is undoubtedly correct since this. This may appear correct in the short term from the local perspective because of the present high subsidies associated with this imported water, but it is economically unsound reasoning for the country in the long term particularly if the replacement of very adequate water sources and schemes forces a large premature investment in the capacity of the Tuyamuyun reservoir and associated pipeline system.

83. The use of artificial recharge schemes introduces supply system flexibility into the vulnerable single source supply scheme currently planned. Water quality and economic considerations may also favour use of artificial recharge schemes especially in Karakalpakstan. In future cost considerations will play an important role in the way Vodakanal and Agrovodakanal exploit various supply options.

84. *Recommendation:* It is recommended that the project feasibility study should study

artificial recharge schemes to complement the Tuyamuyun - Nukus supply system, particularly for the proposed Phase III expansion (to 540,000 m^3/day). Similar schemes should be considered in Khorezm but shorter distances to the Tuyamuyun reservoir may reduce the cost advantage of artificial recharge.

85. ***Groundwater Supply Systems With Desalination Units.*** A 2,200 m^3/day capacity reverse osmosis desalination plant is installed at Takhtakupr, some 100 km northeast of Nukus. The plant was supplied by the German Red Cross and was brought into operation in April 1993. The Red Cross agreed to supply chemicals and free maintenance for the first year, and spare parts for the first three years operation of the plant. However, the plant has only been running a few hours per day since it was brought into operation (the mission estimates less than 10% of total available time), and the connection of the town supply to the Tuyamuyun pipeline system in April 1994 means that it will now be used as a standby source only. The plant reduces the salinity of deep well water supply by approximately 2.0 g/l. The rate of fouling of the membranes, which are the most essential part of the plant seems to be acceptable at the current level of operation as they need cleaning approximately 3-4 times per year. However, if the plant is run on a continuous basis the cleaning frequency will increase, possibly even to unacceptable levels.

86. Some of the reasons for the limited time of operation appear to be: (i) the desire to conserve expensive and difficult to purchase chemicals, which are needed for operation and cleaning; (ii) to reduce operating costs because of the high electricity demand; (iii) to minimise wear and tear of equipment and to extend its life. It is estimated that the water produced by this unit has cost between \$3.0 and \$3.5/m^3, including capital and operating costs, which is excessively high by any standards. In general, reverse osmosis plants are extremely vulnerable to careless operation and maintenance resulting in a rapid fall off in capacity and salt removal, which cannot be restored. This will be particularly true for the sophisticated and fully automated plant at Takhtakupur.

87. *Recommendation:* The mission strongly advises against the installation of such units in the future unless there are no other sources available or likely to be available for the particular area in the near future. In cases where installation may be considered, careful consideration must be given to the need to maintain supplies of chemicals and spare parts for periods significantly longer than 12 months.

88. The main component of the program to utilize desalination equipment has been the installation of 310 Russian made EKOS desalination units based on the principle of electrodialysis. These units are installed in 155 containers (with 2 units in each container, costing \$15,000/container) at 80 village sites throughout Karakalpakstan to desalt brackish (up to 6 g/l) deep well water (300-400 m) for household supply. The first units were installed in 1989 and the last in 1993. At 13 sites the units are not operating due to lack of spare parts, while at a further 5 sites the communities have recently been connected to the Tuyamuyun-Nukus water supply and the units are now being used only as emergency standby. As other communities serviced by these units are connected to the main feeder system they also will be put on standby. Each unit has a capacity of 25 m^3/day, consequently the total design capacity amounts to 2.8 million m^3/yr. However, the mission was not able to assess the true output of these units as no operating records were available to evaluate the amount of time that they operate each year. From the mission's observations and discussions it was concluded that the actual output is only a fraction of the design figure quoted above.

89. The EKOS units do not require the addition of chemicals for operation or cleaning and

are, therefore, much simpler and less expensive to operate and maintain than the reverse osmosis plants. Even so, the operators often fail to follow procedures for regular cleaning with the result that the membranes become fouled and have to be serviced more frequently. Their performance is also affected by the lack of spare parts and absence of conductivity meters to constantly measure salinity and plant operating performance.

90. Taking into account the limited operating time of these units, the current average membrane life of 2 years is very short and reflects the problems of operation and maintenance discussed above. The Karakalpakstan Agrovodakanal estimates that it costs 3 times the current tariff of $\$0.06/m^3$ charged the collectives and state farms for the production and supply of water from these units, which is two to three times the tariff it charges these organisations for water from other sources.

91. *Recommendation* Since there will be some areas outside the proposed piped water distribution system where it will be necessary to continue operation of the EKOS units, it is recommended that during project preparation three operating units should be fitted with monitoring and recording equipment and a 6 month testing program be carried out on the three units. This will enable a better evaluation of the performance of these units than is currently available. It will also be necessary to rehabilitate operating units and to purchase a comprehensive set of spare parts.

92. ***Groundwater Development Capacity.*** The PreAralia Hydrogeological Expedition in Nukus employs about 200 people of which some 25 hydrogeologists and geophysicists, a variety of technical, administrative and other support staff. The Expedition's facilities include, among other things:

- a vast body of information, including that of an extensive groundwater level and groundwater quality monitoring network (250 wells)
- operational exploration equipment
- 5 drilling rigs in working order, workshops
- a colorimetric field laboratory for water analysis
- two computers (286, 486)
- a limited quantity of software
- electronic mail communication facilities

93. The Ministry of Water Resources also has a Hydrogeology Expedition which maintains a monitoring network of 2,000 shallow wells, particularly for study of soil-water-plant relationships. One well serves to monitor 30 to 600 ha.; maximum depth is 6 m. Issues such as canal water and irrigated field water quality profiles are studied. Levels are measured every 10 days, and during cropping period every 5 days.

94. There is little doubt that the PreAralia Hydrogeological Expedition of the State Committee of Geology and Mineral Resources is a professional and capable organization. In spite of this it is felt that institutional support would further enhance their performance. Such support may include:

- spare-parts for non-amortized essential equipment (geophysics, drilling)
- casing and filter material for wells
- modern chemical testing (mass spectrophotometer, gas, etc)
- a variety of computer hardware (digitizer, plotter, 486 computers) and software (pumping tests, solute transport, geo-electrical sounding, hydrogeological database)
- groundwater modelling and other training courses

95. *Recommendation:* It is recommended that the Hydrogeological Expedition and/or staff derived from it in a private capacity, be involved as consultants and/or contractors in the project feasibility study, the project demonstration, and the follow up project implementation. In order to enhance their performance, some institutional support (training, equipment) is proposed for project implementation.

C. POSSIBLE PROJECT COMPONENTS

96. The Project will focus on urban but primarily rural households in Karakalpakstan and Khorezm Oblast, and will seek to identify and implement an integrated strategy to increase the quantity of reasonable quality water supply available to households based on the most cost-effective use of available ground and surface waters in each locality considering as well imported surface water from Tuyamuyun. The full range of water supply modes will be utilized to give the most cost-effective solution. Improved sanitation will be developed on a pilot/demonstration basis through community participation and cost sharing schemes. New and improved low-cost sanitation technologies will be tested. Institutions will be strengthened, and planning and coordination among all the concerned agencies enhanced by the joint use of modern information system tools such as Geographic Information Systems.

97. At this stage of the project identification and preparation cycle it is not possible to be definitive as to the detailed scope of the project that will be financed by the Bank and other donors. However, it is already possible to give some indication of the components of the project that will be considered for financing once the detailed project preparation studies have been completed. The components could include the following:

(i) Completion of Phase I and Phase II of the Tuyamuyun - Nukus and Tuyamuyun - Urgench water supply systems depending on the results of the project feasibility study, which will also consider other supply options such as artificial groundwater recharge the supplement the Tuyamuyun reservoir supply;

(ii) Completion of part or all of the secondary and tertiary water supply networks connecting with the Tuyamuyun-Nukus and Tuyamuyun-Urgench water supply system, installation of water meters at least in the primary system;

(iii) Development of other water supply sources, for example: local surface or ground water resources for supply to industrial and commercial facilities; shallow wells and

hand pumps for remote rural villages; and improvement and rationalization of the EGOS desalination plants supplying villages that do not have access to good quality surface or shallow ground water;

(iv) Completion of the sewage collection and treatment systems for Nukus and Urgench and possibly up to 4-6 towns in Khorezm oblast, as well as installation of improved pit latrines in urban and rural areas for individual households and communal facilities such as schools, health centers, bath houses, and other commercial and government buildings;

(v) A community based health and hygiene education programs and strengthening of the institutional and organizational structure for water supply, sanitation and health, including improved laboratory facilities for the Sanepid Service and the vodocanals;An integrated water/health information systems in each Rayon using a Geographical Information System to aid reporting, planning, and policy analysis;

(vi) Preservation of unique Uzbek cultural heritage threatened by the Aral crisis by completion of the new art museum in Nukus, assistance and training in the cataloging, preservation, and display of its irreplaceable art treasures, and development of a regional center in support of central asian artists;

(vii) If feasible, an income generating scheme for low income rural households based on a town/village credit facility through local commercial banks.

98. A supplemental Terms of Reference (TOR) has been drawn up for the detailed project feasibility study covering both Karakalpakstan and Khorezm (Attachment II). This TOR will be used by the Kuwait Fund as the basis for requesting consultant proposals and negotiation of a contract with a foreign consulting firm and the local design institutes.

E. PILOT DEMONSTRATION ACTIVITIES

99. Pilot demonstration activities will be implemented concurrent with the project feasibility study. The objectives of the pilot demonstration are to:

(i) maximize community participation and involvement of the local authorities in the design and implementation of water supply, sanitation and health education in rural areas, to improve project design, and to increase community understanding of the value of clean water and of the relation between poor sanitation and hygiene conditions and ill health, especially for children;

(ii) boost rural incomes through local contracts to install water distribution systems and sanitation facilities;

(iii) to test new and improved technologies, develop and test new planning processes and procedures, strengthen monitoring, and develop guidelines and specifications;

(iv) evaluate and assess the performance, and operating costs of a representative sample of operating desalination units.

100. Four pilot demonstration projects are proposed:

1. Integrated Community Based Rural Water Supply, Sanitation and Health Pilot Demonstration Project

(i) *Community Development Activities:* As a necessary step towards any outside intervention at community level which is to be successful and sustained to participation of all stakeholders, and above all the beneficiaries is a prerequisite. The community development activities are a means to reach project objectives and do not form a goal in itself. The focus of attention will be two communities from pre-selected rayons, one in Karakalpakstan the other in Khorezm. Community selection will be done on the basis of an inventory at the onset of the assignment. The community development should lead to raising of awareness so that subsequent interventions become demand driven to ensure full involvement and support of the community.

(ii) *Rural Water Supply Activities:* Up to a maximum of 100 handpumps will be installed. The handpump supply system, including screens, pipes, pump, concrete slab, will meet high quality standards, as yet unattained in the region. As an alternative or complement to handpumps, depending principally on the communities selected, one or two small scale groundwater based supply systems will be constructed, and operational and management regulations specified. Purpose of this demonstration is not only to set design and construction standards, but also to create confidence in groundwater development as clean water source and improved supply service level. Water quality controlled well siting and production water quality monitoring will be an integral part of this activity.

(iii) *Provision of Latrines and Septic Tanks.* An indefinite number of private VIP and/or double shaft latrines, communal latrines, and septic tanks will be constructed in each community. The quantity will depend greatly on people's interest and their ability to pay (in part through contributed labor). Satisfactory targets proposed per community are 50 latrines, and 5 communal latrines or septic tanks. Use of latrines is common throughout the project area. The object of demonstration is to improve standards, as well as to provide opportunity for income generating activities (latrine construction, slab production, etc).

(iv) *Public Bath Refurbishment:* Public baths are often underused or remain unfinished. The demonstration project is to undertake the reactivation of at least one public bath in each of the two communities, be it by finishing or refurbishing of the facility, and including personal hygiene in its health education program. Baths are in the process of being privatised and an assessment will be made of fitting operational possibilities, affordable to the beneficiary community.

(v) *Public Health Awareness Raising:* None of the preceding activities make sense when their impact is not increased by obtaining behavioural changes in the target group. Public awareness raising activities on issues of domestic and personal hygiene have formed part of the authority's approach to improve the population's health status. Other, possibly innovative approaches must be used to recapture the attention of the community, this may include subtarget group specific products (discussion groups for mothers with infants, videoclips for teenagers). Behavioral change will be measured and evaluated.

(vi) *Public Health Data Collection System Improvement:* Without necessarily changing the current health data collection system, the project is to support the automatization of health

data handling, processing, and dissemination in order to increase data access and understanding, and to facilitate timely responses to changes in the incidence of particular diseases and mortality rate. In addition the relationship between health and unpiped water supply is to be explored. This will be carried out for the rayon in which the two selected communities are situated.

II. Effective Operation and Maintenance of Small Scale Desalination Units Pilot Demonstration Project

(vii) *Desalination Units Operation and Maintenance:* In Karakalpakstan 310 EKOS desalination units based on electrodialysis are installed in areas which are not yet or will not be served by other water supply systems. The performance of these units suffers seriously from a lack of spare parts and poor operation and maintenance. Approximately 54,000 people living in rural areas are supplied by desalinated water. This pilot demonstration project aims at assessing under controlled conditions their operational requirements and to estimate the costs for rehabilitation of other units.

III. Hand Pump Survey and Data Base Creation

The project will survey 500 handpumps throughout Karakalpakstan and Khorezm installed by either the private or public sector. Users will be questioned and water samples taken for analysis. A data base will be created for the results and for further sampling results to be added after the completion of the project. The objective of the project is to establish the working conditions and the variation in water quality over a period of time. The results will be used to assist in policy selection in the feasibility study.

IV. Water Quality Survey

Modern sampling and analytical procedures will be used to evaluate quality variations of surface and ground water drawn from a number of sites, including Tuyamunyun reservoir, different sites in Karakalpakstan, including deep wells and one artificial recharge scheme. Technology transfer is ensured via on the job collaboration, and workshops.

101. A supplemental Terms of Reference (TOR) has been drawn up for each of the pilot demonstration projects (Attachment III). This TOR will be used by the Swiss funding agency as the basis for procuring equipment and requesting consultant proposals and negotiation of a contract with a foreign consulting firm and the local institutes and organizations.

F. NEXT STEPS

102. During the mission it was agreed that the Ministry of Water Management in Karakalpakstan and the Committee of Water Management in Khorezm would set up a Project Office in Tashkent and Project Preparation and Implementation Units (PPIUs) in their respective organizations prior to the start of the feasibility study and implementation of the

pilot demonstration activities. They will select 2-3 local experts to staff these units and will provide the necessary office space and furniture to support the foreign and local experts from the region and from Tashkent who will be involved in this work. It was also agreed that suitable living accommodation will be provided for the foreign experts and experts from Tashkent on a reimbursable basis.

103. It was also agreed that a portion of the grant funds for project preparation would be used to provide office and communication equipment for these teams and will contribute to the rent of office space for them at local costs. In addition, some funds for purchase of equipment for the PPIUs to be set up under the Aral Sea Program will also be provided since these PPIUs will also provide services for other projects to be executed in the Project area under the programs approved by the Heads of State. The proposed list of equipment to be purchased for the PIU is given in Attachment V. If possible the foreign made equipment for the PIUs should be purchased from local sources to speed up deliveries.

104. All government officials that the mission met stressed the urgent need to complete the feasibility study and to begin implementation of the project as soon as possible. We were constantly reminded that they had hosted numerous large missions over the past three years from bilateral and multilateral agencies, which had made offers of assistance, but with almost no concrete results. It will be necessary for the Bank to find means of speeding up the selection of foreign and local experts supported by the Kuwait Fund and Swiss Government for project preparation. The mission promised to do all in its power to speed up this process so that the work could begin early in 1995.

105. Several actions have been initiated to follow-up the social assessment of the project. These consist of (a) a study of patterns of rural development and water supply in Uzbekistan, establishing regional differences and the sources of these; (b) a study of rural patterns of infrastructure development with a focus on water supply in Karakalpakstan and Khorezm; (c) a study of patterns of household utilization of water and willingness to pay for water and sanitation; (d) the establishment of a national/regional social science network to encourage community focus on water resources development in Uzbekistan[16]; and (e) to pursue efforts to save the cultural heritage of Karakalpakstan. The Terms of References for the socio-economic studies have already been prepared, the survey instruments have been designed and pre-tested and the core network has been established during the mission. Finalization of the studies are expected by February 1995 during which time the first general meeting of the regional network will also be held.

[16] Through a national network an Aral region wide network of social scientists will be promoted to enhance social and participatory content of development efforts in the region, including for the water and sanitation sector.

H. PROJECT PROCESSING SCHEDULE

Identification Mission	Sept 23 - Oct 15, 1994
Set up of Tashkent Project Office and Nukus/Urgench PPIUs	Feb 1, 1995
Carry-out Project Feasibility Study and Pilot Demonstration Program	Feb 1 - Nov 1, 1995
Preparation Mission	Feb 1 - Feb 15, 1995
Pre-Appraisal Mission	July 1 - July 20, 1995
Appraisal Mission	Oct 9 - Oct 31, 1995
Negotiations	Jan 5 - Jan 10, 1996
Board Presentation	March 1, 1996
Loan Effectiveness	May 1, 1996

ATTACHMENT 1

UZBEKISTAN WATER SANITATION AND HEALTH PROJECT

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ANNEX 1

EQUIPMENT TO BE PROVIDED BY CLIENT

	Tashkent Project Office	Nukus PPIU	Urgench PPIU
Specialist Equipment			
Computer workstations, 486	4	2	2
Laptop computers	2		
LAN Fileserver	1		
A4 Laserprinter	1		
Dot Matrix Printer		1	1
A1 Penplotter	1		
Digitiser	2		
Fax machine	1	1	1
A3/A4 Photocopier	1	1	1
Fax modem and software	1		
Uninterruptible Power Supply	1		

Software for computers including Wordperfect v5.2, Excell, Lotus 123, GIS software (to be specified), Virhunt anti virus, fileserver software.

Office Equipment

Desks
Chairs
Filing cabinets
Bookshelves
Telephones

Other
2 Nr. Vehicles

ATTACHMENT 2

ARAL SEA PROGRAM - PHASE I

Programme 5, Project Nr 1
Uzbekistan Water Supply Sanitation and Health

Supplemental Terms of Reference for Project Feasibility Study

A. BACKGROUND

a) The Project Area

1. The project area comprises the Autonomous Republic of Karakalpakstan and Khorezm Oblast, both within the Republic of Uzbekistan. The Republic of Karakalpakstan includes the southern Aral Sea and the Amu Darya delta and is the area of Uzbekistan most affected by the unsustained irrigation practices, seasonal variation in river flows and upstream discharges of polluted drainage water into the Amu Darya.

2. Karakalpakstan comprises 38% of the land area of Uzbekistan, but only a small proportion of the land area is inhabited, with only some 3% under irrigation. The remainder is desert, with little or no water resources and sparse nomadic population. The total population of the Republic is 1.38 million of whom 500 000 live in the six largest cities of Nukus, Khodjeliy, Takhiatash, Turtkul, Beruni, Kungrad and Chimbay.

3. While officially only 52% of the population of the Republic is rural, agricultural activities provide the basic income for a much larger percentage of the population. Even in the major cities of Nukus and Takhiatash, garden agriculture provides a major sources of livelihood to many households and, when connected to the piped system consumes a large portion of the available water. There are some 120,000 rural households, including those in small towns of less than 20,000; of these the great majority have poor access to water and no sanitation infrastructure.

4. Khorezm Oblast lies to the south of the Amu Darya river and its 12,000 km^2 are almost entirely under irrigation fed from the Amu Darya. The total population is 1.25 million of whom 150,000 live in the Oblast capital, Urgench. Agriculture is much more intensive than Karakalpakstan and village communities tend to be larger with the smallest having populations of around 5,000. There are several large towns with populations between 40 000 and 50 000.

5. Since the mid 1960s flows from the two rivers, the Amu Darya and Sir Darya, which discharge into the Aral Sea have been increasingly used for irrigation. At the same time much of the drainage water has flowed back into the rivers. The overall effect in Uzbekistan has been to reduce the flows in the Amu Darya and reduce the quality of the river water.

6. The project area lies at the downstream end of the water system of the Amu Darya. Over the last 30 years the annual discharge of the river to the Aral Sea has reduced from 32 to 4 km^3. At the same time salinity has increased significantly and during the Soviet period the amount of pesticides and fertiliser used on the irrigated lands were excessive even by Soviet standards. Since independence pesticide use has dropped dramatically and is now approaching international levels with the result that there is a reported improvement in river water quality.

b) Urban and Rural Water Supply

7. By early 1993 some 80% of the urban population and 29% and 54% of the rural populations of Karakalpakstan and Khorezm respectively had access to public water supplies. In the 1960s, when water quality in the Amu Darya was good, water was taken from the river at a point local to the community or from the irrigation canals. The rapid deterioration in river and canal water quality has forced the construction of major water supply schemes to try to maintain supply quality, although the new schemes do not extend to all communities, who must still rely on the old, often unsafe, supply arrangements.

8. Treated surface water, although meeting Uzbekistan's water quality standards, does not meet internationally accepted standards particularly with regard to turbidity and hardness. Other parameters for which the water may not meet standards are bacteriological content and pesticides. The present water sampling and testing regime is however unable to confirm or refute the current concerns regarding these parameters.

9. There are three main sources of potable water in the project area. Surface water is obtained from the Tuyamuyun Reservoir, the Amu Darya, and to a lesser extent from irrigation canals. The raw water quality in the Amu Darya fluctuates according to the water flow and the agricultural practices in the irrigated areas. Salinity decreases during the period of high river flow in the summer months of June to September and increases during subsequent low flow months, reaching a peak during December when fallow saline soils are washed out prior to the peak growing season. However pesticide and fertiliser use peaks during the summer months when there is considerably higher river flow so that the impact on river water quality is far less significant. This water is supplied to most of the large towns through the recently constructed and commissioned trunk main systems. Water from irrigation canals is used in rural areas where there are no alternative supplies.

10. Groundwater has been widely used for potable supplies for rural areas not covered by the surface water systems, either directly from freshwater lenses where river or irrigation canals flow across porous strata, or from deep wells which require desalination prior to potable use. The yields from individual systems varies from 5 m^3/day to 60 000 m^3/day for the larger aquifers adjacent to the Amu Darya and stretching for up to 40 km along its banks. Where there is ready access to the trunk main system the groundwater supplies are no longer used on a regular basis but are kept in reserve for emergency use.

11. The principal surface water source is the Amu Darya upstream of Khorezm Oblast, where the Tuyamuyun Reservoir has been created by construction of a barrage across the river. Three additional reservoirs have also been constructed for irrigation use although one of these, the Kaparas, with a usable volume of 750 M m^3, is being converted for potable use.

12. Two treatment plants have been constructed near Tuyamuyun to supply Nukus and Urgench respectively. Both plants have an output of 170,000 m^3/day and use two stage sedimentation followed by rapid gravity filtration and chlorination. Operation of the plants is hampered by lack of spare parts and shortages of chemicals. There is no treatment to remove pesticides that may be present in the raw water. Treated water is pumped 90 km to Urgench and 240 km to Nukus through 1000 mm and 1400 mm diameter steel pipelines respectively. The water is rechlorinated at Urgench and Nukus prior to being pumped into the distribution systems. At Nukus it is also booster pumped to other major towns in Karakalpakstan.

13. The Nukus plant is currently being extended to provide an output of 340,000 m^3/day and there are plans to extend this further to 540,000 m^3/day. For the first stage extension construction of three booster pump stations is proceeding slowly (only foundations are completed to date) on the existing transmission pipeline to increase the capacity of the trunk main to 340,000 m^3/day.

For the second stage extension a second pipeline of 1400 mm diameter is planned. It is also planned to double the capacity of the Urgench plant to meet the projected demand following completion of connections to the main trunk system.

14. At present the towns of Takhiatash, Khodjeliy, and Kungrad on the west bank of the Amu Darya in Karakalpakstan are supplied from a treatment plant owned and operated by Gasprom. The works has a capacity of 80,000 m^3/day and connections to other towns on the west bank from this system are planned or under construction. However, the two stages of expansion of the Nukus plant would allow all major towns and villages on both the east and west banks of the Amu Darya to be supplied from the Tuyamuyun Reservoir and a link pipeline between the two systems is planned.

15. Within Khorezm a trunk supply system is under construction and Phase I is almost complete. This will supply all the major towns of the Oblast. Secondary trunk mains and distribution systems are also planned to connect over 90% of the population to the Tuyamuyun system, but construction of these systems has not yet started.

16. Groundwater resources have been extensively investigated and mapped over the past 30 years. Approximately 84 areas where freshwater lenses exist within Khorezm and Karakalpakstan have been identified, and over 20 of these are being exploited at present, although often not efficiently. Research and pilot scale trials have also been carried out of artificial recharge of the lenses, and promising results have been obtained.

17. Boreholes of between 200 and 500 m depth have been drilled throughout Karakalpakstan to investigate the Aral Basin artesian aquifer's cretaceous sandstone deposits which underly the entire area. In general the water quality deteriorates from east to west: in the area east of the Amu Darya delta it is suitable for potable use after desalination, whereas to the west it is too saline for desalinators to be economically used (salinity varies from 25 g/l to over 100 g/l). In the irrigated areas to the east of the Amu Darya delta 155 Russian manufactured electrodialysis sets with a capacity of 50 m^3/day each (in two units of 25 m^3/day capacity) have been installed to treat well water with salinities in the range 2 - 3 g/l.

18. In Karakalpakstan water is distributed usually by piped systems in urban areas and farm centres, with final distribution being either by house connection in some cities and mostly standpipes and yard connections in other areas. Few standpipes or yard taps have satisfactory bases or drainage systems to ensure hygienic conditions in the vicinity. Pressures in the systems are variable and often the systems are only operating for a few hours each day, which leads to contamination of the piped supply by groundwater.

19. Many households within the piped water areas have no connection and those who do only enjoy yard connections. The main reasons for this are that: water is perceived to be more important for income generation (livestock production and garden agriculture) than for convenience of drinking and sanitation; houses are made of stabilized mud without sewerage or drainage and thus waste water handling causes inconvenience if connections are made to the homes; and water pressure is too low to allow its use within the household (yard connections are often made in the lower parts of the yard to allow access during hours when water is available).

20. The situation in Khorezm is somewhat better particularly as the population has significantly higher incomes. This enables them to construct brick houses which are suitable for house connections and internal plumbing, and the planned supply systems assume this mode of supply to households.

21. Responsibility for the provision of water supplies is divided between a number of Government bodies. Two organisations are responsible for the development of bulk water supplies from the Amu Darya at Tuyamuyun: Vodavod Tuyamuyun-Nukus and Vodavod Tuyamuyun-Urgench, who own and maintain the corresponding main conveyors, supplying bulk water to the two distribution organisations, Vodakanal and Agrovodakanal. The Vodakanal, under the Ministry of Urban Construction is responsible for the construction and operation of urban water supply systems and sewerage systems, and the Agrovodakanal (under the Ministry of Agriculture) for the rural systems. The Agrovodakanal has a branch in each rayon responsible for rural water supplies in the Rayon. The Hydrogeologic Expeditions, part of the Ministry of Geology, are responsible for groundwater exploration and development and monitoring. One Expedition is based in Nukus.

22. The quality of the water in rural areas is measured by the rayon Sanepid stations. They measure the quality of tapwater or well water at or near the point where it is consumed. For instance in the rayon of Chimbay (pop 84,000 of which 46,000 live in rural areas) Sanepid has 63 sampling points: 15 at the pumping stations, 18 in the rural areas, 29 in the city distribution system and one at the reservoir at the pump station. It is estimated that about 30% of these points are not used for various reasons. Samples are generally taken at 4 to 5 times a month, although the reservoir water is tested every day.

b) Urban and Rural Sanitation

23. Only two cities in the project area have a waterborne sewerage system with treatment facilities. Nukus has a recently constructed sewerage system which covers 70% of the town. Treatment is by means of waste stabilisation ponds with a capacity of 65,000 m^3/day discharging into the irrigation system through reed beds. Urgench has a sewerage system covering approximately 40% of the population, discharging to an activated sludge treatment works with a capacity of 80,000 m^3/day, although only the primary settlement stage has been commissioned at present. Sludge from the works is disposed of to drying beds.

24. There are no plans at present to extend sewerage systems in Karakalpakstan. However, sewerage systems are under construction in the towns of Khiva and Druzlba in Khorezm Oblast, together with wastewater treatment plants with capacities of 15,000 m^3/day and 11,000 m^3/day respectively. Both of these plants will have primary and secondary treatment and will be completed by 1995. The authorities plan to construct another 4 to 6 treatment plants of around 10,000 m^3/day to cover the major towns in Urgench.

25. The most common form of sanitation in Karakalpakstan is the unlined, usually unventilated, pit latrine, located approximately 15 to 20 metres from the house. These latrines are not normally situated in the vicinity of a well but are often close to ditches which allows bacterial contamination to spread throughout the vicinity, including areas around standposts. The pit latrines are emptied only in a few communities that provide a central service to this end. The pits are emptied by vacuum truck and the waste transported by truck and used as fertilizer. If such service is not available a new pit is dug when the pit is full. In some areas flush toilets discharge into unlined pits, providing a serious risk of aquifer pollution.

26. There is normally no water supply of any kind in the neighbourhood of the latrine that can be used for washing hands or cleaning the latrine. Latrines in public buildings in rural areas are no different, only larger and extremely unkept and extremely unhygienic. Most public buildings have simple hand washing basins somewhere at the entry. There is usually no soap available.

27. Contamination of piped supplies by human excreta from the pit latrines is common in

rural areas. The principal causes are the unlined latrines, high groundwater levels (less than one metre below ground) and a piped water system with leaks and intermittent pressures.

28. The sanitation in Khorezm is considerably better with the improved standard of housing and higher incomes, although some of the basic problems regarding siting of latrines persist. The use of flush toilets is common.

29. Sanitation is the responsibility of Vodakanal in the urban areas: no particular agency is responsible for this service in the rural areas.

c) **Health and Hygiene**

30. Karakalpakstan is one of the poorest regions in Uzbekistan, with a high birth and a death rate well over the average. The Karakalpaks also show high overall mortality rates and suffer one of the highest infant mortality rates (ranging from 51.4 per 1000 according to official figures and 92 according to studies undertaken by other demographers). A rapid rural assessment based on about 25 community visits, including four towns of 10-15,000 population and discussions with large number of households and neighbourhood groups revealed large scale poverty, especially in areas to the north and northeast of Nukus.

28. All households have access to multiple sources of water: hand dug wells, handpumps, irrigation canals, lakes and ponds, vendors as well as to public piped water; depending upon their safety some are used for drinking and others for other purposes. The intermittency of available tap water encourages use of unsafe sources of water. This multiple access to unsafe or uncontrolled water complemented by inadequate knowledge of water quality often hinder demand for safe water. Those who are most vulnerable, the children, carry the greatest risk and drink contaminated water directly from polluted sources.

29. Fetching and transportation of water is nearly universal in rural areas. Although the distances are not large, several trips have to be made to meet the most basic needs. The transportation and storage of water discourages its utilization for hygiene purposes and many households with a population of ten report using no more than 40-80 litres daily for human consumption.

30. Overall household sanitation conditions are extremely poor: latrines are badly constructed and maintained and are hardly used by the children; children play in yards full of animal excreta, waste water and other waste; water is rarely boiled or filtered and little care is devoted to ensuring that children do not drink directly from unsafe sources; and personal hygiene does not appear to be high in the agenda with relatively low attendance at public bathing facilities and use of soap. The closing of most public baths in cotton growing areas for nearly two months of the year attests to this. The lack of cleanliness in school latrines is yet another indication.

31. The awareness of the importance of personal hygiene in sanitation is promoted by the rayon health centres and by the rayon Sanepid stations. Each physician has the official task to participate in health education for four hours each month. Records are kept of these activities at the health centre in Nukus. The transfer mechanisms are lectures, public discussions, mass media, articles and epidemiological bulletins. The effect of this health education is impaired by the lack of reliable water supplies, since most programmes stress the use of water for personal hygiene. This education programme does not take account of the local drinking wate r supply situation.

32. The educational program "Make mothers more healthy" of the Ministry of Health has

proved more successful in this respect because the number of deliveries decreased from 27615 to 25120 (10%) and the number of abortions decreased from 3153 to 2559 (20%) in the period 1993-1994. This program apparently reaches the relevant group at risk in the population. This group of young women has also a key position if attitudes on sanitation in households are to be changed.

B. OBJECTIVES

33. The objectives of the project are

(i) to improve the present health conditions in the poorer areas through improvements in the water supply and sanitation facilities.

(ii) to upgrade and improve the reliability and availability of information on public health;

(iii) to ensure support for the project by involving local communities and non-governmental organisations in the planning and implementation of the project.

C. SCOPE OF WORK

34. The consultant should note that pilot projects related to the studies required under this assignment will be being carried out by others concurrently with this assignment. The Consultant should liaise closely with the other consultants to ensure that any data and experience from the pilot projects are reflected in the findings and recommendations of this study.

a) Urban and Rural Water Supply

35. The Consultant will develop a comprehensive strategy for providing short and medium term water supplies to the populations in the project area using all available resources and delivery methods. It is expected that the strategy will make use of surface water, shallow and deep groundwater and possibly desalination plants in specific areas. Delivery methods will range from full house connections in areas served by sewerage systems to handpumps in isolated areas. Maximum use should be made of local materials and expertise. The Consultant's tasks will include:

(i) Data collection and preliminary studies

Collect and evaluate data on existing water supply systems and their performance and current design standards and criteria. Assess the levels of service provided by existing water supply systems and impacts of intermittent supply on consumer demand and water quality at the consumer's tap;

Develop and agree with the Client design criteria for water supply and distribution, especially area specific water quality design parameters (eg salinity), population growth rates, realistic consumption levels, chlorination levels, distribution system operational philosophy (pumped systems or gravity storage), construction materials etc;

Carry out a broad assessment of the current condition of the existing water supply systems, determine the useful life of the system components and make recommendations

for any immediate rehabilitation measures needed. A more detailed assessment should be made of key assets such as the Tuyamuyun pipelines;

Establish current practice with regard to pipe material selection, assess the various alternatives available and their suitability for use in the project area and make appropriate recommendations;

Collect and evaluate data to establish current population distribution in the project area, settlements currently supplied with water and the sources of water, the layout of the existing secondary and tertiary systems and extensions currently underway or planned;

Study river flows and water quality in the Amu Darya River and demand patterns for the project area to confirm the suitability of the source and the need for additional offstream storage in the Kaparas reservoir for either quality or quantity reasons;

Investigate the present facilities for sampling and testing of raw and treated water and make recommendations for purchase of additional equipment or supplies and training of laboratory technicians as required;

Determine existing water demand and current supply. Assess the components of the water demand to determine the scope for reduction in demand for treated water by control of leakage and wastage, use of alternative sources for industrial and commercial use, etc. Assess the possibility of introducing demand management by metering, taking into consideration the results of the willingness to pay surveys;

Prepare water demand projections up to the year 2015 based on improvements to the present system and demand management that would be introduced.

(ii) Evaluate alternative supply mechanisms

Evaluate the performance of the existing treatment process at Tuyamuyun to determine what improvements need to be made to produce water quality to the agreed standards for the project areas being serviced. Investigate current operation and maintenance procedures and recommend improvements;

Develop a programme for monitoring of flows within the trunk main systems from Tuyamuyun to assist in assessing the system performance, together with flow and pressure metering. Determine the system capacity at present and with the planned improvements;

Evaluate the results of a handpump survey being carried out by others and use the results to assist in determining those areas where handpumps would provide a reliable safe supply of water;

Assess the shallow groundwater resources (up to 40 m depth) to confirm sustainable yields under natural conditions and with artificial recharge. Determine the potential for supplying the main trunk network with water from these resources;

Visit the EKOS desalination units to establish the operational condition and current performance of each plant. Assess the feasibility of repairing such units as are inoperable and of moving them to alternative locations in the event water from Tuyamuyun is made available to the area;

Determine locations where EKOS units are viable in terms of groundwater quality and distance from alternative sources.

(iii) Development of Supply strategy

Assess the appropriate levels of supply for various communities bearing in mind the long term nature of the investment in water supply and the changing economic and environmental circumstances of the area. Levels of supply are expected to range from full piped supplies in urban areas to handpumps from shallow aquifers in isolated rural areas;

Develop scenarios for maximising the efficiency of the Tuyamuyun schemes using alternative demands based on various forms of demand reduction and the levels of supply for different communities;

Evaluate the need for treated water storage to provide security of supply and to meet peak demands;

Propose a programme for study and implementation of a policy for reduction of leakage within the Tuyamuyun systems;

Develop regional schemes utilising the available water resources, both surface and groundwater to provide the population within the project area with access to safe drinking water supplies;

Assess the environmental impact of the proposed project following the financial and economic analysis, using standard World Bank guidelines.

(iv) Bid packaging

Assess local capabilities for supply of materials and provision of skilled and unskilled resources to ensure that their use is maximised during planning, design and construction;

Prepare bid packages for work that has been identified by the study. This will include design and further investigation work, purchase of imported materials and equipment and implementation of construction work such as borehole drilling and on-site sanitation.

b) Urban and Rural Sanitation

36. In conjunction with the health and water supply components the Consultant will identify the levels of sanitation appropriate for different parts of the project area and develop a strategy for implementing this. It is expected that for the majority of the area on-site sanitation will be most appropriate, but it is critical that decisions made relate to the findings of the socio-economic survey and have the support of the community. The Consultant will therefore:

(i) Data collection and evaluation

Determine areas currently provided with waterborne sewerage systems and wastewater treatment and any plans for extension of current schemes or construction of new schemes;

Establish the treatment processes currently in use and assess their suitability and effectiveness in the conditions of the project area. Assess the current operation and maintenance practices and make recommendations for any improvements that may be

needed;

Visit Vodakanal laboratories to determine what additional equipment or supplies are required to satisfactorily monitor the performance of sewage treatment plants;

Establish current sanitation practices in the remaining areas of the project;

Establish current methods of disposal of industrial waste, and any systems of monitoring and regulating discharges;

(ii) Development of Sanitation Strategy

Develop schemes for providing waterborne sewerage schemes to new areas only when necessary from a health standpoint (ie where house connections are planned or existing with no sewerage system);

Develop alternative sanitation standards for other areas taking account of the data from the socio-economic surveys carried out by others. Small scale sewage treatment plants using basic processes should be considered for hospitals and other institutions, septic tanks for health centres and public baths with improved latrines for domestic use. Consideration should be given to sanitation methods that permit the safe reuse of sewage as fertiliser for local use (e.g., through the use of composting latrines);

Formalise the standards and proposals in a sanitation strategy for the area with suggestions for further pilot scale projects if required and an implementation programme for the strategy.

(iii) Preparation of bid packages

Prepare bid packages for works identified during the study such as on-site sanitation construction, supply of laboratory equipment etc.

c) **Health and Hygiene**

37. Current health statistics, particularly infant morbidity and mortality, will provide fundamental information for targeting those areas most in need of water and sanitation improvements. At present the data system is of limited value due to adjustments which are made to the basic data at different levels of Government and the restricted availability of the data. In addition the current health education programme requires targeting more effectively, and personal hygiene awareness promoting. The Consultants will therefore carry out the following tasks:

(i) Improvement of Health Statistics Collection System

Collect and evaluate Government health data and assess the reliability of this data at rayon and Republic/Oblast level;

Examine the data reporting and compilation processes used and make recommendations for any improvements needed;

Visit Government laboratories responsible for bacteriological and virological testing and determine what additional equipment is required for the laboratories to function effectively;

Develop a computer based data reporting system that combines geographical health information with water supply and quality information on a monthly and seasonal basis at the rayon level.(The software and hardware components of the Geographical Information System will be made available to the Consultant);

Agree the parameters to be reported for water supply, sanitation and health with the Client;

Apply the reporting system to one rayon in Karakalpakstan and one rayon in Khorezm, and ensure the system satisfactorily integrates the available data;

Oversee the expansion of the system by local specialists to other rayons.

ii) Health Education Programme

Assess the present health and hygiene education programmes for effectiveness and develop new programmes that are related to the conditions in the project area using such elements of the existing programmes that are useful. The programme should be targeted at youths, girls and young mothers who are the groups most at risk from current poor hygiene in the project area, or likely to be most receptive to the education programme.

(iii) Personal Hygiene Development

The feasibility of improving public baths should be investigated based on the results of the socio-economic surveys and the pilot programme. The demand for such facilities should be determined and standard designs suitable for local construction prepared. Locations and numbers should be derived from the socio-economic surveys;

The Consultant should develop a programme for the school system which will include provision of safe water, adequate well constructed sanitation facilities and an education programme on personal hygiene.

d) Public Sector Management and Organisation of Water and Sanitation Services

(i) General

39. Development of urban water supplies and sanitation throughout the region is the responsibility of the Vodakanals, originally organized as part of the national water company, Uzvodakanal under the Ministry of Communal Services, but now under this same Ministry in the Government of Karakalpakstan. Piped water supplies in rural areas, particularly for agricultural cooperatives and state farms are provided by the Agro-vodocanals organized by the Ministry of Agriculture. There is an Agro-vodocanal in each rayon in the Republic, and an umbrella organization that provides overall coordination and other technical services.

(ii) Assessment of Organizational Structure, Administration, and Management.

40. While the least-cost strategy in the near term will involve both public and private investment in several different modes of water supply and sanitation depending on local groundwater quantity and quality, the long term goal is likely to be achievement of maximum feasible coverage by piped water supply. As this mode is the responsibility of the Vodakanal and Agro-Vodakanal (referred to in this document collectively as the Vodokanals), the Consultant should carry out a thorough analysis of the organizational, administrative, and management

constraints faced by the two organisations as well as their financial condition and capacity.

41. The period of rapid change since the separation of Uzbekistan from the Soviet Union has created new challenges for the Vodakanals at a time when they have been trying to introduce a new, higher quality water supply source, implement a major expansion of piped water supply, and introduce modern sanitation in the main city of Nukus. The present financial strains are expected to continue for some time, and mean that the organisations will have to become much more effective and efficient - in particular, maintenance will have to be more effective to extend the life and improve the performance of existing equipment and facilities, operations will have to be more efficient and lower cost, and financial management will have to be strengthened. The proposed Project should initiate the process of strengthening the organisations including necessary legal changes to increase the accountability and autonomy of the Vodakanals.

42. The Consultants will assess the adequacy and performance of the present organizational arrangements and related administrative and management systems to provide public water and sanitation services to rural and city households to an acceptable standard of service at reasonable cost. The Consultant will assess the adequacy and appropriateness of the existing organizational structure and staffing, particularly the number and types of skill available and how they are utilized, and the administrative arrangements for the smooth and effective functioning of the organization. The Consultant will make recommendations for the strengthening of each organization including organizational and administrative reforms, new management systems and procedures, improved incentives, staff and management training and capacity building, and organizational consolidation and streamlining. The Consultant should evaluate the rationale for separate organizations to serve the cities and rural areas, and identify structural reforms and economies of scale that could increase the efficiency and cost-effectiveness of services in both sectors.

43. The Consultant will assess the following four functions of the Vodakanals in detail: operations; maintenance; planning and financial management.

(iii) Operations.

44. The Consultants will identify the requirements for effective operation of each vodakanal's water production, treatment, and distribution systems, and waste water collection and treatment systems, and assess the performance of the existing arrangements for carrying out this function. In particular, the Consultant will:

> assess the present organizational arrangements for planning, budgeting, and administration of operations, the adequacy of present operational staffing including the numbers and availability of skills, availability and present condition of essential equipment, adequacy of monitoring programs and facilities, and the adequacy and general availability to responsible staff of up-to-date manuals and guidelines for sound operational practices, and make recommendations for essential improvements in each area as appropriate;
>
> analyze budget allocations and expenditures for labour, materials, energy, chemicals and supplies, and miscellaneous direct costs for operations over the last five years. To provide a comparison to past expenditure and a basis for estimating future operating costs, the consultants will make an estimate of the reasonable cost for operating the present system of each vodakanal. The Consultant will analyze the consequences of past shortfalls in budget allocation for operations, and make recommendations for improvements in cost accounting, planning, and administration that could ensure adequate

operations in the future.

(iv) Maintenance.

45. The Consultants will assess the organization and performance of the maintenance function. The Consultants will assess the present condition, and routine and periodic maintenance requirements, of the main features of each vodakanal's system. The Consultant will assess the adequacy of present organizational arrangements, budget and accounting systems and practices, staffing, equipment, and program to meet these requirements, and make recommendations for strengthening the maintenance function and improving its performance.

46. The Consultants will carry out a detailed analysis of budget allocations and expenditures for the past five years and compare these to an estimate of budget allocations needed to meet the maintenance requirement of the present system as determined above, identifying in particular expenditures needed for replacement, rehabilitation, and repair. The Consultant will also determine the additional budget needs for investments to be provided under the Project.

(v) Planning

47. The Consultants will identify the requirements for effective planning of the priorities to be set in the expansion of water supplies. These priorities must also depend on concerns other than technical and financial grounds. The Consultant will investigate the possibilities of integrating health and socio-economic aspects into the planning processes of the Vodokanals.

(vi) Financial Management.

48. The Consultant will assess the present system of financial management and accounting to determine the financial condition and capacity of the *vodocanal* to finance operations, maintenance, and investment, and to identify actions needed to improve financial management and financial sustainability. The Consultant will among others assess the following areas:

Revenues, Billings, and Collections. The Consultant will determine the source and magnitude of all revenues for the past five years including subsidies, collections, and other payments. The Consultants will collect, analyze, and present data on water produced and purchased, water sold, number of customers (collectives, state farms, households and population, industries, etc.) served, tariffs, billings, and collections for the past five years for each category of customer. The Consultant should also estimate the quantities of water lost and un-accounted for.

Cost Recovery, Tariffs and Affordability. The Consultants will collect data on the present system of water charges and tariffs, and describe the system for setting and adjusting tariffs. The Consultants will assess the affordability of present tariffs in terms of the ratio of projected monthly water costs to monthly income for domestic household consumers for different types and level of service. The consultant will analyse the present modes for the payment of water tariffs including indirect payment through collectives and state farms, and its effect on cost recovery and incentives for efficient water use. The Consultant will analyse alternative future tariff needs and structures taking into account affordability, systems of payment, O&M needs, and future investment needs, and recommend a system of setting and adjusting tariffs that is able to readily adapt to future favourable economic development and changes in income.

Assets and Debt. The Consultants will develop a current balance sheet for each vodocanal that identifies in particular the present working capital, accounts receivable including all arrears, and short and long term debt.

Cash Flow Model- Sources and Use of Funds. The Consultants will develop a cash flow model of the vodakanal that includes among other things all revenues including sales, and investment and operating subsidies, depreciation, investment including construction expenditures, equipment purchases, scheduled replacements and rehabilitations, cost of water purchased, debt service, and operation and maintenance. The Consultant will use the cash flow model to analyze the overall financial condition of the vodakanal for the past five years and to simulate its financial condition during the period of Project financing and beyond. Subsidies, grants and other transfers from local and central government should be separated or distinguished by purpose, i.e. for investment including major replacement and repairs, and for operation and maintenance.

Financial Accounting and Management Systems. The Consultant will assess the suitability of the present financial accounting and management systems including billings and collections, and determine reforms, improvements, and new procedures and systems needed to improve and maintain the financial condition and capacity of the vodakanal to implement the project. The Consultant will identify the type and specifications for the new systems and procedures needed, the policy and legal reforms required, and the staff training requirements to implement them.

e) Project Financial and Economic Analysis

49. The project must be capable of delivering improvements to water supply, sanitation and health at a cost that is affordable to the Government of Uzbekistan with maximum cost recovery from consumers. Use of local resources, both human and material, is to be maximised and the Consultant's scope of work will include:

Preparation of capital cost estimates for the alternative project components, based on world prices for imported equipment and services and local prices for locally available resources;

Calculation of operating and maintenance costs for the alternative projects, and preparation of whole life costs for the alternative project components to select the least cost option;

Confirming the economic viability of the project taking into consideration; increased income generated by Vodokanals by the increased supply of water. The assessment of future income must use likely future tariffs based on the willingness to pay survey and the financial requirements of the Vodokanals; the increased productivity and lower sickness costs for the population served; indirect benefits to the local economies resulting from improved infrastructure; and other benefits which may not be directly quantifiable.

D. SCHEDULE AND BUDGET

50. It is expected that the study will commence in March 1995 and will be completed in 9 months. The project budget is US$ 800,000 and the Consultant should indicate clearly in his

financial proposal whether he considers this sum sufficient for the scope of works requested.

E. PROJECT ORGANISATION

51. The Client has set up a Project Office in Tashkent to liase with the Consultant and two Project Implementation Units, in Nukus and Urgench.

52. It is expected that the Consultant will maximise the use of skilled local specialists and engineers in the study. It is envisaged that approximately 36 man months of expatriate input will be required to carry out the services and 100 man months of local technical staff. A working group (.....) has been set up to provide suitable staff, drawn from Government organisations with experience in the specialities required and of the project area.

F. FACILITIES TO BE PROVIDED TO THE CONSULTANT

53. The Client will provide the following facilities and services:

- assistance in obtaining visas and permits to enter the country and travel throughout the project area;
- exemption from all taxes, duties and imposts on equipment imported for the purposes of carrying out the study, and on payments made to the Consultant and his staff, including any liability to personal income tax.
- furnished office space in Tashkent, Nukus and Urgench suitable for up to 10 staff in each location;
- access to all reports and data relevant to the project. The Consultant should note that in most cases information will be in Russian;

54. In addition the Consultant will be provided free of charge the equipment listed in Annex 1 for use during the study. This equipment will revert to the Client on completion of the assignment.

G. REPORTING ARRANGEMENTS

55. The Consultant will prepare and submit the following reports:

Inception Report. This will be submitted 6 weeks after commencement of the study and will contain the Consultant's progress and findings to date. Its main function will be to confirm the staffing and programme for the project for the remainder of the study period and to identify any additional work or equipment thought to be necessary.

Interim Report. This will be submitted after 5 months. It should contain the results of the Consultant's investigations of the existing water supply and sewerage systems, preliminary findings relating to demand management and an outline of the work remaining to completion.

Draft Final Report. This will contain the results and recommendations for the whole study and will be submitted at the end of the 9 month study period.

Final Report. This will include any comments or amendments requested by the Client and will be submitted within 30 days of issue of comments on, or approval of, the Draft Final Report.

Monthly progress reports will be required to be submitted at the end of each month. They will contain a brief note of progress during the month, costs incurred during the month and on the study to date, project staffing, notes of any problems arising and the action needed from the Client to resolve these.

ARAL SEA PROGRAM - PHASE I

Programme 5, Project Nr 1
Uzbekistan Water Supply Sanitation and Health

Supplemental Terms of Reference

I Integrated Community Based Rural Water Supply, Sanitation and Health Pilot Demonstration Project

A. GENERAL BACKGROUND

1. The region of Karakalpakstan and the Khorezm Oblast of the Republic of Uzbekistan are amongst the poorest and most environmentally devastated parts of Central Asia. Karakalpakstan with an area of 165.000 km2 is inhabited by 1.3 million people, which live almost exclusively in the towns and communities situated in the irrigated areas, or one third of its surface area. The remaining two thirds are the Kyzylkum, Karakum and Ustjurt deserts. The Amu Darya river carrying water derived from the Tien Shan mountains in the distant east, forms its delta in Karakalpakstan and discharges in the southern Aral Sea. Water use principally for electricity generation and irrigation development (cotton, rice, wheat) has reduced considerably the riverflow and has led to a dramatic drop of the Aral Sea level.

2. The arid climate and the vast expanse of irrigated agriculture have led to soil salinization, surface and groundwater water quality deterioration. This combined with both the effects and the remnants of a highly centralized plan economy have contributed to the poverty and poor health of the Karakalpak population, in particular its rural population.

3. A project to improve the water supply, sanitation and health of the population of Karakalpakstan and Khorezm Oblast was identified as part of a wideranging package of projects prepared by the donor community in support of the Aral Sea disaster zone. Project identification in October 1994 led to the formulation of two concurrent project activities; one, the project feasibility study as precursor to a large scale investment in the rural water supply, sanitation and health sector, and two, the present demonstration project serving to test methodologies and to immediately improve the lot of some, albeit a few, rural dwellers.

B. PILOT DEMONSTRATION PROJECT BACKGROUND

4. Large scale investments in the provision of rural water supply and sanitary facilities and related health activities are proposed for the Karakalpakstan Autonomous Republic and Khorezm Oblast with the aim of bringing about an improvement in the health and living conditions of the affected population.

5. In support of and concurrent with the feasibility study for this project, a pilot demonstration project is proposed to test the latest concepts and lessons learned from community based rural water supply, sanitation and health activities elsewhere in the world. Various initiatives will be developed and their applicability examined involving all stakeholders in the sector, such as the beneficiaries, the local authorities, NGO's, professional agencies, and entrepreneurs.

C

6. Project demonstration serves to examine those components of the project which require relatively small investments, but are believed to have a maximum positive impact on the living conditions of the community concerned. Examples are provision of clean water from handpump wells or small groundwater based schemes which are properly located and built, improved latrine design and construction, hygiene education on water-health relationships, income generating activities, initially those related to project related activities such as: pipelaying, slab production, handpump production, repair jobs, etc.

7. Included in the demonstration project will be a trial with a rural credit facility, similar to those which have proved very successful in South East Asia, Albania and Mexico in boosting rural incomes and ability to pay for public services. Alternatively, a separate study may be carried to determine the feasibility and design of small scale village credit schemes specific for this area, providing the community level modalities for this demonstration project.

8. The demonstration activities must necessarily be small scale and test particularly those elements of project design and implementation in which stakeholder participation is most needed. Project design and implementation activities to be included in the follow up related to large scale investments such as the expansion of the surface water transmission pipeline, treatment and distribution infrastructure, or the construction of sewerage systems, as may be appropriate for the larger communities, will not be included in the demonstration project.

9. The demonstration project area will be identified in two rayons of Karakalpakstan and Khorezm from an inventory of a limited number of rayons expressing interest in participating in the demonstration programme. A community will then be selected communities in each rayon according to criteria discussed below.

C. OBJECTIVES

C.1 General Objectives

10. The general objectives for the demonstration projects are to:

a. improve living conditions for the selected communities through the provision of clean water, sanitation, health education and rural credit
b. test and improve project methodology
c. show immediate and active involvement of the international community with the population of Aral Sea Disaster Zone

C.2 Specific Objectives

11. The objectives of the project are to:

a. maximize community participation and involvement of the local authorities in the design and implementation of water supply, sanitation and health education in rural areas, to improve project design and to increase community understanding of the value of clean water and of the relation between poor sanitation and hygiene conditions and ill health, especially for children
b. boost rural incomes through the local contracts to install water distribution systems and sanitation facilities, and
c. to make it possible for even the poorest households to generate additional incomes through community based credit schemes.

D. SCOPE OF WORK

12. The demonstration project primarily serves to develop a correct project approach. All activities and tasks outlined below, although they are described as sharply distinct issues, must be developed simultaneously and in an integrated manner. The project must be guided by the demand of the population, and shall involve local capacities and local materials to full extent. The role of the Consultant is referred to explicitly in the following sections, but should, in fact, be no more than that of a facilitator.

13. Main issues at stake are:

Community Development	
. Communication model	How to develop a relationship between the beneficiaries, the community worker, and the (distant) PIU and other authorities?.
. Beneficiary confidence	How to gain confidence from the beneficiaries? What makes this project different from faltering government involvement in the past?
Water Resources Assessment	
. Well siting (handpumps)	What need beneficiaries know to site themselves? Can a community member be trained to reliably locate wells and assist others?
. Well siting (subm.pump)	Is the Hydrogeological Expedition equipped to do a good siting? Is technological backstopping desirable (software, training course)?
Low Cost Water Supply	
. Handpumps	Can designs be upgraded with local materials and fabrication capacity? If not, what to import? Can people install and service handpumps themselves? Is there scope for private enterprise? What affordable handpump base and spillway to use? Will people pay for private pumps installed?
. Supply system	How can people be made to feel it is their system? Will they contribute to it? Can a flat rate be introduced based on metering at pump? How to overcome freezing pipes in winter?
Low Cost Sanitation	
. Latrines	What design is best (local material use; high groundwater table). How best to raise people's interest? What is affordable? Scope for private enterprise?
. Septic tank	What design (see above)? Affordable? Private interest? Private enterprise development?
Public Health	
. Health Awareness	Innovative ways to attract attention?
. Public Baths	Project involvement feasible? How to obtain increased beneficiary interest? Scope for private enterprise?
. Health Statistics	Automatization sustainable? Data dissemination feasible?
Rural Credit Facility	
. Credit	Revolving fund type of set-up? Credit-worthiness of recipient? Best income generating activities? What investments to support? Credit conditions?
. Repay default	What guarantees? Are there sanctions?

14. Quantifiable **targets** for project demonstration are not easily set. Development of an integrated project methodology largely based on self propagation is the fundamental issue. Yet, targets proposed are:

. communities involved	2
. handpumps installed	50
. supply systems constructed	2
. latrines constructed	50
. septic tanks constructed	4
. bathhouses refurbished	2
. health awareness campaigns	2
. rayon health statistics automated	2

E. ACTIVITIES AND TASKS

Community Development Activities

15. At the onset of the demonstration project the Consultant shall design and implement an inventory of a limited number of communities in one pre-selected rayon for each sub-area (Karakalpakstan and Khorezm). On the basis of approved criteria pre-set by the Consultant one community will then be selected for the demonstration per sub-area. The inventory results and subsequent analysis must be reported. The Consultant is to specify on the basis of which criteria community selection is to be made early on in the assignment. Criteria such as current water supply, sanitation and health situation, community organization and leadership, community dynamic, interest in improving basic infrastructure, willingness to contribute to project implementation, availability of water resources, distance to Nukus etc. all come into play.

16. Preceding and concurrent with the community inventory, the project demonstration methodology is to be further adjusted, and readjusted as appropriate during the demonstration period. The principal points of departure in project demonstration are:

- . community initiative
- . full beneficiary involvement
- . small scale intervention
- . maximum impact
- . nominal cost recovery
- . maximum local professional and other staff input
- . private enterprise development

17. After community selection has been made, an organizational relationship between the PIU, the Consultant, the authorities of the selected communities, the beneficiaries, beneficiary representatives, and third parties (such as NGO, and other subcontractors) must be finalized and agreed upon. Appropriate lines of communication between the Consultant and the beneficiary level must initiate and strengthen to reach a high level of confidence. Community workers are to be assigned as moderators to guide demonstration project development at the community level. The Consultant shall see to it that moderators are suitably qualified by attitude and experience to fully appreciate their role. Awareness both at conceptual as on practical level should exist on the project aim and implementation modalities. Insight in rural poverty, water - waste - health relationships, gender issues, women and child care, domestic and personal hygiene are required.

18. Community development activities are geared towards awareness raising and demand creation for all actions subject of this project. Project demonstration is to be demand driven ensuring beneficiary involvement and thus a willingnes to contribute in kind or pay. For communal systems (piped supply, schoollatrine) a fee collecting system is to be devised and introduced by the Consultant, to offset operation and maintenance costs. Cost recovery for capital investments are unlikely to be supported by the communities. For privately owned and used facilities installed by the project cost recovery should be unconditional. Follow up or re-attendance of the beneficiaries ultimately leads to behavioural adjustment towards domestic and personal hygiene (continued use of safe water source, continued use and cleanliness of latrines, etc.).

19. The Consultant shall propose a systematic and well structured approach to project demonstration, highlighting the community development activities, and the role of the moderators. They are to ensure that all interventions at community level are properly planned and executed from the point of view of project - community relations, and are given the correct follow-up.

Water Resources Assessment

20. There are ample groundwater resources in the project area. The restriction to groundwater use is the quality of the water, which is often mineralized and/or polluted. The surficial alluvium of the Amu Darya Delta consists of up to 40m thickness of sands with clay lenses with transmissibilities of 300 to 1000 m2/d and water quality of 0.5 to 2.0 g/l. Well discharges may reach 25 m3/h. In the immediate viscinity of the Aral Sea (may now be several 10s of km) water has 20 to 50 g/l TDS. Of the underlying rock, the Cretaceous sandstones have been extensively used for water supply. Nearly all wells of 200 to 400 m depth are artesian freely discharging water at the rate of a few l/s up to 20 l/s of 1.5 to 4 g/l, but reaching 35 g/l in places. For these wells desalinization plants are in common use. It is not proposed that this project be involved with deep well drilling.

21. Aquifers are replenished from the nearby Amu Darya or irrigation canals. The surface water is known to contain fluctuating saltlevels as a result of the arid climate and the irrigation activities, as well as pesticides, insectides, defoliants, etc. which may exceed water quality standards. No data are available on traces in groundwater.

22. The Consultant must carry out some 50 appropriate water resources studies to ensure that minimal risk of contamination occurs. He will therefore collect, analyse and report on the regional and local hydrogeology. The hydrogeological siting of up to 50 handpump wells should be in balance with the minimal capital investment. Wells with a higher capacity require separate reports. Prudent well siting for the construction of 2 schemes is imperative to ensure that the water quality remains acceptable, also when surface water quality deteriorates (after field flushing, and during low flow). It is therefore necessary that the Consultant checks water quality for those parameters which he considers determinant for public health. Salinities above 1 g/l are not formally accepted in Uzbekistan, but guideline values exceeding this norm can be considered.

Low Cost Water Supply

23. Throughout the irrigated areas of the project area the communities which have an unreliable or no water supply system use water from nearby canals or ditches, shallow dug wells or drilled wells equipped with hand pumps. There is no inventory of existing handpumps, but the total

number was said to be high. Pumps are of very simple design, local production and low cost. Such wells and handpumps are built at the people's own initiative and expense. Based on field visits it was found that the water quality is unlikely to meet quality guidelines principally due to inadequate design of the well, the handpump and the spillwater drainage infrastructure. Currently, an international charity organization with the assistance of the Karalkpakstan Hydrogeological Expedition is implementing a shallow wells program. Water quality is generally found to be in accordance with quality guidelines with TDS of 0.5 to 1.5 g/l. Nitrate values, however, are not determined.

24. The Consultant must ensure that designs, construction materials, pumps, pipes, etc. are of proper standard. This need not imply that locally built handpumps need to be rejected off hand, but the introduction of distinct, extensively tested suction or direct action handpump must be considered. The possibility of local handpump production (improved local or foreign design) and sparepart supply is an aspect which the Consultant in close liaison with the PIU will needs to report on.

25. As an alternative and complement to handpump installation, two small scale groundwater based water supply systems are foreseen to be constructed. Some 220 wells are in operation in Karakalpakstan (150) and Khorezm (70). All were recently surveyed. These wholly or partly supply tens of towns and villages from a 30 to 40m deep aquifer. Water quality of these wells varies from 0.5 to 1.5 g/l but may rise to 3 to 5 g/l. The higher values occur when water is drawn from the less permeable alluvium (silts, clays), and at greater distances from the irrigation canals. The water then becomes more alkaline and contains higher levels of SO4 and Cl. For low abstraction rates, of say 2 to 4 m3/h well sites should be relatively easy to locate.

26. The Consultant must locate, design, and implement two of these systems using to full extent local capacities and ensuring beneficiary involvement. Prior to construction work, proposals from the Consultant on the most appropriate design (communal taps, yard connections), water metering, water pricing, cost recovery, and water quality control must be discussed, adjusted and agreed upon with all stakeholders. As an alternative, and depending mostly on the community selected, the rehabilitation of an existing water supply system can be considered.

Low Cost Sanitation

27. The overall household sanitation conditions are extremely poor. Latrines are badly constructed and maintained and are hardly used by the children, which play in yards full of animal excreta, waste water and other waste. Personal hygiene does not appear to be high in the agenda with relatively low attendance at public bathing facilities and use of soap. The closing of most public baths in cotton growing areas for nearly two months of the year during harvest attests to this. The lack of cleanliness in school latrines is yet another indication.

28. Pit latrines are in common use and situated at some 10 to 15m from the house. They are of poor design, unkept and notoriously unhygienic. Communal ones can be equally poorly constructed and kept, and cannot but invite to defecate in a ditch. Latrines in public buildings in rural areas are no different.

29. The Consultant must introduce an improved latrine design, and where suitable the design for a sceptic tank. The latter may apply to a rural clinic, or in case of private interest, a cluster of permanent houses. The Ventilated Improved Pit latrine and the double shaft latrine, which permits waste to ferment to fertilizer, are of special interest. High watertables fluctuating between

0.5 and 3.0m depth, however, are a point of special attention. Construction work to standard designs can be contracted out to interested local builders. It is of interest to promote businesslike interventions, and the Consultant is to assist the appointed builder in market development, quality standards, etc. when necessary.

Public Health Activities

30. Karakalpakstan is one of the poorest regions in Uzbekistan, with a high birth and death rate well over the average. The population show high overall mortality rates and suffer one of the highest infant mortality rates (ranging from 51 to 92 per 1000 depending on the source). Enhanced information communication on domestic and personal hygiene with particular emphasis on the relationship water - sanitation - health, is likely to generate the demand for safe water and improved sanitary facilities, and ultimately, i.e. when behavioural changes take place, have a positive effect on the health status of the rural population. Health education and awareness raising is, in fact, regarded as one of the best cost effective prophylactic against diarrhoeal diseases.

31. The Consultant is to set up and supervise a health education campaign. This campaign if it is to be successful must evidently be accompanied by the provision of improved basic infrastructure. Public awareness raising has formed part of the authority's approach to improve the population's health status. Other, possibly innovative approaches must be used to recapture attention of the community, this may lead to sub-target group specific products (discussion groups for mother's with infants, videoclips for teenagers, etc.). Public bathhouses can be found in most communities but their effectiveness leaves to be desired. Privatization of these facilities is ongoing. The Consultant is to assess their operation and propose a program for service improvement, bearing in mind that entry charges remain within reach of the overall community.

32. Furthermore, the Consultant is requested to support the automatisation of health data handling, processing, and dissemination in order to increase data access and understanding, and to facilitate timely responses to changes in the incidence of particular diseases and death rate. This is to be done for the rayon in which the two selected communities are situated. The data reporting and handling system must be evaluated, and proposals may be made to increase reliability. On the basis of the health statistics, the Consultant is to explore the relationship between health and non-piped supplies of drinking water.

Rural Credit Facility

33. The single most important problem faced by the majority of the rural households is the lack of food. With practically no income received from their labour from the State Sector for the past many months, most households are in need of flour. Since few have cash, farmers' ability to sell small quantities of vegetables and animal products is also hindered. Lack of capital, even as small as to allow purchase of tools for repair jobs or a few meter of plastic to start a green house, make it impossible for the rural poor to create alternative income earning opportunities. There is therefore a high demand for small scale credit for home based or local income generating investment and activities.

34. The Consultant is to propose a suitable set up for small rural credits, either based on modalities of a purpose made study, or tuned to reported experiences from elsewhere (Bangladesh, Indonesia, Albania, Mexico) for similar credit facilities. Since project duration is limited, the Consultant should take care that any proposal suitably covers the post-demonstration period.

Activities will evidently be limited to the selected project demonstration. Once formal backing is granted, these activities will be implemented in a fitting organizational set up, and supervised by the Consultant.

F. SCHEDULE AND BUDGET

35. It is expected that the study will commence in February 1995 and will be completed in 9 months. The project budget is US$ 370.000. The possibility for extending the project period to bridge the gap between demonstration and actual large scale replication will be determined in the light of the impact of project demonstration, extension proposals and appertaining minimum costlevels.

G. PROJECT ORGANIZATION

36. The Consultant will work under the direction of the Government's Project Implementation Units (PIU) installed in the offices of the Ministry of Water Management based in Nukus (Karakalpakstan) and Urgench (Khorezm). The Consultant in performing his duties will closely liaise with the PIU and with other related project activities implemented by the PIU, such as the concurrent project feasibility study.

37. Principal liaison between the Consultant and the communities form the PIU and the regional and local authorities mobilized by it, as well as a suitably qualified NGO to which much of the community development activities is to be subcontracted. For local consultancies and contracting activities the Consultant is to approach qualified institutions or individuals, who will work under his guidance as subcontractors or staff. The Consultant must accept responsibility for the quality of the studies and works implemented under his supervision.

G. FACILITIES TO BE PROVIDED TO THE CONSULTANT

38. The Client will provide the following facilities and services:

- assistance in obtaining visas and permits to enter the country and travel throughout the project area
- assistance in the duty and levies free importation of personal goods and project equipment
- furnished office space in Nukus and Urgench suitable for up to 4 staff in each location.
- access to all reports and data relevant to the project. The Consultant should note that in most cases information will be in Russian

H. REPORTING ARRANGEMENTS

39. The Consultant will present his findings in the four following ways, notably:
- workshops: Inception (after 6 weeks of project start)
  Intermediate (after 4 months)
  Final (after 8 months)
- monthly progress briefs
- technical briefs per project activity

- final report on project methodology, achievements, and recommendations for the large scale replication

Under direction of the PIU, the Consultant shall organize the mentioned workshops and promote participation of stakeholder representatives.

ARAL SEA PROGRAM - PHASE I

Programme 5, Project Nr 1
Uzbekistan Water Supply Sanitation and Health

Supplemental Terms of Reference

II Effective Operation and Maintenance of Small Scale Desalinization Units Pilot Demonstration Project

A. BACKGROUND

1. In Karakalpakstan 310 Russian made desalination units (EKOS) based on the principle of electrodialysis are installed in 155 containers at 80 village sites to desalt brackish (up to 6 g/l deep well water (300-400 m depth)for household supply. These units are designed to reduce salinity below 1 g/l. The first units were installed in 1989 and the last in 1993. Each unit has a capacity of 25 m3/day, consequently the total design capacity amounts to 2.8 million m3/yr.

2. In areas to be serviced by the Tuyamuyun-Nukus water supply network these desalination units are considered to be a temporary solution and it is planned that they will only serve as a stand-by supply incase the main system fails. However, in other areas not served by this network, especially the areas in the northern delta region, some rural populations will continue to be served by these units. The performance of these units suffers seriously from a lack of spare parts and poor operation and maintenance conditions.

3. Approximately 54,000 people living in rural areas are supplied by desalted water. This represents 8% of the rural population of 713,000. In total approximately 342,000 rural people (48%) have access to public water supplies.

B. OBJECTIVES

4. The objectives of the demonstration program are to:

(a) evaluate the performance of three test desalination units under well defined and controlled conditions and to identify the necessary conditions for proper operation and maintenance of the units;

(b) assess the performance and condition of a representative sample of units that will continue in operation for at least several years to determine the need for rehabilitation of these units and the overall cost of this rehabilitation program;

(c) make a detailed estimate of operation and maintenance costs for these units from the data collected in the test program (a) described above.

C. SCOPE OF WORK

5. In order to achieve objective (a) it is proposed to carry out the following activities:

Three existing operating units, which will need to be operated for at least 5-6 more years will be selected for the test program. If possible the three sites will be representative of low, medium and high salinity ground waters. Prior to the start of the program these units should be brought into full operating condition with the replacement of inoperating, missing or damaged parts. In addition it will be necessary to purchase and install metering equipment as follows:

(i) water meters for product and raw water;

(ii) conductivity meters for product, raw and (brine) waste water;

(iii) kWhr meter; and

(iv) Multipen strip recorder(s) for the above, or a small computer to serve the same function.

6. Daily operating logs should be kept by the operators to record the performance of the units in relation to the following:

- percentage salt removal;
- energy consumption/m3 water produced;
- salinity of product water;
- total production of water/day;
- percentage conversion;
- frequency of reversing polarity;
    - downtime for cleaning and maintenance;
    - description of maintenance activities and parts replacement or repair;
    - etc.

7. The units should be operated on a continuous basis for the six month test period, except for downtime due to maintenance. Moreover, they should be operated and maintained according to the manufacturer's operating and maintenance instructions. If improved operating and maintenance procedures have been developed these should be tested and the results recorded in the operating logs. Operators should be trained in all aspects of the test program and required to carefully follow all instructions. Their performance should be regularly monitored and evaluated during the test period and also recorded by the test supervisors.

8. In order to accomplish objective (b) it will be necessary to select and visit a representative sample of sites that will continue operation during the period of implementation of the main project and for the future in order to obtain the following information:

- analytical results for salinity of product, raw and waste water over the operating life of the unit;
- estimates of energy consumption/m3 of product water
    - estimates of the quantity of product water/day;
    - frequency of membrane cleaning and maintenance;
    - frequency and causes of membrane and electrode replacement and that of other relevant parts such as: pumps, motors, rotameters, electrical switches, etc;
    - inventory listing non-functioning, missing and damaged parts requiring

replacement;
- etc.

9. From the above survey propose an inventory of spare part purchase and a parts replacement program to be implemented under the main project. In order to accomplish objective (c) it is proposed to carry out the following activities from infomation obtained under (a) and (b) above:

- from recent cost data provided by parts suppliers estimate the cost of replacing damaged or non -functioning parts in units, which will continue operating in the future and compare the cost with that of using parts from units which are no longer required for continuous opertion;
- from the test program results prepare and cost a program of operator and maintenance personnel training as well as an estimate for upgrading the units with better monitoring facilities to improve operator performance and supervision;
- provide a detailed breakdown of maintenance and operating costs;
- from the above analysis and data from the test program estimate the maintenance and operating costs/m3 product water for the range of raw water salinities treated by the three test units.

D. REPORTING

The following reports should be prepared:

(i) A report on the results of the test program with recommendations for improving the operation and maintenance of these units and their overall performance; and

(ii) A report (including costs) of a spare parts replacement, desalination unit rehabilitation and personnel training program that will be required during the implementation of the main project, including upgrading of these facilities to improve their operation and supervision;

(iii) Two one day workshops are to be organized for managers and specialists on project approach and findings.

E. SCHEDULE AND BUDGET

It is expected that the test and analysis program will take approximately 6 months to implement following an initial 2 months for program definition, purchase of equipment, training of test plant operators and survey personnel and other start up activities. The following is the budget estimate for this pilot project:

		US $	
•	Foreign expert		
	. Water Quality Adviser (1.25 m-m)	17.600	22.000
•	Local expert		
	. Water Quality Adviser (3.0 m-m)	1.600	4.800
	. Plant Operator 3 No. (9.0 m-m)	400	10.800
•	Equipment		
	. Spare parts for 3 units	lump	15.000
	. Monitoring equipment	lump	5.000

•	Expenses		
	. Foreign accommod. (1.0 month)	500	500
	. International airfare (3)	2.200	6.600
	. National airfare (3)	200	600
	. Miscellaneous expenses	lump	2.000
•	TOTAL COST		67.650

INTEGRATED COMMUNITY BASED RURAL WATER SUPPLY, SANITATION AND HEALTH PILOT DEMONSTRATION PROJECT PROJECT COST

Post	Foreign (F) or Local (L)	Rate/month (US$)	Input (months)	Total (US$)	Remarks
Project Manager (Urgench)	F	16000	9	144000	Hydrogeology
Community devt. advisor	F	14000	2	28000	
Water quality specialist	F	18000	1	18000	
Mechanical Engineer	F	14000	1	14000	Handpump production
Hygiene advisor	F	14000	1	14000	
Sub-total			14	218000	
Deputy Project Manager (Nukus)	L	600	9	5400	Hydrogeology
Community devt. advisor 1	L	600	9	5400	
Community devt. adviser 2	L	600	9	5400	
Mechanical engineer	L	600	4	2400	Handpump production
Water quality specialist	L	600	2	1200	both areas
Physician 1	L	600	2	1200	
Physician 2	L	600	2	1200	
Civil Engineer	L	600	2	1200	
Audio-visual adviser	L	600	2	1200	both areas
Moderator 1	L	600	6	3600	
Moderator 2	L	300	12	3600	
Support Staff (6 No)	L	100	36	3600	2 drivers, 2 secretaries, 2 translat
Sub-total			98	35400	
Total staff costs				**253400**	
Equipment, Materials, etc.					
PIU Office equipment		lump		1000	
[illegible]		lump		1000	
Handpumps		50	50	2500	
Submersible pumps		3000	4	12000	2 boreholes
Storage tank, pipes, etc		7500	2	15000	
Drilling, building subcontracts		lump		10000	
Total eqt, materials,etc.				**59500**	
Expenses					
Foreign accomodation		500	14	7000	
Airfares to Tashkent		2200	8	17600	
Local airfares		180	20	3600	
Office costs		1000	18	18000	2 offices
Miscellaneous		lump		10900	
Total expenses				**57100**	
Total cost				**370000**	

Project Preparation cost

Post	Foreign (F) or Local (L)	Rate/month (US$)	Input (months)	Total (US$)	Remarks
Project Manager	F	16000	9.0	144,000	Water supply
Sanitation Engineer	F	14000	8.5	119,000	Sewerage
Hydraulic Engineer	F	12000	4.0	48,000	
Hydrogeologist	F	16000	3.0	48,000	
Water treatment specialist	F	16000	1.5	24,000	
Desalination specialist	F	18000	1.0	18,000	
Hygiene adviser	F	14000	2.0	28,000	
Community participation advisor	F	14000	2.0	28,000	
Financial analyst	F	20000	3.0	60,000	
Management specialist	F	16000	4.0	64,000	
Sub-total			38.0	581,000	
Senior water supply engineer	L		15.0		
Senior sewerage engineer	L		12.0		Mostly in Lig each
Senior hydrogeologist	L		6.0		
Water supply engineers	L		16.0		2 each at...
Sewerage engineers	L		12.0		Mostly in Lig each
Asst engineers	L		20.0		
Costing engineers	L		8.0		
Total local professionals		600	89.0	53,400	
Other staff	L	30%	108.0	32,400	2 drivers, 2 secretaries, 2 translat
Total staff costs			286	666,800	
Expenses					
Airfares to [illegible]	No	2200	15	33,000	
Local airfares	No	100	60	6,000	
Office expenses	Month	400	15	1,800	2 offices
Printing of reports	Sum			12,000	
Field expenses	Day	25	270	6,750	
Miscellaneous				10,000	
Total expenses				**137,150**	
Total cost				**803,950**	

ATTACHMENT 5

UZBEKISTAN WATER SUPPLY SANITATION AND HEALTH

Equipment required for Project Office, Project Preparation Implementation Units and Consultant's use

Computers and associated equipment

PC Workstation, 486 processor, 25 MHz	16 Nr
Laptop computers, 486 processor	2 Nr
LAN Fileserver	1 Nr
A1 Digitiser	2 Nr
A4 Laserprinter	2 Nr
Dot Matrix printer	4 Nr
A1 penplotter	1 Nr
Fax modem	2 Nr
Fax machine	6 Nr
A3/A4 Photocopier	4 Nr
Uninterruptible Power Supply	3 Nr

Software

Software for computers including WordPerfect, Excell, Lotus 123, GIS software (to be specified), Virhunt.

Miscellaneous

Set flow and pressure measurement equipment 1 Nr

Spares and service for equipment, paper for copiers and printers, annual license fees for software etc

Transport 2 Nr vehicles

Estimated cost **US$ 140,000**

ARAL SEA PROGRAM - PHASE I

Programme 5, Project Nr 1
Uzbekistan Water Supply Sanitation and Health

Supplemental Terms of Reference

III Hand Pump Monitoring and Data Base Creation Pilot Demonstration Project

A. BACKGROUND

1. A large proportion of the rural population in Karakalpakstan and Khorezm rely on hand pumps for their primary drinking purposes. A far larger percentage use hand pumps for home based agricultural and livestock production. Thus, household reliance on hand pumps is critically related to rural incomes and family subsistence. Many of the existing hand pumps have been installed by the government; however, it appears that yet a larger percentage is installed and fully financed by the households themselves at their own initiative. At the same time, many hand pumps which have been privately installed serve a community of people and arrangements for their maintenance are easily made.

2. Preliminary field observations reveal that self-installed hand pumps are perceived as safe by the users and are well maintained. In contrast, there appears to be greater efficiency in the management of the government installed hand pumps. However, self installation of hand pumps without adequate control and monitoring of water quality poses potential risks. There is, therefore, need to establish working conditions and the water quality of existing hand pumps, understand the current formal and informal arrangements for their maintenance and operations and incorporate emerging lessons to an overall strategy of water resources management for the rural areas concerned.

B. OBJECTIVES

3. The key objectives of the monitoring program consist of the following:

(i) To create a data base for the existing hand pumps by using data available through the PreAralia Hydrogeological Expedition and by questioning of local population;

(ii) To prepare a standard questionnaire to be filled in during household visits including information of household demand for new hand pumps, willingness to improve existing installation and/or preferences for shifting away from the hand pump system;

(iii) To establish the operating conditions of hand pumps and gather household and community based data to analyze differences in operating conditions; to find out the reasons of breakage of the pumps and to determine possibilities of repair;

(iv) To collect samples for laboratory examination and quality control; and

(v) To determine the methods through which households and communities establish drilling points and to uncover implications of these. Provide the data as necessary to allow public

education and outreach programs to incorporate specific messages to avoid the potentially hazardous implications of further utilization of these methods.

C. TASKS TO BE PERFORMED BY THE CONSULTANTS

(i) To establish an inventory of existing hand pumps through use of available data;

(ii) To sample 500 hand pumps for monitoring. For this purpose, visit a sample of rural communities, inspecting equal numbers of hand pumps installed by the public and private sectors;

(iii) design and pre-test a comprehensive user questionnaire;

(iv) To measure water characteristics using spectrophotometer and other devices, existing in the UAAP[1]. Establish quality of water and seasonal variations over a period of time;

(v) To create a data bank for the hand pumps under monitoring for long term monitoring purposes, inputting household and community based information as well as the results of chemical tests; and

(vi) To prepare a comprehensive report of lessons learned and implications for rural water supply management.

D. SCHEDULE AND PROGRAM

4. The program, once launched, will require 5 months for completion. It is expected that the work will start February 1, 1995 and will be completed by July 30, 1995. About 25 hand pumps will be visited per week and field inspection of each pump will take 1-2 hours, depending on the operating conditions.

[1] It is required to take spectrophotometer to remote wells. Samples from the nearby wells can be transported to a laboratory in Nukus.

E. STAFFING AND COSTS

5. Two senior professionals will be involved in carrying out the study program: a chemist and an engineer. During the first phase and particularly for pre-testing of the procedures and preparation of questionnaire, a sociologist will also be involved. Technical staff will be employed for laboratory analysis and for the evaluation of the household data. A driver will also have to be a part of the team.

The budget is itemized below.

Engineer:	500 x 1 x 5	2 500
Chemist	400 x 1 x 5	2 000
Driver hire (including car rent)	500 x 1 x 52	500
Car rental (without driver)	300 x 1 x 51	500
Gasoline expenses	4 x 22 x 5	440
Sociologist's work on questionnaire preparation	100 x 1	100
Programmer's work on database preparation	100 x 1	100
Sociologist's work on analysis of data obtained	100 x 1	100
Chemicals for analysis		1 000
Miscellaneous expenses		760
Total: without diver		8 500
with driver		9 500

ATTACHMENT 3 - 4

ARAL SEA PROGRAM - PHASE I

Programme 5, Project Nr 1
Uzbekistan Water Supply Sanitation and Health

Supplemental Terms of Reference

III Pilot Demonstration Project to determine the Quality of Water intended for Human Consumption

A. BACKGROUND

1. People living in Karakalpakstan and Khorezm take water for consumption from different sources including the public water distribution system, hand pumps, shallow dug wells canals and lakes. The source of water for the public water supplies in the region include:

- water abstracted from the Tuyamunyun reservoir;
- water abstracted from canals at 19 sites in Karakalpakastan, some or all of which may no longer be used when the Tuyamunyun distribution system is expanded;
- water abstracted from fresh water lenses in ground water aquifers at 11 sites in Karakalpakstan;
- ground water abstracted from deep wells and treated in desalination units; and
- other ground water sources will be considered for exploitation under the proposed project, involving at least one experimental artificial recharge site.

2. There is general concern as to the quality of water abstracted from these various sources, especially contamination of these supplies by pesticides, nitrates and microbiological (bacteria and viruses) sources. The health concern regarding salinity is overexaggerated, as the WHO limit for this parameter mainly relates to taste considerations especially when Magnesium is present. There is limited data available on the level of contamination of the sources indicated above because of difficulties in measuring these parameters (except nitrates), or because current analytical procedures are not sufficiently accurate.

3. Prior to 1989 Uzbekistan was one of the highest users of pesticides in the World with average application rates of 54 kg/ha. Since that time lack of funds for the purchase of pesticides from foreign suppliers has greatly reduced their application rates. Moreover, agricultural enterprises are using Integrated Pest Management techniques which are proving effective in controlling pests without the need for heavy applications of pesticides. Application rates of urea and phosphatic fertilizers have remained almost constant. It is, therefore, necessary to obtain an up-to-date assessment of the quality of the water sources that are proposed to be exploited under the proposed project, as it is likely that nitrate and pesticide levels are now quite low and well within acceptable standards.

B. OBJECTIVES

4. The objectives of the demonstration program are to use modern sampling and analytical procedures to evaluate the quality variations in water sources that will be exploited under the proposed project.

C. SCOPE OF WORK

5. The following activities are proposed under this demonstration project:

- identify the water supply sources in the project area that are being considered for exploitation under the proposed project;
- develop a sampling program at sampling points which are representative of the sources being exploited and at sampling frequencies that will give a representative picture of the variations in water quality that occur during the season when the agricultural chemicals are applied or possibly flushed out of the soil during the months of November and December when the fields are flooded to wash out accumulations of salts;
- specify sampling and sample preservation procedures;
- identify the agrochemicals that are being applied on major crops such as cotton and rice and their application rates to determine the parameters that should be monitored in the analytical program in addition to microbiological parameters and salinity;
- identify the most toxic agrochemicals that are being used in significant amounts to limit the amount of analytical work that will be reguired in this survey;
- recommend analytical procedures that are sufficiently sensitive to detect these chemicals below the recommended norm for drinking water supplies and that can be analysed by equipment currently available in Uzbekistan;
- train local laboratory specialists in the recommended sampling and analytical procedures and a quality assurance program; and
- carry out the sampling and analysis program with the trained personnel under supervision as required. Special attention has to be devoted to analytical procedures to be followed to ensure the validity of the generated analytical. This validity must be demonstrated.
- organize three one day seminars for managers and specialists involved to exchange information on project approach, progress and findings.

D. REPORTING AND SCHEDULE

6. An interim report will be prepared after 1 month outlining the proposed sampling and analysis program and findings of the initial survy of pesticide use. At the completion of the survey a final report will be prepared summarizing the findings of the work and giving detailed results of the sampling and and analysis program analytical procedures and applied equipment. It is expected that the survey will be carried out from March 1995 to December 1995 inclusive.

E. BUDGET

	US$
Sampling and analytical equipment	20,000
Foreign experts	30,000
Local experts	15,000
TOTAL	65,000

ATTACHMENT 4

ARAL SEA PROGRAM - PHASE I

Programme 5, Project Nr 1
Uzbekistan Water Supply Sanitation and Health

Supplemental Terms of Reference

Needs Assessment for Water Supply in Rural Karkalpakstan

A. BACKGROUND

1. One of the planet's most serious environmental and human tragedies continues to unfold in the basin of the Aral Sea. Over the past 34 years, the sea has steadily shrunk as a result of a huge reduction in inflow from its two tributaries, the Amu Dar'ya ad Syr Dar'ya, caused primarily by rapidly increasing use of water for irrigation of mainly cotton fields in their basis. In the aggregate, the area of the Aral decreased by 52% from 69,000 to 33,000 km2 and its volume fell by 74% from 1083 to 277 km3 between 1960 and 1993. The environmental and economic consequences of the Aral's dessiccation have been wide-ranging and severe.

2. The sea's fisheries was destroyed by the early 1980s. The ecosystem of the deltas of the two tributaries have suffered from spreading desertification, a direct consequence of reduced spring floods, dropping stream and ground water levels, and increasing soil salinity. Salt and dust from the former sea bottom is lifted as high as 4 km and carried as far as 500 km downwind. The population in the area suffered a variety of health problems, of which the most common are respiratory afflictions and possible cancer from the inhalation of dust ad salt, and intestinal disorders from poor drinking water. Reduced fertility of land and increased incidence of animal diseases further aggrevated poverty and drained local resources to combat the ill effects of the crisis.

3. The hardest hit area by the conditions leading to the Aral Sea crisis is along the lower Amu Dar'ya in Karakalpakstan, an autonomous republic with an area of 165,000 km2 and a population of 1,380 million. Khorem Oblast lies to the south of the Amu Dar'ya river and is a relatively more developed region than Karakalpakstan. There is need to study the socio-economic characteristics of these areas, understand the issues faced by its rural populations and map out action priorities as perceived or identified by its population in order to develop strategies to combat the crisis in the short term. Longer term and more sustained solutions should be sought to deal with the root causes of the problem.

Urban and Rural Water Supply

4. By early 1993 some 80% of the urban population and 29% and 54% of the rural populations of Karakalpakstan and Khorezm respectively had access to public water supplies. In the 1960s, when water quality in the Amu Dar'ya was good, water was taken from the river at a point local to the community or from the irrigation canals. The rapid deterioration in river and canal water quality has forced the construction of major water supply schemes to try to maintain supply quality, although the new schemes do not extend to all communities, who must still rely on the old, often unsafe, supply arrangements.

5. Surface water often does not meet Uzbekistan's water quality standards, particularly with

regard to total dissolved solids, turbidity and hardness. Other parameters for which the water may not meet standards are bacteriological content. The present water sampling and testing regime is however unable to confirm or refute the current concerns regarding these parameters.

Water Supply - Distribution

6. There are three main sources of potable water in the project area. Surface water is obtained from the Tuyamuyun Reservoir, the Amu Dar'ya, and to a lesser extent from irrigation canals. The raw water quality in the Amu Dar'ya fluctuates according to the water flow and the agricultural practices in the irrigated areas. Salinity decreases during the period of high river flow in the summer months of June to September and increases during subsequent low flow months, reaching a peak during December when fallow saline soils are washed out prior to the peak growing season. However pesticide and fertiliser use peaks during the summer months when there is considerably higher river flow so that the impact on river water quality is far less significant. This water is supplied to most of the large towns through the recently constructed and commissioned trunk main systems. Water from irrigation canals is used in rural areas where there are no alternative supplies.

7. Groundwater has been widely used for potable supplies for rural areas not covered by the surface water systems, either directly from freshwater lenses where river or irrigation canals flow across porous strata, or from deep wells which require desalination prior to potable use. The yields from individual systems varies from 5 m^3/day to 60 000 m^3/day for the larger aquifers adjacent to the Amu Dar'ya and stretching for up to 40 km along its banks.

8. The principal surface water source is the Amu Dar'ya upstream of Khorezm Oblast, where the Tuyamuyun Reservoir has been created by construction of a barrage across the river. Three additional reservoirs have also been constructed for irrigation use although one of these, the Kaparas, with a usable volume of 750 M m^3, is being converted for potable use.

9. Two treatment plants have been constructed near Tuyamuyun to supply Nukus and Urgench respectively. Both plants have an output of 170,000 m^3/day and use two stage sedimentation followed by rapid gravity filtration and chlorination. Operation of the plants is hampered by lack of spare parts and shortages of chemicals. There is no treatment to remove pesticides that may be present in the raw water. Treated water is pumped 60 km to Urgench and 240 km to Nukus. The water is rechlorinated at Urgench and Nukus prior to being pumped into the distribution systems. At Nukus it is also booster pumped to other major towns in Karakalpakstan.

10. The Nukus plant is currently being extended to provide an output of 340,000 m^3/day and there are plans to extend this further to 540,000 m^3/day. For the first stage extension construction of three booster pump stations is proceeding slowly on the existing transmission pipeline to increase the capacity of the trunk main to 340,000 m^3/day. For the second stage extension a second pipeline is planned. It is also planned to double the capacity of the Urgench plant to meet the projected demand.

11. The two stages of expansion of the Nukus plant would allow all major towns and villages on both the east and west banks of the Amu Dar'ya to be supplied from the Tuyamuyun Reservoir.

12. Groundwater resources have been extensively investigated and mapped over the past 30 years. Approximately 84 areas where freshwater lenses exist within Khorezm and Karakalpakstan have been identified, and over 20 of these are being exploited at present. Research and pilot scale

trials have also been carried out of artificial recharge of the lenses, and promising results have been obtained.

13. Boreholes of between 200 and 500 m depth have been drilled throughout Karakalpakstan to investigate the Aral Basin artesian aquifer's cretaceous sandstone deposits which underly the entire area. In general the water quality deteriorates from east to west: in the area east of the Amu Dar'ya delta it is suitable for potable use after desalination, whereas to the west it is too saline for desalinators to be economically used. In the irrigated areas to the east of the Amu Dar'ya delta 155 Russian manufactured electrodialysis sets with a capacity of 50 m^3/day each (in two units of 25 m^3/day capacity) have been installed to treat well water with salinities in the range 2 - 3 g/l.

14. Responsibility for the provision of water supplies is divided between a number of Government bodies. Two organisations are responsible for the development of bulk water supplies from the Amu Dar'ya at Tuyamuyun: Tuyamuyun-Nukus Vodavod and Tuyamuyun-Urgench Vodavod and the corresponding main conveyors. The Vodacanal, under the Ministry of Urban Construction is responsible for the construction and operation of urban water supply systems and sewerage systems, and the Agrovodacanal (under the Ministry of Agriculture) for the rural systems. The Agrovodakanal has a branch in each Rayon responsible for rural water supplies in the Rayon. The Hydrogeologic Expeditions are responsible for groundwater exploration and development.

Urban and Rural Sanitation

15. Only two cities in the project area have a waterborne sewerage system with treatment facilities. Nukus has a recently constructed sewerage system which covers 70% of the town. Treatment is by means of waste stabilisation ponds dicharging into the irrigation system. Urgench also has a sewerage system discharging to an activated sludge treatment works. Sludge from the works is disposed of to drying beds. (Check completion of the systems)

16. In the remainder of the project area the most common form of sanitation is the unlined pit latrine. These are generally constructed by each household with no particular siting or sizing guidelines being used. They are not usually ventilated. In some areas flush toilets discharge into unlined pits, providing a serious risk of aquifer pollution.

17. Sanitation is the responsibility of Vodacanal in the urban areas: no particular agency is responsible for this service in the rural areas.

B. OVERALL OBJECTIVES:

18. The key objective of the socio-economic needs assessment project is to guide investments in the rural water supply and sanitaton sector in the Aral Sea basin of Uzbekistan. Community specificity in problem and solution identification is, therefore, essential. The overall objectives of the socio-economic study are to : (a) describe the water supply and sanitation conditions in each district of Karakalpakstan by community type and size; (b) identify community infrastructure needs and preferances to meet these; (c) assess prospect for and risks associated infrastructure provision to rural areas.

C. SPECIFIC OBJECTIVES:

19. Specific objectives consist of (a) describing the socio-economic conditions of the project area by using existing demographic, historical, administrative, economic and sociological information; (b) by carrying out and analyzing a representative survey of households in rural communities and small towns with a population of less than 20,000; and (c) carrying out community infrastructure inventories in sampled communities.

20. The following information will be included in the description of the overall characteristics of the region:

- History of Karakalpakstan and Khorezm Oblast: peoples, cultures and politics;
- Administrative structure: state farms, collectives, towns, current status and prospects
- Patterns of infrastructure development;
- Patterns of rural production: past, present and future trends;
- Patterns of ownership: housing, land, livestock, infrastructure;
- Demographic patterns: size and type distribution of communities over time by sub-district; other community specific demographic characteristics, patterns of morbdity, mortality; female headed households; impications for sampling design;
- Patterns of migration ;
- Infrastructure development by sub-district and community type;
- Water supply and sanitation: by sub-district and community type, including community basis of maintenance and operations;
- Implications for proposed project

21. The household survey (see attached draft) will be implemented in a representative sample of households after a full pre-test. All interviewers will be fully trained and supervised. Each interview team will be accompanied by a senior social scientist who himself/herself will undertake household questionaires. In addition, each supervisor will obtain most recent demographic, health and socio-economic data from each community visited, as well as obtaining full details of community water supply overview, especially if piped connections are available. The consultants will submit to the Bank a draft community inventory survey developed during the pre-testing of the household questionnaires.

Research Administration

22. The research will be carried out by EXPERTS under the guidance of a Board consisting of the President of the Academy of Sciences of Karakalpakstan, Vice-President of the Academy of Sciences of Tashkent and Deputy Chairman of the Union for the Defence of the Aral Sea and the Amu Der'ya river (NGO). The board members will also participate in the drafting of various chapters of the report. All interviewers (about 20) will be recruited from local social science institutions as will their supervisors. Coding will be done during the interviews to allow feed back. All analyses will be undertaken in Tashkent by EXPERTS and draft reports will be reviewed by the Board. The Board and EXPERT specialists as well as all senior social scientists taking part in different phases of the project also constitute the NETWORK of Social Scientists for the Aral Sea Program. Network members will get together with social scietists of other Aral countries as similar studies are lauched in them as well.

D. SCHEDULE:

22. The following schedule will be employed.

---Completion of the general overview report	November 15, 1994
---Translation of questionnaire	October 30, 1994
---Pre-testing	November 10, 1994
---Preparation of sampling design	November 15, 1994
---Preparation of community inventory surveys	November 10, 1994
---In-term report consisting of general overview, sample design proposal and community inventory survey	November 15, 1994
---Launching of household surveys	November 15, 1994
---Completion of surveys and coding	December 1, 1994
---Completion of analysis and write-up	January 15, 1995
---Final report	February 1, 1995

E. PAYMENT SCHEDULE:

Advance payment for questionnaire development, pre-testing, overall report preparation (October 10, 1994)	$2,500
Payment for field work and coding (November 15, 1995)	$8,500
Payment for final report	$2,500