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ASSESSMENT AND MITIGATION OF WATER RELATED ENVIRONMENTAL HEALTH IMPACTS IN THE BAGRAMI DISTRICT OF KABUL PROVINCE

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ASSESSMENT AND MITIGATION OF WATER RELATED ENVIRONMENTAL HEALTH IMPACTS IN THE BAGRAMI DISTRICT OF KABUL PROVINCE

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ACRONYMS

ADB (Asian Development Bank)

AEP (Agency for Environmental Preservation)

CSO (Central Statistic Office)

DACCAR (Danish Committee for Aid to Afghan Refugees)

MAIL (Ministry of Agriculture Irrigation and Livestock)

MRRD (Ministry of Rural Rehabilitation and Development

MOPH (Ministry of Public Health)

MUD (Ministry of Urban Development)

NEPA (National Environmental Protection Agency)

OWSS (Organization for Water Supply and Sanitation)

UNEP (United Nations Environmental Program)

UNICEF (United Nations Children Fund)

USGS (United States Geological Survey)

UNFAO (United Nations Food and Agriculture Organization)

WHO (World Health Organization)

EXECUTIVE SUMMARY

My professional paper addresses problems associated with water quality and sanitation in the Bagrami District of Kabul Province in Afghanistan. Like many other districts in the Kabul Province, Bagrami has serious problems with waterborne disease morbidity and mortality, which are major public health concerns that pose a threat to social and economic development.

My paper includes: (1) an analysis of cases of waterborne diseases in Bagrami District from 2003-2007; (2) a review and assessment of the effectiveness of three recent water supply and sanitation projects carried out by aid organizations; (3) a description of a Bagrami water sanitation project that I helped manage in 17 villages in collaboration with the United States Agency for International Development (USAID) in spring 2008; and (4) my recommendations on how to improve the effectiveness of water supply and sanitation projects in Bagrami and other areas of Afghanistan based on insights gained from this study.

To analyse the incidence of waterborne disease, I gathered hospital discharge data to examine four of the most prevalent waterborne diseases, including amoebiasis, diarrhea, typhoid, and dysentery. I also included an analysis of cholera outbreaks in 2003 and 2006. Each of the four most prevalent diseases contributed roughly an equal share of the total cases of illness episodes from 2003 to 2007. The number of cases of each disease increased overtime during this period, though amoebiasis and dysentery showed the largest increase. There was a 44.5 percent increase in the number of cases overall.

After critical reviews of previous water quality interventions, discussions with stakeholders, analysis of well test data, and informal conversations with villagers, I determined that contaminated water sources and a rapid increase in population due to the return of refugees are the main causes for the increase in waterborne disease in Bagrami District. Other factors contributing to the public health problem include poor hygiene practices, limited access to health care, deterioration of infrastructure and poverty.

The three water supply and sanitation projects I reviewed and assessed included:

- A hand pump installation project carried out by the Ministry of Rural Rehabilitation and Development and UNICEF in three villages.

- A wells chlorination project carried about by the Ministry of Public Health and UNICEF in five villages.

- A spring and *karez* system rehabilitation project carried out by Ministry of Rural Rehabilitation and Development and UNICEF that involved three villages.

The purpose of the assessment was to determine what aspects of the projects worked well, what could be improved, and what lessons should be learned. My assessment included an examination of project completion reports, a critique of their strategies and

approach, informal conversations with villagers, and direct observation on the ground. I found that a lack of consideration for equity in selecting wells for both the installation of hand pumps and chlorination, and the selection of villages for the projects in most of the projects resulted in the lack of access to clean drinking water and social conflict, which could have been avoided with better consultation and planning.

I also reflect on and assess the Bagrami Water Purification Project, for which I coordinated the implementation. My assessment considers how local expertise was incorporated in various stages of the project, for example, by involving local authorities and village-level councils in the decision making process and in project activities. I conclude that it is very important to clearly define the roles of each and every person involved in the project. By doing this, we were able to establish a very good understanding of stakeholder involvement, responsibility, and authority.

Several recommendations and suggestions for rural water supply projects in Afghanistan emerge from my review of previous projects and my reflections on my experience with the USAID project. Some of the recommendations and suggestions include the following:

- Include more involvement and participation of villagers during the planning and implementation of water and sanitation projects, and give greater consideration to potential social conflict and equity of access to clean drinking water.
- Use project resources more efficiently, for example, by chlorinating only the wells that exceed World Health Organization (WHO) bacterial contamination guidelines as determined from water sampling test results.
- Monitor wells after chlorination, i.e., to go back and recheck for contamination, especially the wells that have high levels of contamination.
- Develop and implement strategies to address health risks from wells where contamination reappears subsequent to chlorination, e.g. re-chlorinating, controlling the source of contamination or closing a well if there are no resources to monitor and chlorinate over the long term.
- Facilitate private sector development in service delivery, maintenance, stocks and supplies.
- Promote proven, locally appropriate technology, based on best practices, which provide safe drinking water on a continuous basis that is best suited for local conditions. These include dug wells and bore wells with hand pumps, the protection and rehabilitation of *karez* systems and springs, and the maintenance of gravity piped water supply schemes.
- Provide assistance to Internally Displaced People, support the return to their place of origin in order to ameliorate the local water supply and environmental health problems and improve political and social stability in the study setting.
- Improve coordination between government and non-governmental entities working in water sector to reduce redundancy and lack of harmonization among efforts. NGOs need to prepare implementation guidelines for a coherent development approach through stakeholder consultancies.

INTRODUCTION

In eastern Afghanistan's Province of Kabul, waterborne disease poses a major health problem. In the capital city of Kabul and the surrounding districts, waterborne disease accounts for approximately 38 percent of all medical consultations, with a high percentage of bloody diarrhea; recent outbreaks of cholera have also presented significant challenges to the public health system (Ministry of Public Health 2005). As in other cities in Afghanistan, there is a centralized water supply system in Kabul, but due to decades of war, armed conflict, and inadequate funds, the infrastructure is very poorly maintained and large amounts of water are lost through leaking pipes and reservoirs (Oriakhel 2007). In spite of the relatively moderate cost of maintaining centralized water services, the many years of civil conflict and political upheaval have led to a strong focus on humanitarian and emergency aid and assistance, with less attention being given to the construction of centralized waters supply systems. According to the United Nations Children's Fund (UNICEF), 60 to 70 percent of the Kabul province population relies on alternative water sources, such as shallow-dug wells through hand pumps (Saquib 2007). In addition to these bore wells, residents use open unprotected wells and deep drilled wells. These groundwater resources with the exception of deep drilled wells are located at shallow depths, making them vulnerable to contamination from insufficient waste removal and cesspits.

In Kabul City, a severe drought affected the population between 1999 and 2002. Many of the shallow private wells remained dry even up to the end of 2007. The Ministry of Public Health (MOPH) estimates that 20 percent of the more than 3000 public hand pumps present in Kabul City do not provide water because of a low water table (UNICEF 2007). UNICEF, in coordination with the MOPH and some non-governmental organizations (NGOs), are now working on a strategy to address these interrelated problems by digging bore wells in many locations within the city and surrounding districts. However, the depletion of groundwater resources continues and makes reliance on bore wells an insufficient approach that is unlikely to provide a long-term solution to the drinking water problems (Samay 2007).

Surface water sources are also used for drinking water and include rivers, small streams, springs, and *kare*zes which are engineered water canals that are covered and often centuries old with a multiple access points. The traditional *karez* system is an amazing groundwater use technology. The technology of the *karez* system is ancient. It entails underground aqueducts that stem from what is often referred to as the 'mother well' that extends down into the aquifer. The underground aqueduct, often thought of as an underground water channel, starts at the 'mother well' and brings groundwater from the upper portions of the aquifer to the surface via the use of gravity, flowing for often great distances to an end point where it is utilized in fields. The mother well is usually at a higher elevation site and the aqueducts flow underground but down hill from that site and at some point come to the surface of the land. Each hand-dug channel has holes above it at the surface level spaced at regular intervals that allow the channels to be cleared of debris and sediment that accumulates in the channel over time. The word *karez* originates from old Persian (*qirez*) and is typically written in italics. *Karezes* are often used for irrigation purposes, but they are increasingly used as drinking water sources. There are also ponds that are used for drinking and other domestic purposes. The use of ponds is not as prevalent in the rural Bagrami District as in other parts of the

Province of Kabul, but they still constitute one of the primary sources for drinking water there. Ponds are human made and are very common in areas with lower water tables and in drought-affected areas.

Both the MOPH and NGOs have started a number of water programs to improve water supply, equitable access to water, and sanitation throughout the country. The programs include sanitation and hygiene education campaigns and the dissemination of messages through villagers and religious leaders (Imams). There are also water testing and chlorination projects in many locations of the country combined with installation of new or improved water supply and purification facilities that have had varying degrees of success and failure. Since water supply, access, and sanitation problems are chronic and widespread, it will take the government and the international community quite a long time to cope with these complex problems in an effective and sustainable manner.

My paper seeks to understand and address these problems in the Bagrami District by improving our understanding of the health impacts of water contamination and the effectiveness of water and sanitation projects. More details about the Bagrami District and an explanation about why it was selected are provided below. The four parts of my professional paper include: (1) an analysis of trends in the number of cases of waterborne disease in the Bagrami District from 2003 to 2007; (2) an assessment of three water supply and sanitation projects carried out by aid organizations; (3) a description of and my reflections about a Bagrami water sanitation project that I helped carry out with the United States Agency for International Development (USAID); and (4) my recommendations on how to improve effectiveness of water supply and sanitation projects in Bagrami and the rest of the country, based on insights gained from the above work.

The objective for the first part is to provide a detailed description of water contamination problems that contributed to waterborne diseases in recent years. I rely on five years of data I gathered from medical clinics and MOPH on waterborne diseases. I examine the trends over this time in the number of cases of waterborne disease to provide insights about how the environmental health conditions related to water and sanitation conditions have changed over time. I use that information to assess water and sanitation conditions in general. I also attempt to identify factors that explain the trends observed, and I use the disease data to consider how effective the various programs have been in addressing waterborne disease during last five years in the Bagrami District.

The objective for the second part of my paper is to provide a review and assessment of three water-related projects in the Bagrami District. I review the project objectives, activities, and expected outcomes. The projects were assessed through informal community conversations, review of project completion reports, and actual observations at the various sites. The main reasons for reviewing and assessing these projects are to identify positive and negative aspects, to offer valuable lessons, and to provide relevant recommendations for conducting water and sanitation projects and programs in Afghanistan, and in rural areas of the country in particular. My hope is that the findings and recommendations will be of particular interest and use to government entities such as MOPH and the Ministry of Rural Rehabilitation and Development (MRRD), and other organizations working in waters supply and sanitation sector.

The third objective is to describe the implementation of the Bagrami water purifications project, which I coordinated for USAID in early 2008. The project included water testing, water filter distribution, well chlorination and hygiene education. It is my belief that many of the same insights I have gained through my professional experience can be applied more broadly, for example, to other areas of Afghanistan that have a similar development pattern as the Bagrami District, which, with its many small dispersed villages, is predominately rural in character. Thus, drawing on these analyses and my experience, I conclude my professional paper by providing overall recommendations and suggestions for rural water supply projects in Afghanistan.

In addition to government and aid agencies, those interested in water and environmental health in developing or underdeveloped countries particularly in the southern Central Asia region would be interested in the lessons learned from my review and assessment of some recent water and sanitation projects and my review, assessment and reflection on my experience with the USAID and UNICEF.

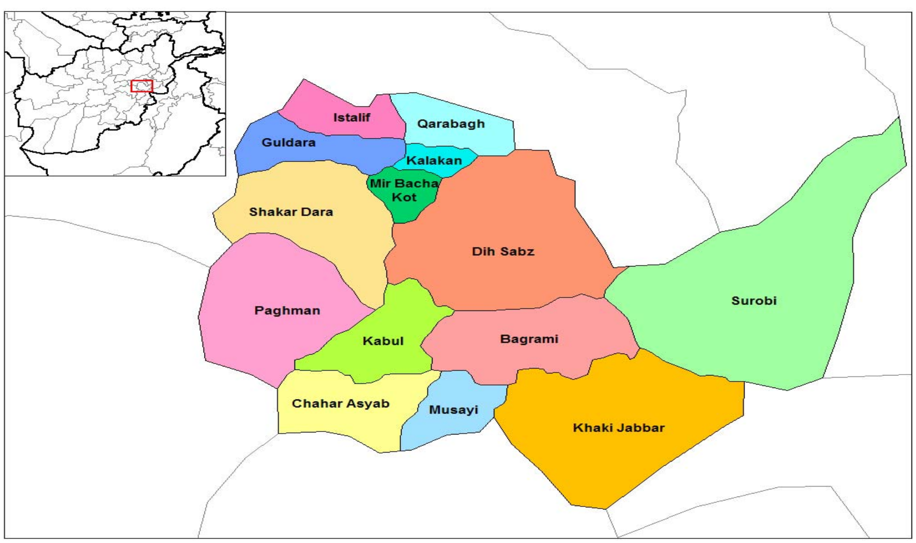
STUDY SETTING

The following background section on the study area, the Bagrami District, covers the following areas: (1) the geographic and geophysical setting; (2) the human setting; (3) water and sanitation infrastructure conditions; and (4) prior drinking water and sanitation projects. This information not only provides important background for my analyses, reviews, assessments, reflections and recommendations, it also explains why I have chosen to focus on the Bagrami District.

Geographic and Geophysical Setting

The Bagrami District is located in the central part of Kabul Province. It is a 30 minute drive east from the capital city of Kabul. The district borders with Kabul City to the west, De Sabz to the north, Surobi to the east, and Khaki Jabbar, Musayi and Char Asiab districts to the South. Figure 1 shows the location of the Bagrami District relative to other districts of Kabul Province.

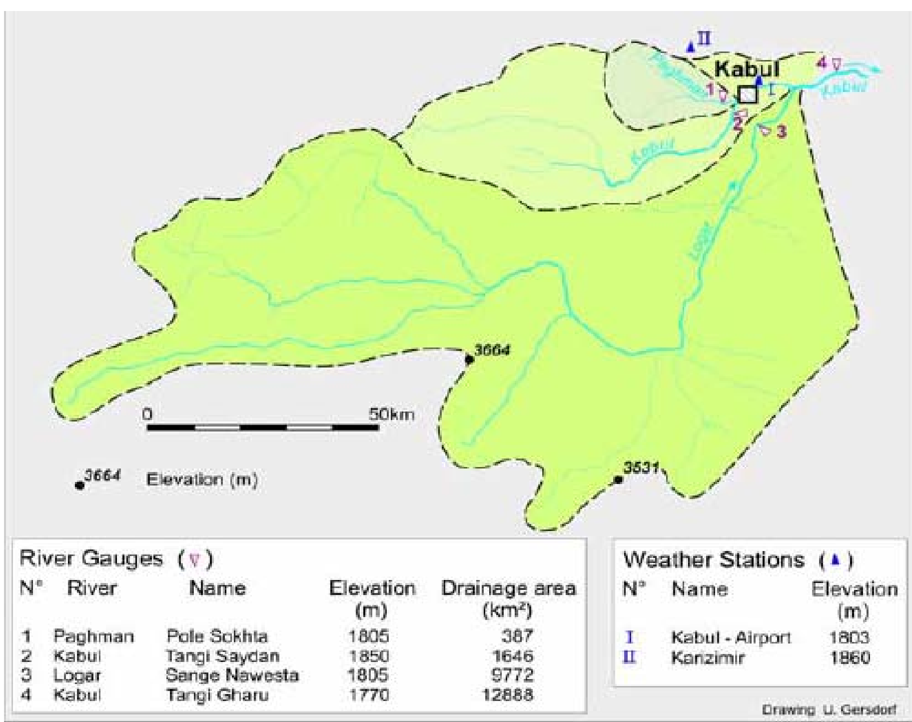
Figure 1 – Location of Bagrami District in Kabul Province



(Source: Afghanistan Accelerated Agriculture Program, funded by USAID, 2004)

The approximate average elevation of Bagrami District is 1820 meters above sea level. Figure 2 shows the catchment areas of Logar River and Kabul River, both of which flow through the district. The upper reaches of the Logar River flow easterly before turning north toward the Kabul City and the confluence with the Kabul River, which flows east into the Bagrami District. The Kabul Basin is dominated by the Kabul River and its tributaries, such as the Logar. The Kabul River is one of the largest river systems in Afghanistan. It reaches the Indus River in neighbouring Pakistan, thereby making it the only river system originating in Afghanistan that eventually flows into the ocean. These rivers are fed by snowmelt that originates in the Hindu Kush Mountains, the westernmost range of the Pamir-Himalayan Arc that extends from the southwest to the northeast of Afghanistan.

Figure 2 - Catchment Areas in Kabul Basin



(Source: Tünnrmeier, Houben, and Himmelsbach 2005)

From March through May, the Kabul River and its tributaries play a very important role in providing water for drinking and other domestic purposes; however in other months of the year, these rivers are usually dried up and are used as dump sites.

A 2005 report titled *Inventory of Ground-Water Resources in the Kabul Basin, Afghanistan* states:

> The water-table surface generally mirrors topography, and ground water generally flows in the directions of surface-water discharge. Groundwater flow in the Kabul Basin is primarily through saturated alluvium and other basin-fill sediments. Some groundwater may flow through the weathered bedrock immediately beneath the alluvium and through fractures in the bedrock, but the amount of flow in these zones is believed to be small compared with flow in the alluvium. Thus bedrock outcrops effectively isolate groundwater flow into several distinct sub-basins (Broshears et al. 2005: 12).

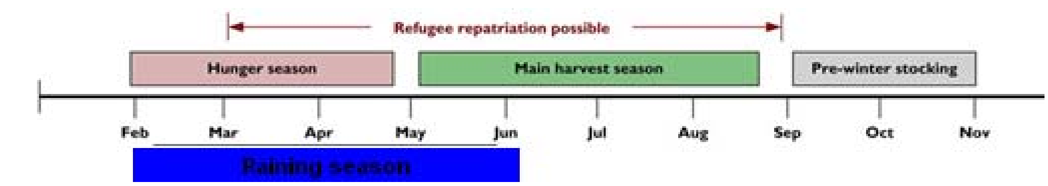
In most of the Kabul Basin, the water table is within 30 meters of the land surface. The depth to water ranges from less than 5 meters to more than 60 meters. Along most stream channels, depths to water are less than 15 meters (Broshears et al. 2005). The water table in upper elevations of the Bagrami District is relatively lower than those in lower elevations (Samay 2007).

As mentioned above, water supply throughout the district is mainly from rivers, traditional *karezes*, springs, and ponds. As previously mentioned, *karezes* in Bagrami District are human-engineered constructions. The water in *karezes* comes from underground water resources and can be accessed through multiple holes at the surface. As in many other parts of the country, *karezes* in the Bagrami District are considered to be the property of particular villages with specific water rights. The water rights are applied only for irrigation; everyone can use the *karez* water for drinking purposes.

In Afghanistan rainfall plays a fundamental role in providing water for drinking and other domestic uses and for irrigation. Bagrami District is no exception. Based on data from the World Meteorological Organization gathered from 1953 to 1983, the United States Geological Society (Broshears et al. 2005) reports that average annual rainfall in Kabul is 332 mm. This is also likely to be a good estimate of average rainfall in the Bagrami District.

The rainy season in Afghanistan usually begins in February and continues to June (see Figure 3); however, during below average years of precipitation, the rainy season is often from February to April. See Appendix A for seasonal rainfall and total annual rainfall data from 2003 to 2007.

Figure 3 – Rainy Season in Afghanistan



(Source: Famine and Early Warning System Network – USAID activity 2008)

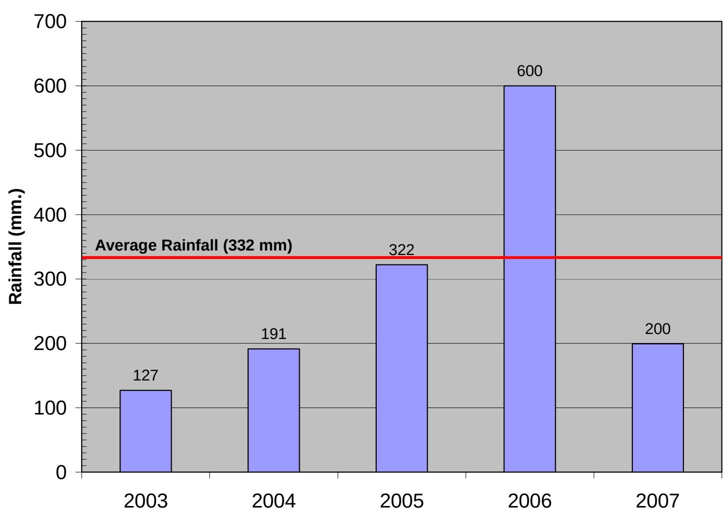
In 2006, seasonal floods and run-off of surface water significantly impaired groundwater quality in many parts of Bagrami District (Samay 2007). Many *karezes* and springs were washed out, and for many weeks people were drinking muddy flood water. The floodwater in many locations entered the wells that were not covered or those without hand pumps (Samay 2007).

An extended drought has occurred since 1998, and it is believed to be the worst in a century (Broshears et al. 2005). The water supply and sanitation situation previous to the most recent ongoing drought was approaching a crisis stage, and the drought has further deteriorated the lives of people. All water, including surface waters (rivers and streams), underground and near-surface water resources, such as those of *karezes*, springs, and shallow wells, were significantly impacted throughout the country, including in the Province of Kabul and its surrounding districts.

The quality of water in villages in Bagrami District located in the Kabul Basin is not of a good quality for drinking or other domestic purposes; however, the further toward the mountains in the north one goes, the better the quality of water gets. The water depths also vary in many villages. Most of the shallow wells are located in villages closer to the center of Bagrami District. In the remotest villages near the mountains to the north well depth is normally between 50-60 meters (Samay 2007).

As a result of yearly variations in rainfall, the depth of groundwater in the district has fluctuated over time. According to the Ministry of Rural Rehabilitation and Development (MRRD), during drought years the water table dropped between 5-10 meters. However, depletion of groundwater was also associated with increased use from a greater number of wells.

Figure 4 – Annual Rainfaill in Bagrami, 2003-2007



(Source: USGS 2008; Ministry of Agriculture Kabul, Afghanistan 2004)

To examine relatively recent rainfall trends, I compared the annual rainfall in Bagrami District in the last five years (2003-2007) to the average annual rainfall for the last 21 years, 332 mm. In 2003, annual rainfall in Bagrami totaled 127 mm, or 58 percent below the annual average according to USGS data. (see Figure 4).

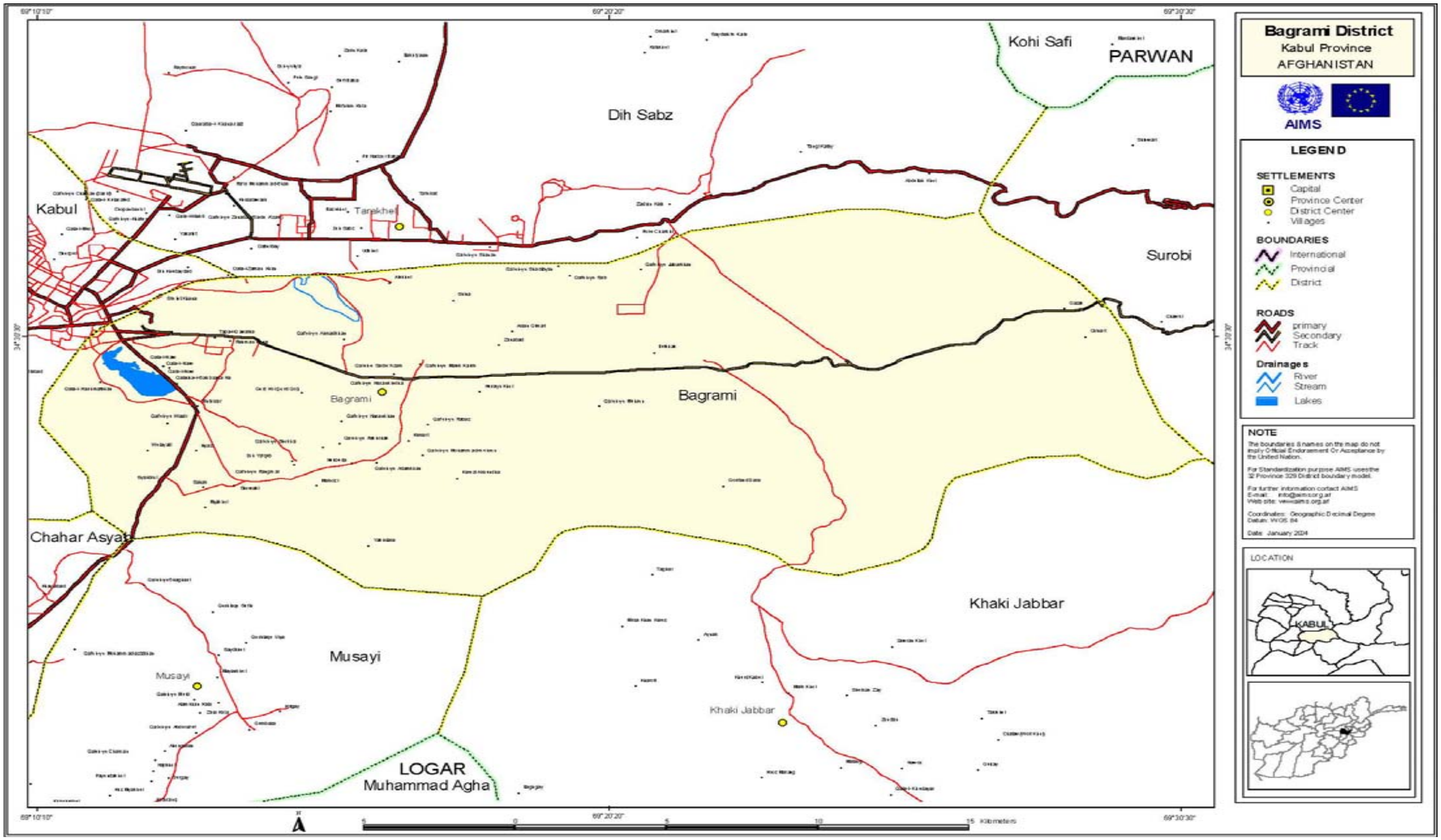
Although annual rainfall increased in 2004 to 191 mm, it was still 34 percent below average. As shown in Figure 4, rainfall returned to about average in 2005 (322 mm), and then in 2006, it increased to 600 mm, which is about twice the average amount and the highest rainfall amount in the last 12 years. However, in 2007 the precipitation amount was 199.5 mm, 33 percent below average. By 2008, drought in 3 out of 5 years and increased population pressures (see Human Setting below) had significantly degraded and depleted ground water resources.

The Human Setting

The Bagrami District is a fertile area with abundant agricultural activities. The villages in relatively higher elevations are located in the upper Kabul River Basin, while some of villages in the lower elevations are located along the Logar River.

The estimated total population of Bagrami District is 68,287. The villages are widely distributed geographically throughout Bagrami. The population in most villages is between 1000 and 1300; however, in the largest villages the population is approximately 2500. Villages are located in subdistricts that tend to have an ethnic majority that is either Pashtun or Tajik. In Bagrami District, there are 26 subdistricts that are primarily ethnic Pashtuns. The remaining 11 subdistricts are predominantly populated by Tajik-speaking people. Pashtuns and Tajiks are Muslims.

Figure 5 – Location of Villages in Bagrami District



(Source: Afghanistan Information Management Services (AIMS) 2008)

Sia Bini, Qala Ahmad Khan, Gosfand Dara, Qala rabas, Qala Hassan Khan and Qala Ahmadzai are the most populated villages and received the greatest influx of refugees since 2003. Figure 5 shows a map of village locations.

The majority of the residents of Bagrami District are farmers. There are some micro-entrepreneurs who used to work in industrial factories in 1970's. Since the factories are no longer operating, there is a small portion of people who are weaving Bagrami textiles, which are famous countrywide.

Community decisions are made by community councils and district administrators. There is not a system in place for managing drinking water in villages; however, for the water used for the irrigation purposes, there are customary water rights and water user associations that control the distribution of water among villagers and between villages sharing a common resource.

The Bagrami District is very unique in terms of its geopolitical location. In the past, it has always had strategic value to the warring fractions. During 1980's until 1992 Bagrami was the battle field between Mujahidin and the pro-communist regime. From 1992 to 1996, Bagrami was the war zone which has witnessed many bloody internal conflicts between the supporters of various factions such as Hizb-e-Islami and Shura-e-Nizar. During 1996 to 2001, Bagrami was one of the strongholds of the Taliban and was bombarded many times.

More than 90 percent of the water supply infrastructure was destroyed during three decades of war that resulted in a massive population migration to distant areas. The trend of internal displacement and migration was much severe in Bagrami, compared to other districts (Kabul Mayor 2007). After the ousting of the Taliban from the area in late

2001, the return of refugees to Bagrami was very slow for the first year, because most of the infrastructure including private houses, clinics, schools and the water supply infrastructure were destroyed. However, after the first year, the return of refugees was quite massive and fast compared to other districts of Kabul Province.

In Bagrami the rapid return of refugees, in turn, has led to problems with access to safe drinking water and sanitation facilities. According to a 2007 United Nations High Commission on Refugees (UNHCR), the majority of returnees in Bagrami are coming from Iran and Pakistan; however, there are also some returnees from other parts of Afghanistan who were displaced from Bagrami during 1992-1996 civil conflicts (Schroder 2007).

One of the reasons I selected Bagrami for my research work was the level of political complexity in these recent years. A second reason is the severity of the water situation that is characterized by a virtually destroyed water supply infrastructure. Thus, Bagrami is an area where a great deal of resources, personnel and expertise are needed to address the interrelated problems of a war-ravaged infrastructure, lack of resources, contaminated water supplies, poor sanitation, waterborne disease, and lack of education, all of which are aggravated by the rapidly growing population.

Water and Sanitation Infrastructure Conditions

As noted above, access to potable safe drinking water is still considered one of the most important concerns to the residents of Bagrami, despite the multiple sources of water supply, such as shallow wells, springs and *karezes*. Due to limited water resources, communities are often compelled to drink biologically contaminated water from ponds. Needless to say, this poses a major health hazard.

The lack of safe drinking water has and continues to cause many waterborne diseases in Bagrami District. Low levels of knowledge and awareness of proper sanitation and general health practices also contribute to the spread of diseases.

Moreover, precious time is wasted on collecting water from far-off locations. It is widely known and documented that there are gender-related aspects of the lack of access to water (Halvorson 2002, 2004; Wijk-Sijbesma, 1998). Work of water collection and transportation is largely the responsibility of women and children (mainly girls) throughout Afghanistan. Water scarcity also adversely impacts livelihoods and food production in the area, as there is little water to irrigate crops, causing crop failures and a lack of food.

Outbreaks of cholera and acute diarrhea in these villages justify the urgent need for water supply, sanitation, and hygiene services. Worldwide experience has shown that the provision of safe water through hand pumps or other interventions reduces the spread of diarrhea and other water-related diseases (Kaihan 2008; UNICEF 2007).

The combined effort of the Ministry of Rural Rehabilitation and Development (MRRD) and UNICEF to improve access to safe drinking water through hand pumps in numerous villages has begun to provide communities in the district with potable water through hand pumps.

UNICEF considers schools in Bagrami to be appropriate points for intervention efforts for two main reasons. First, the school is often the central point of activities within a village where everyone can access and receive information, either directly or indirectly through their children. Second, to encourage children (especially girls) to go back to school, the provision of a clean and healthy environment is essential. Thus, health and social development goals can work in tandem. At the community level, individuals selected as hygiene promoters can target households with appropriate messages, and households with young children can be educated about improved hygiene practices that can reduce the incidence of diarrhea and many other waterborne diseases. In Afghanistan, specific standards for the level of contamination have not been established to make any comparisons of existing rates with previous ones. World Health Organization (WHO 2006) has drinking water quality guidelines that can be used, though their application requires water testing programs for which sufficient resources may be lacking, but are nevertheless needed.

Drinking Water and Sanitation Projects

In the last five years, a wide variety of drinking water and sanitation projects have been implemented in the Bagrami District. Various government offices and aid agencies have been involved. Nearly all of these projects have been financed by international donors, though Afghani government agencies have assisted with implementation of most of these projects along with many national and international NGOs.

Table 1 is an inventory of projects implemented in Bagrami District during the last 5 years, other than the three projects I review below. I obtained this information from the Afghanistan NGOs Coordination Body (ANCB). If we carefully look at Table 1, almost all the projects are funded by international donors and implemented by different NGOs in collaboration with local entities. The projects include agriculture, construction, micro-finance, education and water supply activities with different goals and objectives. Almost 50 percent of the projects in Bagrami are implemented by the U.S. Agency for International Development (USAID), which is leading most of the urban and rural development programs in Afghanistan. Although the United Nations, and particularly

UNICEF, is focusing on relief and emergency programs, in Bagrami these organizations are mostly involved in rural development efforts. There are number of international consultants who play important roles in the design and conception of projects, but in areas like Bagrami the project workers are mainly Afghan nationals.

Table 1 - Water and Sanitation Projects in Bagrami during Last 5 Years

Project Title	Type of Project	Village Name	Summary of activities	Year	Duration	Cost	Sponsored by	Implementer
Safe Motherhood Initiative (SMI)	Maternal Health Project	District-wide	Conduct midwifery courses, hygiene education, distribution of first aid kits, etc	2003	3 months	$ 40,000	UNICEF	WEE (Women empowerment Entity)
Improved seed and fertilizer distribution project	Agriculture Project	District-wide	Conduct PRA surveys, train district extension agents, distribute improved seeds and fertilizers	2003	40 days	$120,000	USAID/AQIP (Afghanistan Quick Impact Program	GAA (German Agro Action
School Support Project	Education Project	Seya beni, Suhak, Meya Khail, Qala Ahmad Khan, Alo Khail, Shena , Qala Zanabad, Qala Sar abyan	Restore school facilities, increase capacity and ensure improved educational standards, fund to purchase education resources, provide food aid to the families of school going children and hygiene practices	2004	6 months	$70000 & 100 MT wheat	World Food Program	ACDO (Afghanistan Community Development Organization)
Polio Control Project	Health Project	District-wide	Vaccinating 10000 children against polio and provided basic health education	2004	15 days	No record	UNICEF	Ministry of Public Health
Grain post-harvest storage and milling in Bagrami	Agriculture Project	District-wide	No record	2005	6 months	$219,000	USAID/RAMP (Rebuilding Afghanistan Market Program)	Grain Industry Alliance (GIA)
Business Development Services	Micro-Finance	Qala zard, Shewaki, Dahi Yaqub	Provided loans to 150 households in three village of Bagrami to produce dairy products	2005	3 months	$10,000	FAO (Food and Agriculture Organization)	CDA (Community Development Agency)

Project Title	Type of Project	Village Name	Summary of activities	Year	Duration	Cost	Sponsored by	Implementer
Construction of bridge in Qala-e-zan abad	Construction	Qala Zanabad	Bridge construction	2006	2 months	$90,000	ADB (Asian Development Bank)	AACC (Alyas Afghan Construction Company)
Rehabilitation of farm to market road in the villages of Alo Khail and Qala Ahmad Khan	Construction	AloKhail and Qala Ahmad Khan	25 km of farm to market road	2006	6 months	$300,000	UNDP (United Nations Development Program	ABR (Afghanistan Berue for Reconstruction)
Rehabilitation of Darodi Canal	Construction	Mamozai village	Installation of gates, desilting, and widening is some locations	2006	2 months	$120,000	USAID	IRC (International Relife Committee)
Water supply and sanitation facilities	Water supply & Sanitation	District-wide	Construction of latrines, hand pumps in 9 district schools	2007	1 year	$700,000	UNICEF & UNESCO	Ministry of Education

METHODS AND APROACH

My paper has four objectives, which I describe below along with the approach I have taken to achieving each objective. First, I explain how I obtained and analyzed secondary data on the number of cases of waterborne diseases in Bagrami over the last five years. I use this information to highlight the seriousness of waterborne disease in Bagrami. Others can use this information as baseline data to assess improvements in drinking water and sanitation in the future. I also describe below my case selection criteria for the water and sanitation projects I review and assess, and I explain how I carried out that assessment. In addition, I summarize my role in a USAID drinking water and sanitation project carried out in spring 2008, and I describe my reflections on my experience and my overall assessment of the project that follows. That reflection and assessment has provided me with unique professional insights about implementing water and sanitation project in my country. Thus, I am able to recommend ways to improve effectiveness of water supply and sanitation projects in Bagrami and the rest of the country, based on insights gained through my review and assessment of three projects and my reflections and assessment of my experience with the USAID project.

Objective 1

My first objective is to assess the health impacts of waterborne diseases in Bagrami since the return of the refugees, i.e., in the last five years. To achieve this objective, I analyze trends in the number of cases of waterborne disease in Bagrami District from 2003 to 2007. Because of a lack of reliable population statistics, I was not able to determine disease prevalence rates in the Bagrami District.

I was able to compile and analyze existing medical data on numbers of cases of waterborne diseases related to unsafe and unsanitary drinking water. The data were obtained from discharge records of patients at two MOPH clinics. One clinic is located in the center of district and is called Bagrami Health Clinic. The second one is located in the village of Qala Ahmad Khan. Both clinics treat people from all villages of Bagrami. However, severe cases are usually referred to Kabul city, because the health facilities in Kabul are well equipped and more resourceful compared to the health clinics located in Bagrami District.

The records that I accessed included the number of patients diagnosed and treated for waterborne diseases (i.e., cases) each month. Attributing cases of diseases to water was based on consultation with the physicians in the clinics and senior officials at MOPH. The World Health Organization (WHO) states that "waterborne diseases are caused by pathogenic microorganisms which are directly transmitted when contaminated drinking water is consumed" (Tariq and Hawing 2003: 66). Contaminated drinking water, used in the preparation of food, can be the source of food-borne disease through consumption of the same microorganisms.

According to the World Health Organization, water-related diseases such as cholera, diarrhea, and dysentery account for an estimated 8.1 percent of the total global burden of disease. It was estimated that 88 percent of that burden is attributable to unsafe water supply, sanitation and hygiene, and is mostly concentrated in children in developing or underdeveloped countries (Sakhi 2008). Unsafe drinking water is a leading cause of preventable disease, particularly among young children in developing countries. Waterborne pathogens, including a variety of viral, bacterial and protozoan agents, account for much of the estimated 4 billion cases and 2.5 million deaths from endemic diarrheal disease each year. Among children under 5 years in developing countries, diarrheal disease accounts for 21% of all deaths. Microbiologically contaminated water also contributes to the heavy burden of disease associated with cholera, typhoid, and others. Low-income populations are particularly at risk of such diseases because of the unavailability of safe water and sanitation (Clasen 2006)

The diseases I have examined in my paper are quite prevalent in Bagrami and the main cause for these diseases is mostly contaminated water. Although cholera is not a prevalent disease in Bagrami, it is a very serious disease, and there were two outbreaks of cholera during last five years. Therefore, I included data on the number of cholera cases in my analysis. There is no doubt that there are many cases of waterborne disease that went unreported and untreated, and hence, the data I present only represents a portion of the health impacts that are actually occurring. More description of these diseases is provided in the next section of my paper.

The epidemiological data available from the clinics was not systematically organized and was stored in different formats and locations. I compiled the information for each month from both clinics and tabulated it in Microsoft Excel. In addition to noting the relative numbers of the various disease cases each year, I analyzed the trends over time in the number of cases of each disease and the changes in overall number of cases each year and over the 5-year period, 2003-2007. This analysis allowed me to determine whether the number of cases is increasing or decreasing and use this information to make a rough assessment of water and environmental health conditions in Bagrami.

<u>Objective 2</u>

My second objective was to review and assess the effectiveness of three water supply and sanitation projects carried out by aid organizations in Bagrami District. The following three programs were reviewed and assessed:

- Hand pump installation project carried out by MRRD and UNICEF in 3 villages;
- Wells chlorination project carried about MOPH and UNICEF in five villages;
- Springs and *karezes* rehabilitation project carried out by the MRRD; and UNICEF.

The programs were selected based on level of accessibility to the type of information needed to assess project effectiveness, i.e., project completion reports, informal interviews and direct observations.

The main purpose of the assessment was to determine what worked well, what could be improved, and what lessons can be learned. My assessment involved an examination of project completion reports, informal conversations with villagers and direct observation on the ground. These methods allowed me to find out what work actually occurred and to critique the strategies and approach used. For example, I was able to observe that due to lack of maintenance, many hand pumps that were installed by UNICEF were not functional and needed to be repaired. In some villages I also noticed the water purification devices that were provided by MOPH were not used by villagers.

I also considered the type of the projects, their duration, the beneficiaries and most importantly the sustainability of the programs, i.e., the prospects and possibility of their being maintained in the long-term.

Objective 3

My third objective was to apply the lessons learned from the review and assessment of three water supply and sanitation projects (i.e., Objective 2) to an analysis of a USAID project I recently completed. The project sought to mitigate health impacts from contaminated drinking water and poor sanitation by: (1) distributing water filters; (2) providing hygiene education through community-based training programs; (3) chlorinating wells; and (4) providing hygiene education. The project also involved testing of wells for various contaminants, including *E.coli*, nitrates, nitrites and lead. The 17 target villages were selected based on requests from Bagrami District authorities and survey results of a preliminary water testing project. More details are provided in the next chapter in the Bagrami Water Purification Project section.

Though it will take a while to assess the effectiveness of this project, I was quite careful in incorporating the lessons learned from other projects. The lessons learned included: (1) assessing the level of community participation during all stages of the project; (2) maintaining good working relationship with local authorities, for example, the district administrator, MOPH representatives, and other stakeholders who are working in the Bagrami District; (3) purchasing the most user-friendly water filters so that the villagers can use them easily with some training on how and where to fix them if needed in the future, and (4) providing training to villagers on how to chlorinate their wells in future.

Objective 4

My fourth objective is to use the research, analyses, assessment and lessons learned in carrying out Objectives 1-3 to offer my own recommendations and suggestions for improving implementation effectiveness of similar programs, not only in Bagrami, but in different parts of the country. The health impact research, along with the project assessment work and my professional experiences, allow me to offer professional judgments and insights about water and sanitation projects in my country. Because the water supply and sanitation situation is directly linked to socioeconomic and political conditions, many of the recommendations and suggestions can apply to other developing and underdeveloped countries, particularly in our region of the world.

ANALYSIS OF WATERBORNE DISEASE TRENDS

I have assembled and analysed time series data (2003 to 2007) on waterborne disease for the Bagrami District as a whole and for 37 villages in Bagrami. I examine five waterborne diseases: amoebiasis, diarrhea, typhoid, dysentery, and cholera which are described below.

Overall Trends from 2003 to 2007

Table 2 shows the total number of cases registered with the Ministry of Public Health for Bagrami as a whole during the last five years (from 2003 to 2007). Four of the diseases analysed contributed roughly an equal share of the total cases from 2003 to 2007.[1] The number of cases of each disease increased overtime. There was a 44.5 percent increase in the total number of cases, with cases of all diseases increasing, though amoebiasis and dysentery showed the largest percent increase.

Table 2 - Total Number of Waterborne Diseases during Last Five Years

	Amoebiasis	Diarrhea	Typhoid	Dysentery	Total Cases
2003	207	250	246	200	903
2004	282	359	286	313	1240
2005	285	294	310	336	1225
2006	336	343	361	339	1379
2007	358	290	340	317	1305
Total Cases	1468	1536	1543	1505	6052
2003-07 %Change	72.9%	16.0%	38.2%	58.5%	44.5%

Table 2 shows there was a consistent increase in the number of cases of amoebiasis during last five years. Amoebiasis is a parasitic infection caused by *Entamoeba histolytica*. It is the third most common cause of death from parasitic infections in Afghanistan (Kaihan 2008). This disease generally occurs in young to

[1] Note that cholera is excluded. I consider it separately below. Also note that data pertain to 36 of 37 villages, because I could not get data for the Qala-e-Mohsin village.

middle aged adults. Amoebiasis is usually transmitted by contamination of drinking water and foods with fecal matter, but it can also be transmitted indirectly through contact with dirty hands or objects as well as by oral-anal contact. Amoebiasis is mostly associated with people living in areas of poor sanitation, but it also shows up in domestic suburbs with non-hygienic conditions, which are also areas of poor sanitation. According to Ministry of Public Health, amoebiasis needs more prolonged treatment compared to other waterborne disease as it is believed that a patient carries the E. *histolytica* organism in their intestines, particularly when full or complete medical treatment is not obtained, which is almost always the case in Afghanistan. According to UNICEF poor hygiene and sanitation are very common problems in Afghanistan, which is generally attributed to the poor economy, lack of resources and inadequate hygiene awareness among people, particularly in rural Afghanistan (Samay 2007).

The decrease in the total cases of waterborne disease from 2006 to 2007 (see Table 2) may indicate that the water and sanitation projects were beginning to improve environment health conditions; although more focus on hygiene education and sanitation practices could make these programs more successful. More details in this regard and general recommendation are provided in the last part of my paper.

There are many factors that have likely contributed to the overall increase in the cases of waterborne disease in the last five years. Between 2003 and 2004 the 37 percent increase was likely to be mostly due to the return of refugees and already existing contributory conditions, such as poor hygiene practices, degraded water supply infrastructure and poverty. However, the 13 percent increase between 2005 and 2006 was likely related to most of the same contributory factors with the exception of the return of refugees, because during 2005 to 2006 the return of refugees has almost stopped. Therefore, the return of refugee in this period is not the cause of the increase in cases of waterborne diseases.

There also were cholera outbreaks in 2003 and 2006 in the Bagrami District. There were 198 and 334 cholera cases in 2003 and 2006, respectively. Cholera is a serious infectious waterborne disease caused by the bacteria *Vibrio cholera*, which affects the intestinal system of the body. An infected person experiences severe vomiting, explosive diarrhea, and severe dehydration. Without immediate medical treatment, cholera may result in death within four to twelve hours after symptoms begin. Due to a large loss of body fluids, cholera is gruesome in the way that it leaves survivors in their physical appearance, as well as in the toll it takes on the body. Cholera is very contagious. It is spread by the unintentional consumption of infected feces that contaminate food and water (WHO 2005).

Trends by Village from 2003 to 2007

Table 3 shows the number of cholera cases by village during the outbreaks in 2003 and 2006. In 2003, 21 villages of the 37 villages (62 %) had cholera, and in 2006, 26 villages (70 %) had an outbreak of cholera. All villages (100%) had a cholera outbreak in either 2003 or 2006. This indicates that cholera outbreaks were widespread in the district. Cholera in Afghanistan is identified as a seasonal disease which usually occurs during summer months.

Table 3 – Number of Cholera Cases in 2003 and 2006

No	Village	2003	2006	Total
1	Adam khan	3	0	3
2	Alo khail	0	13	13
3	Butkhak	0	6	6

No	Village	2003	2006	Total
4	Char khab	8	23	31
5	Dahi yaqoub	12	0	12
6	Gard kol qoul	2	12	14
7	Gosfand dara	0	25	25
8	Gul buta	0	8	8
9	Hussain khail	11	6	17
10	Kamari	0	11	11
11	Mamozai	5	0	5
12	Markaz wolluswali	2	8	10
13	Meya khail	0	9	9
14	No burja	11	0	11
15	Qala ahmad khan	0	9	9
16	Qala ahmadzai	8	0	8
17	Qala bakar	8	0	8
18	Qala Hassan khan hulya	5	12	17
19	Qala Hassan khan payen	9	0	9
20	Qala jabar khan	0	17	17
21	Qala khandari	32	11	43
22	Qala Mohsin	0	12	12
23	Qala neyazi	7	7	14
24	Qala noman	40	34	74
25	Qala pakhchak	9	5	14
26	Qala rabaz	4	12	16
27	Qala sar abyan	0	5	5
28	Qala zan abad	0	12	12
29	Qala zard	10	0	10
30	Sayfuddin	9	0	9
31	Seya beni	0	6	6
32	Shena	0	16	16
33	Shewaki	13	0	13
34	Suhak	0	23	23
35	Wollayate hulya	3	32	35
36	Wollayate sulfa	5	12	17
37	Yakh dara kariz bala	5	0	5
	Total cases of cholera	221	346	567
	# of villages with cholera (% of villages with cholera)	23 (62%)	26 (73%)	37 (100%)

Village-level data on the number of cases of other waterborne diseases from 2003 to 2007 show that waterborne disease was relatively evenly widespread throughout Bagrami District, as were the district-wide increases noted above in 2003-04 and 2005-06. Twenty-two of 36 villages (61%) had increases in cases from 2003 to 2004, and 28 villages (78%) had increases in the number of cases from 2005 to 2006. From 2003 to 2007, the number of cases increased in 25 of 36 villages (69%) and the average increase in cases over that period was 24%. See Appendix B for detailed listings of total cases and percent changes in the number of cases of waterborne disease (diarrhea, dysentery, typhoid, amoebiasis and cholera) for each village.

Preliminary Explanations for Increases in Waterborne Disease from 2003 to 2007

According to representatives of UNICEF and MOPH, the increase in cases of waterborne disease noted above is closely related to the rapid return of refugees. The evidence supporting this observation is that the greatest annual increase in the number of waterborne diseases (2003-04) coincided with the return of a significant number of refugees between 2002 and 2004. The refugees returned to devastated water supply systems, which were further overwhelmed and contaminated by the increased population. Crowding increased stress and malnutrition, which also makes people more susceptible to diseases.

Although a precise analysis of the situation will need comprehensive study that is beyond my scope of work and objectives, I believe that proximity to the health facilities may be an influential factor in the disease rate. For example, the villages of Qala Ahmad Khan and Qala Noman are among the villages with highest number of cases of waterborne disease (see Appendix B). These two are among the most remote villages and are very far from the health facilities in the district.

I also think that the household size is a factor in the incidence of waterborne disease. In some informal conversations with villagers, I learned that in some households more than seven people live in one room, and more than 15 people use the same toilet without any hand washing facilities. I also believe that the primary source of drinking water in a village is another determinant of waterborne disease. Large numbers of cases of waterborne diseases in some of the villages are simply due to the quality of water itself. For example in Qala-e-Pakhchan and Dai-e-Yaqub the primary sources of water is the Logar river and community ponds. In these villages, there are no springs or wells, which are less likely to be contaminated, though certainly not immune to contamination.

The return of refugees varies from village to village and is another important factor that could explain variations in the numbers of cases of waterborne disease. For example more refugees have returned to villages that are close to Kabul City than have returned to villages located in remotest part of the district to the east. The greater the return of refugees, the greater their impacts are on the water supply and the more likely there is to be waterborne disease. Table 4 below shows 12 villages with the highest number of cases of waterborne disease. Seven of these villages experienced a large return of refugees. According to UNHCR, the most refugees returned to the villages of Budkhak, Gusfand dara, Seya Beni, Qala Kandari, Qala Ahmad Khan, Charkhab and Qala Niazi, and five of these seven are listed in Table 4.

Table 4 – 12 Villages with the Highest Rates of Waterborne Diseases

Name of Village	2003	2004	2005	2006	2007	Total
Char khab	21	51	44	61	47	224
Dahi yaqoub	41	54	39	52	49	235
Gard kol qoul	35	49	48	68	54	254
Gusfand dara	40	25	48	60	45	218
Qala ahmad khan	41	29	42	76	36	224
Qala noman	48	37	21	72	35	213
Qala Niazi	38	28	33	21	41	161
Qala rabaz	38	55	20	72	24	209
Seya beni	19	26	23	13	20	101
Wollayate hulya	26	32	26	77	33	194
Wollayate sulfa	26	31	23	34	45	159
Yakh dara kariz bala	37	37	43	20	46	183

REVIEW AND ASSESSMENT OF THREE WATER AND SANITATION PROJECTS IN BAGRAMI DISTRICT

This section of my paper carries out my second main objective, that is, to review and assess three water supply and sanitation projects or programs in the Bagrami District. The nature of activities conducted, overall goals and objectives, and project assessment tools were reviewed.

I selected these three projects because of their focus on water supply issues and because they had the best information available. Furthermore, these projects were carried out about 4-5 years ago, which allows sufficient time to assess the impacts and outcomes of them.

Table 5 – Summary of Three Water Projects Reviewed

Type of Project	Location	Cost	Duration	Funding Agency	Implementer
Hand Pump Installation Project	The villages of Seya Beni, Suhak, and Qala Ahmad Khan	250,000	April 21 to June 30, 2003	UNICEF	MRRD
Wells Chlorination Project	The villages of Qala Bakar, Yar Dara, Sayfuddin, Adam Khan and Bujra	90,000	July 01, to July 15, 2003	UNICEF	MOPH
Springs/Karezes Rehabilitation Project	The villages of Gulbuta , Alo Khel, and Shena	18,000	March 10 to May 11, 2006	UNICEF	MRRD

The villages covered by these projects are both Pashtun and Tajik and are rural in nature. In fact, they are rather remote, far from basic health facilities. Most of the villages covered by these three projects are among the largest in Bagrami. These were the main reasons that the aid agencies selected these villages as sites for the projects, that is, a large underserved population could potentially benefit from the interventions. I do not know if the villages for the three projects were also selected by the aid agencies based on the severity of health cases during last five years, because the health data do not clearly indicate that these villages are among the ones with the highest number of cases of waterborne disease. Please refer to Table 5 above about the type, cost, duration and location of the projects.

Bagrami Hand Pump Installation Project

To improve access to clean drinking water to the residents of Bagrami District, a hand pump installation project was initiated in April 2004. The project was carried out by Ministry of Rural Rehabilitation and Development and sponsored by UNICEF. The project goal was to install 250 hand pumps in schools, community centres and households in five villages to reduce morbidity and mortality from diseases associated with inadequate water supplies and water contamination. The project also sought to protect wells and minimize wasting water during use. The project goal was to achieve a ratio of one pump for every three households.

Diarrhea, dysentery, and a few cases of cholera were health issues that had previously been identified in the villages of Seya Beni and Qala Ahmad Khan. A report about prevalence of serious water diseases was published by Ministry of Public Health in 2003, which was followed by a site visit to the area and a meeting with villagers. UNICEF personnel along with representatives from MOPH visited the areas and made a decision to implement the hand pump project.

Prior to this project people were using water from springs, *karezes*, and community wells that were located in community centres and mosques. People in Bagrami knew that dirty water could harm their family's health; however, they continued using it because they did not have a choice. People also knew that covering their wells after the hand pumps are installed can significantly reduce contamination and adverse health impacts of drinking water in Bagrami. The local awareness among the population was assessed through their level of comprehension about dirty water versus clean and their health impacts. Proper use of water supply facilities in proper manner was another measure that enabled me to assess the local awareness about water supply and sanitation programs.

Hand pumps are used to bring the water out of the wells and are commonly known as a low-cost, simple technology for distributed (as opposed to centralized) water supply systems. This project was located in three villages of Bagrami: (1) Seya Beni, (2) Suhak and (3) Qala Ahmad Khan. They are all located in the east of district centre, relatively far from Kabul city. Suhak and Qala Ahmad Khan are Pashtun-speaking people; whereas in Seya Benin, the majority of the people are Dari speakers. The water table in all three districts is between 20 to 25 meters deep during average years (UNICEF 2005). This is basically one of the reasons that the aid agencies chose the hand pumps option in these villages. The reason for selecting shallow water table areas for hand pump installation is because the hand pumps used in the project can lift water only 32 meters.

Assessment Methods

To assess the effectiveness of the Bagrami hand pump project, I had discussions with the project's key actors in Bagrami: MOPH, UNICEF, and German Agro Action project staff. I also had group discussions with the users and community leaders at the village and district levels, and I made direct observations. Apart from individual interactions with villagers, during the period of research I had three formal meetings with the villagers.

I also had the opportunity to use the project completion report to determine the number of hand pumps installed. I was able to conduct an inventory of the hand pumps that were installed in the village of Suhak (see below).

Project Activities Carried Out and Outcomes Assessment

The project provided safer drinking water to 1800 people in the area. MRRD technicians were involved in installation of the pumps and training of some community members about how to fix minor hand pump problems. Local communities and district authorities were consulted to identify the most advantageous wells for the installation of hand pumps.

Although the project goal was to install 250 hand pumps with platform construction, I doubt that actually occurred. According to the UNICEF project completion report, 82 pumps were installed in the village Suhak; however, I found only 52 pumps, 16 of which were not functional. I also noticed that very few of the 52 pumps were installed in schools as planned.

Training courses for local communities on maintaining the pumps were conducted. Five water point mechanics and five masons were trained in hand pump platform construction. Five wells caretakers were also trained. The training mainly included how to open and assemble the part of the hand pumps that may need periodic maintenance. Selection of trainees was made based on consultation with local people. However, a few weeks after the project was completed, most of the trainees chose not to stay in the area or refused to repair the pumps with minor problems. This was due to the lack of a proper system or provision of some incentives to the trainees by UNICEF or the community.

The project was implemented by UNICEF. Therefore, UNICEF along with the community was responsible to establish as system for the maintenance. This is strange to hire some one for a job without any incentive or payment from any source.

During the implementation period of my project (see below), I was told by some villagers that in the past, lack of coordination and duplication of activities were major issues among NGOs. In some locations two hand pumps were given for one well, while in the neighbouring villages, no pumps were provided. This is all due to the lack of coordination and harmonization of activities by the decision makers. Decisions on which water wells to install hand pumps were based on personal contacts and reference letters from the district administrator. Communities were never consulted during the selection of the wells for the installation of hand pumps.

In some cases the pumps were installed in locations where people do not have equal access to the facilities. There are examples where pumps are within 20 meter from each other, but in other places the distance between two pumps is more than 200 meters. Sometimes in a community-based project like this, unfair allocation of resources can lead to a community conflict and a complete failure of the project. A greater number of people could be served if the pumps were more widely distributed. Situations like this cause tension among people and reduce the support of communities for such projects.

I did not find the project to be enduring at all. Most of the pumps are already broken or removed from the wells. People are still drinking dirty water in many locations, despite the huge amount of funds spent.

Lessons Learned and Recommendations

The program should have been based on providing the villages with traditional hand pumps, and program coordinators should have learned from an earlier project with high-tech reverse units. The previous hand pump projects implemented by the Danish Committee for Aid to Afghan Refugees (DACAAR) and CARE international were not as successful because the unit was complex and costly for the villagers to maintain. According to UNICEF the most desirable hand pumps in Afghanistan are the AFREDIVE hand pumps. The three types of AFREDIVE pumps as follows:

- The Kabul Pump (traditional pump): good for the shallow wells between 20-25 meters.
- The Indus Pump: used for the wells up to 40 meters.
- The Pamir Pump: used in wells up to 80 meters.

Among the three types of pumps, Kabul pumps are the best and the most frequently used variety in Afghanistan.

Figure 6 – AFREDIVE Kabul Hand Pump

(Source: UNICEF Afghanistan Country Office)

UNICEF/MRRD had planned to work with the villagers to collectively select locations where hand pumps would be located, but they never did. Most of the sites were not chosen where it was known that clean underground water sources existed and would be easily accessible by most villagers. I was told by a villager that as a result, in all three villages, 30 hand pumps were installed, but the water was not drinkable. The bottom line is that there is a critical need for both technical and local inputs in selecting the wells for hand pump installation. Sometimes relying solely on local inputs is not sufficient.

To sustain the program, I think there is a need to establish a Water and Sanitation Committee for the whole district. The main responsibility of these district-wide committees could be to manage and oversee the operation, repair and maintenance of the hand pump units and ensure they provide maximum benefit to the local people. The key to a hand pump program's success is consultation with the communities. This can be achieved through the formation of local committees (comprised of both men and women) to manage and maintain simple technology pumps; and collaborate with tribal heads, district governments and local NGOs. Having such an organizational structure is essential to effectiveness and sustainability of these projects.

A considerable percentage of the people of Bagrami will continue to depend on hand pumps for their water supply for a long time into the future. In view of this, it is, therefore, necessary that the issue of hand pump spare parts supply be addressed not only at the project level but also at the national level. Private entrepreneurs should be identified, encouraged and assisted to import hand pump spare parts, which will be made available to users at sales centres to be established in the local trading centres within the vicinity of the villages.

High-tech equipment is not easy for communities to maintain and has less chance of being a sustainable solution. After further community discussions and investigations into other options, I concluded that the most effective solution would be to install traditional hand pumps. The traditional hand pumps are called AFREDIVE pumps and have been used in Afghanistan for the last three decades. They are very easy to operate and inexpensive to maintain. It is recommended that the government and NGOs stop any drilling of further wells and instead of installing new hand pumps, concentrate on the rehabilitation of the old ones, including harvesting of the excess ones of which the communities may not need.

Review of Bagrami Wells Chlorination Project

Figure 7 – Chlorination of Well in the Village of Qala Bakar

(Photo by Mumtaz Ahmad, 2008)

As in many other parts of the country, there are very few people who have had access to safe drinking water in Bagrami. This has caused high rates of waterborne disease, which has greatly impacted the health and socioeconomic situation of people. The overall goal of the project was to help the people of Bagrami District to have access to safe drinking water so as to reduce the health impacts associated with contaminated water.

The project was funded by UNICEF and implemented by Ministry of Public Health. The purpose of this project was to provide safe drinking water in villages of Qala bakar, Yak Dara, Sayfuddin, Adam Khan and Bujra and to reduce waterborne diseases resulted from using unsafe water. The planned activities included chlorination of 216 wells in the four villages. The project activities also included training of 230 community people about techniques and procedures for chlorinating wells, including the proper dosage per well and safety measures to follow during chlorination. Chlorination of wells has proved to be a very useful approach for purification of water in the Bagrami District. The request for the project came from the people of the four villages that asked to have their wells chlorinated.

Assessment Methods

The project was assessed primarily on the basis of direct observations. It took me two days to observe 65 wells that were labelled "chlorinated." I got the information about the number of wells chlorinated from the project completion reports produced by MOPH and UNICEF. I also had casual discussions with villagers about the dates these wells were chlorinated and by whom.

Project Activities Carried Out and Outcomes Assessment

During this project, 216 (200 private and 16 public) wells were tested for residual chlorine, pH and bacteriological organisms. According to the action plan for the project, the Bagrami District was divided into eight clusters, each with one supervisor of 1-2 teams. Each team was to chlorinate 5-10 wells per day in addition to conducting water testing. The total budget of the project was 90,000 U.S. dollars (USD) and was completed in 15 days. As a precaution based on the water quality data, all 216 wells tested were chlorinated plus an additional 129 wells for a total of 345 wells. The wells were actually tested after the chlorination, which was meant for the planning purposes of the upcoming rounds of chlorination in the future.

However, due to the lack of education and training, many wells have been over-chlorinated. According to MOPH, many people in Bagrami are under the impression that the higher the dosage of chlorine, the cleaner their water will be. One major issue during chlorination is program coordination. Most of the wells chlorinated by UNICEF and MOPH had identifying labels placed on the outside of the wells, which included information such as the well number, depth and date of chlorination. However, some wells did not have a label, and this confused the next round of chlorinators, who were unsure abut whether to chlorinate those wells are not. This lack of knowledge by the chlorinators and perhaps miscommunication of information to the villagers resulted in the over-chlorination of some wells.

The plan also included house-to-house field visits by female hygiene educators. The female health educators were selected from the targeted communities, or were identified by MOPH to convey health messages to each family about family and environmental sanitation and to raise public awareness about the entire sanitation process. School teachers, mullahs, Imams, and mass and print media were also used and played a constructive role in the implementation of this life-saving project.

Lessons Learned and Recommendations

One important general lesson from reviewing this project is that coordination of activities and transparency during the selection of personnel and wells are key for project success. In Afghanistan, many projects fail because of inequity in the provision of services. Beneficiaries and personnel are often selected based on nepotism, personal contacts, and sometimes corruption and bribes.

The over-dosage of chlorine in wells has posed a health threat of its own. Based on casual discussions with some villagers, I was told that in the past some people got sick when they used their well water after chlorination. However, I could not get any credible information about the type of sickness.

One reason the over-dosage of chlorine occurred was that the project leaders brought some personnel from Kabul City that were not familiar with the culture and tradition of the target communities. In Afghanistan, women and children are mostly responsible for water collection activities, and in a typical village women gather around the wells. Based on local custom and norms, it is totally unacceptable when a stranger enters their house without prior permission for whatever reason. However, people of the same village/community can enter a home without a problem. Since the project personnel were brought from Kabul, they were unable to obtain information about whether chlorination had already occurred, if for example, a sign indicating the well had been chlorinated had not been posted by another team or if the sign had been removed. As a result, villagers did not accept or cooperate with project personnel, and relations with the community were seriously strained.

In Afghanistan it is important to be very careful in selecting project personnel when contact with women is involved. Projects like this can end up creating a major conflict in a community or among aid agencies, national and district government, and the community. Thus, it is strongly recommended that they are planned very wisely and in close accordance with local standards and strictly keeping in mind the cultural values.

Governance over water projects at the local level can present challenges especially when a project is being introduced by outside entities and personnel who are unfamiliar with the local setting. Typically, the village head (Malak) usually tries to control a major portion of the project. This individual might also be chosen as a decision maker without any control and monitoring of the resources and outputs. It is always good to involve the village head in projects, but making him the sole decision maker is a serious mistake. To avoid local abuse of power, the village head can be made responsible for the supervision of the activity. However, it is never a wise decision to allow him to control project finances or decisions for the overall project.

In villages people are usually fed up with corruption and the selfish and egotistic behaviour of the village heads. When an NGO and aid agency chooses such individuals to be responsible for projects, people start hating that entity as well, and instead of supporting the project, they start creating obstacles to implementation. That said, it must be recognized that chlorination of drinking water can be very effective in reducing morbidity and mortality associated with waterborne diseases. If well-designed and with full involvement of the men and women in communities, chlorination projects can be an important component of a comprehensive strategy to improve drinking water quality.

The improper use of chlorine to reduce the risk of infectious disease is suspected of posing other health threats. It may account for a substantial portion of the cancer risk associated with drinking water (Samay 2007). During my field observation, I found many wells that were chlorinated two or three times in one month. This underscores the critical need for coordinating the chlorination activities to avoid any further duplication.

In some locations the wells were chlorinated to address coliform bacteria problems, and immediately after chlorination the wells were used. However, technically the well water needs to be tested at an accredited lab before people begin using it again.

To do this, there is a need to collect a water sample to determine if there are proper levels of chlorine in the water about one week after the well is chlorinated. This could also be tested through simplified field tests; in Afghanistan this has not been used in the past.

Review of Bagrami Springs/Karezes Rehabilitation Project

The goal of this project was to provide safe drinking water to villages of Gulbuta, Alo Khel and Shena to reduce waterborne diseases resulting from use of unsafe water for domestic purposes. The project consisted of the rehabilitation of 13 springs and seven *karez* systems in the villages. The project duration was two months, which began on March 10, 2006 and continued until May 11, 2006.

In Afghanistan, most regions are characterized by very windy and dry climatic conditions. Large networks of underground channels, or *karezes*, and open-air canals have been developed, sometimes over many centuries. They are usually regularly maintained by traditional user organizations. The head of the organization is called Mehrab Bashi. The water from springs and *karezes* in Bagrami is used for drinking purpose and for irrigation. *Karezes* and springs are usually considered valuable community assets. Over the last three decades, this important water infrastructure has been neglected during the various wars or destroyed by bombs in some areas. Their rehabilitation, especially for collapsed *karezes*, is a huge task beyond the capacity of local communities. UNICEF supports the rehabilitation program with the aim of lessening dependency of the villagers on collecting drinking water from local streams and ponds or from more distant locations.

Rehabilitation of *karezes* and springs was on the priority list of community needs in this district. Most of the *karezes* and springs were more than 40 years old and are considered the only source of water for the people.

Assessment Methods

Like other assessment methods, my review included studying the project completion report versus actual observation on the site and informal discussions and conversations with community members.

Project Activities Carried Out and Outcomes Assessment

As per communities' requests, 13 village springs and seven community *karezes* were rehabilitated in the three villages. The rehabilitation of *karezes* and springs included removal of broken rocks and debris, construction of a platform and some concrete work on the spring/*karezes* initial flow (10-15 meters from the water source).

In general, the rehabilitation of springs and *karezes* greatly reduced the amount of time for water collection and the health impacts of using contaminated surface waters from alternate sources. However, I also noticed that in some locations people are using springs for bathing purposes while downstream people are using the same water for drinking purposes.

Though the project need was identified by the communities themselves, there was not enough participation of people during the actual design of the project. Villagers were not involved during initial stage of the project, and the equity of access was not good. Due to limitations of the funds (i.e., a budget sufficient for 13 springs and 7 *karezes*) equal number of *karezes* and springs in the two villages should have been rehabilitated. But due to personal contact of some villagers with governor and site engineers, some of the *karezes* and springs were not rehabilitated. I was also told in some interviews with villagers that the project focused on the areas of Dari-speaking people and intentionally excluded the Pashtun-speaking areas from the project, because Pashtuns were a minority in these three villages. One of the unexpected outcomes during the project implementation was a community dispute that claimed the lives of two people in the village of Gulbuta.

Lessons Learned and Recommendations

The general physical implementation of the project was satisfactory, with exception of a few springs and *karezes* that have subsequently collapsed. The *karezes* and springs targeted by the projects were not selected in consultation with local people. The rehabilitation of some *karezes* has significantly impacted the amount of water in neighboring springs and *karezes*, and this has caused social unrest in the community. The rehabilitation of *karezes* usually include desilting, some stone masonry works in the outlets digging them deeper, especially when there is drought. Also, during spring's rehabilitation some laborers were brought from neighboring villages. This was also one of the mistakes that could have been avoided.

Indeed, these problems could be avoided by seeking out and using local expertise and by obtaining local advice during project implementation. For the successful implementation of such projects, it is essential to understand the social and political dynamics in a community. It is also important to communicate to different groups about decisions being made. Equity considerations are essential in making resource allocation decisions to prevent community conflict. I have noticed that some the springs and *karezes* worked on in this project have totally collapsed, apparently due to lack of proper maintenance or use. This means that a certain amount of money was wasted.

THE BAGRAMI WATER PURIFICATION PROJECT

Figure 8 – Community Elders Meeting at District Governor's Office

(Photo by Mumtaz Ahmad 2008)

The third objective of this professional paper was to review and assess the implementation of a water purification project which I helped coordinate. The project was designed to apply lessons learned from previous projects and implement a multifaceted approach to address water and sanitation problems in Bagrami. In addition to describing this project and assessing its effectiveness, I reflect on my experience in order to offer additional insights and recommendations for NGOs, aid agencies, and my government regarding implementing effective, sustainable and equitable water and sanitation projects. The main thing that was different and innovative about this project was the technical and financial support of MOPH. In the past MOPH used to play only the mentoring rule with much less involvement in actual implementation. During the project MOPH was very involved in almost all stages.

The Bagrami Water Purification Project took place in various stages, which included initial water testing (five villages only), chlorination of wells, and distribution of water purification filters and hygiene education. The project was sponsored by United States Agency for International Development (USAID) and implemented by Water Supply and Sanitation Entity (WSSE). WSSE is an Afghan national NGO set up to coordinate and lead work under contract with international NGOs and aid agencies. I was the overall manager of the project and hired by the Organization for Water Supply and Sanitation (OWSS), which is an Afghan National NGO who counterparts with UNICEF, WHO and other funding agencies who work in water supply sector in Afghanistan.

Project Background and Need

The water purification filters were primarily intended for household use in the Bagrami District. This project was a fundamental part of an overall water sanitation strategy that combined well chlorination and intensive educational efforts aimed at improving water hygiene in Bagrami District. Bagrami District is not very far from Kabul city, but it is a neglected and poor district. Bagrami has never been included in rural development programs because of the incorrect impression that Bagrami is within Kabul City tertiary. Unfortunately, the area has regularly been deprived of urban development programs because. Lack of proper leadership and lack of organization in the district are the main reasons for the negligence by the local authorities (Rohullah 2007).

Project Planning and Preparation

The chlorination of wells was decided by Ministry of Public Health after the water testing results were announced. Thirty-nine wells in five villages were sampled by our teams; however, the remaining wells were tested by MOPH under other projects. The villages included Shewaki Wollayate sulfa, Butkhak, Alo khil and Mamozai. The actual testing of water was conducted by MOPH through a private laboratory in Kabul. The results of the tests are shown in Appendix C. I present a summary analysis of the water test results below.

Before starting the actual project activities, we consulted with heads of *shuras*, which are community councils that make important community decisions (see Figure 8). The discussions took place during the last week of January 2008 and primarily focused on: (1) conducting the project work in various phases; (2) assigning teams for each village; (3) assessing the security situation in each village; and (4) assigning duties.

The first step in planning the project was hiring forty female teachers hired from girls' schools in our project villages to work as community educators and filter distribution focal persons. We (MOPH representative, two district council members and I) also trained and brainstormed with the project personnel about how to approach the villagers, how to communicate to the people the benefits of the project, and how to educate them on proper use of filters. We also trained the teachers on how to deliver household hygiene lessons. The selected villages are widely distributed throughout Bagrami and the existing water resources are shallow wells and springs. The selection of villages was based on recommendations by the district officials and MOPH, based on preliminary assessment work.

The project was sponsored by USAID and implemented/administered by OWSS and MOPH. All key decisions including budget allocations and selection of sites were made by OWSS, MOPH and community councils. The project planning was based on preliminary research on what the villagers knew about waterborne disease and initial water testing that indicated the level of contaminated water in different villages. After testing the water, OWSS in consultation with MOHP made a decision to distribute water filters as the most cost effective and efficient water purification tool.

The plan was to use the UNICEF standard filters that are made in Pakistan. Each filter cost USD 70 and is expected to last for up to three years if safely used by a typical household. It is very important to mention that in Afghanistan using filters for water purification has proved to be an effective approach that is supported both by UNICEF and WHO.

Project Activities Carried Out and Outcomes Assessment

The project activities included chlorination of 204 wells in 17 village of Bagrami District. The project lasted 45 days, starting on February 15, 2008 and finishing on March 30, 2008. The total cost of the project was USD 45,000. Target beneficiaries included 1540 people in 17 villages. The project also included distribution of 207 water filters that could clean water for seven people per household with a total service capacity of 1428 people.

Table 6 shows the number and percentage of the 204 wells tested from September 2007 to February 2008 that exceeded WHO health guidelines for drinking water. No wells exceeded the nitrite and nitrate guidelines. It should be noted, however, that the nitrite guideline of 3 mg/l is for short-term exposure, and that WHO has a provisional standard for long-term or chronic exposure of 0.2 mg/l. The WHO issues provisional guidelines when "…there is evidence of a hazard, but the available information on health effects is limited" (WHO 2006: 191). Only 11 wells (5.3%) exceeded the provisional guideline of 0.2. mg/l.

Water test results showed widespread high levels of contamination of *E. coli*. A total of 76 wells (36.5%) were found to have *E. coli*, an indicator of fecal contamination (see Table 6). Thus, a large percentage of wells could be considered to have dangerous bacterial contamination. It should be noted that the U.S. Environmental Protection Agency (US EPA) *E. coli* standard allows no more than 5% of samples to have detectable *E. coli*. It is not practical to take large numbers of samples from the numerous wells in areas like the Bagrami District. Nevertheless, wells exceeding the WHO guidelines should be prioritized for re-testing, especially those greatly exceeding the guidelines.

Table 6 – Number and Percentage of 204 Wells Tested for Bagrami District Water Purification Project That Exceed WHO Drinking Water Guidelines

	E. coli	Nitrite	Nitrate	Lead (Pb)
Unit of measurement	colonies per 100 ml	mg/l (ppm)	mg/l (ppm)	mg/l (ppm)
Detection limit	1	3	50	0.04
WHO guideline level	0	3	50	0.01
Number of wells above WHO guideline	72	0	0	136
Percentage of wells above WHO guideline	35.3	0.0	0.0	66.7

Ten wells had *E. coli* levels of 10 or more colony forming units per 100 ml. Five wells had *E. coli* levels of 100 or more; the villages and well identifications numbers for these wells are: The villages and wells with high levels of *E. coli* are shown in Table 7 (see Appendix C for a complete listing of water testing results). These 10 wells should be re-tested.

Table 7 – Bagrami District Water Purification Project Villages and Wells with High *E. coli* Test Results (10 or more colonies per 100 ml)

No	Village	Well No	Date Sampled	E coli Level
1	Adam Khan	2007-6	11/2/2007	>200
2	Gard kor quol	2007-23	11/7/2007	165
3	Gusfand Dara	2007-31	11/7/2007	>200
4	Mia Khil	2007-60	12/1/2007	165
5	Qala Zan Abad	2007-135	12/11/2007	11

No	Village	Well No	Date Sampled	E coli Level
6	Qala Zard*	SPLD-180	1/12/2008	11
7	Shena*	SPLD-187	1/14/2008	118
8	Sayfudin	2007-141	12/19/2007	11
9	Yakh Dara, Kariz Bala	2007-149	12/20/2007	11
10	Wollayate sulfa	2007-161	12/21/2007	41

Sources: MOPH 2008; Boost Lab 2007, 2008

The water test results also showed very high levels of lead in many villages. Short-term exposure to high levels of lead can cause vomiting, diarrhea, convulsions, coma or even death. Lead exposure is most serious for infants and young children, because they absorb lead more easily than adults and are more susceptible to its harmful effects. Even low level exposure may harm the intellectual development, behavior, physical growth and hearing of infants (Canadian Minister of Health, 2004). One-hundred-and-thirty-six wells (67%) had lead levels that exceeded the WHO guideline of 0.01 mg/l. Because the detection limit of 0.04 mg/l shown in laboratory tests is higher than the WHO guideline, it is possible that many more, even all, wells exceeded the guideline.

Table 8 – Villages and Wells with Extremely High Lead Levels (greater than 100 times the WHO guidelines)

No.	Village	Well No	Date Sampled	Lead Level (mg/l)
1	Adam Khan	2007-5	11/2/2007	2.02
2	But Khak	2007-11	11/5/2007	13.1
3	Gard kor quol	2007-23	11/7/2007	1.28
4	Gard kor quol	2007-27	11/7/2007	2.35
5	Gusfand Dara	2007-30	11/7/2007	2.02
6	Gusfand Dara	2007-35	11/8/2007	13.1
7	Hussain Khail	2007-42	11/8/2007	1.73
8	Mamoozai	2007-47	11/10/2007	7.88
9	Mia Khil	2007-60	12/1/2007	1.28
10	Markaz-e-W.	2007-69	12/2/2007	7.66
11	No Burja	2007-79	12/5/2007	6.63
12	No Burja	2007-83	12/5/2007	4.66

No.	Village	Well No	Date Sampled	Lead Level (mg/l)
13	Qala Pakhchak	2007-118	12/11/2007	6.63
14	Qala Pakhchak	2007-122	12/11/2007	4.66
15	Wollayate sulfa	2007-164	12/21/2007	2.14

Sources: MOPH 2008; Boost Lab 2007, 2008

Some wells had very high levels of lead. For example, 86 wells (42%) had levels of 0.1 mg/l or greater, i.e., 10 times the WHO standard, and 15 wells had levels equal to or exceeding 100 times the WHO standard, i.e., 1.0 mg/l or greater. The villages and well identifiers of the 15 wells and the lead levels are shown in Table 8 above (also see Appendix C).

The *E. coli* and lead water testing results indicate that there is widespread water contamination in the Bagrami District that is a serious public health concern. These findings underscore the need for effective water and sanitation projects, and in some cases rapid public health response. Wells that exceed WHO guidelines should be given highest priority for re-testing and monitoring. In addition, plans for treating well water from these wells should be developed, and if adequate source or point of use treatment cannot be accomplished, wells should be closed to further use and alternative water sources provides, until water quality from these sources can be improved. In fact, the MOPH has already informed the villagers to avoid using some of the highly contaminated wells until further notice. MOPH has plans to decide soon how to deal with this problem.

Lessons Learned

Overall the project was very successful. The strategy of involving the community councils worked very well. Also, prior consent with district authorities, particularly with the district administrator gave us more support and recognition during the project implementation. The brainstorming and training component during the project implementation was also a very positive approach.

However, one of the lessons we learned about women's involvement in the project was the selection criteria. It is highly recommended that women selected for any project should be given a very comprehensive briefing about the political, social and cultural settings of the target communities. It is also very important to clearly convey to the people project goals, objectives, and activities. Sometimes a single confusion about mandates and goals can cause more tension and problems among the target population and the project team.

Continuous discussion and consultation were made with local *shuras* during the planning and implementation of the project. Community participation in various stages was very crucial and key for the success of our activities. Without support from community members the project would not have been viable at all.

The effectiveness of previous water supply and sanitation programs and overall sustainability of our project were discussed with the community members and project team members. So many issues and concerns were raised and discussed during our meetings with villagers. The issues and concerns included water quality and quantity in their respective villages.

We were told that in the past the over-dosage of chlorination greatly polluted the wells in some villages of Bagrami District and surrounding communities. In an informal conversation with a community elder, we understood that UNICEF and MOPH provided a bulk of chlorine to the head of each village who then distributed them to other villagers. People were under the impression that the higher the dosage of chlorine used, the cleaner their water will be. However, in our project, before chlorinating the wells, people were briefed on the advantages of chlorination and the quantity needed for each well. The first round of chlorination was conducted by our teams along with two representatives of each village who would be responsible for the next rounds of chlorination. If there are other rounds of chlorination sponsored by the government or NGOs, incentives will be paid to these representatives, or if the chlorination is done by the villagers themselves, special fee will be given to the representatives.

CONCLUSION AND RECOMMENDATIONS

This chapter provides an overall analysis and synthesis of the findings and lessons from the entire paper and provides insights or recommendations for conducting effective water and sanitation projects in Afghanistan.

In Afghanistan most of water supply and sanitation projects, especially rural projects, have been introduced and implemented with little involvement of the target communities and villagers. This trend has always led to mistrust and lack of support from the intended beneficiaries. Projects have failed because of inadequate maintenance and upkeep of the facilities, due to insufficient local participation and a lack of a sense of local ownership.

I would strongly support the recent systematic reviews of water sanitation and hygiene interventions that suggest that the beneficial effects of improving household drinking water quality at the point of use (POU) to reduce diarrheal disease risks. Contemporary reviews estimate 30-40% reductions in diarrheal disease by improving household drinking water quality at the POU, making such treatment more effective than improvements at the source (Sobsey 2008).

Also, a focus on gender differences is of particular importance with regard to sanitation initiatives, and gender-balanced approaches should be encouraged in plans and structures for implementation. Simple measures, such as providing schools with water and latrines, and promoting hygiene education in the classroom, can enable girls to get an education that will be essential for them when they become responsible for their own households and meet opportunities to reduce health-related risks for all. Moreover, the design and the location of latrines close to home may reduce violence against women, which may occur when women have to relieve themselves in the open after nightfall.

Building capacity is very crucial for the sustainability of Water and Sanitation Programs. It means bringing together more resources, more people (both women and men) and more skills. Yet, when looking closely at capacity building in water supply and sanitation in developing countries, it becomes clear that most of the training is aimed at water resources and water supply specialists. Very few programs and projects are aimed at expertise in social development, sanitation, or hygiene education that emphasizes a gradual scaling down to those responsible for operation and maintenance of water supply and sanitation, who are primarily women. Targeting women for training and capacity building is critical to the sustainability of water and sanitation initiatives, particularly in technical and managerial roles to ensure their presence in the decision-making process.

In my opinion, communities that have demonstrated a willingness and ability to participate in the provision of services are to be empowered through participation in all aspects of delivery, including planning and construction of facilities. The community will be the owner and manager of the completed facility and responsible for its operation, maintenance and management through existing or a newly established representative bodies. The role of traditional leadership is extremely critical in project designs and implementation. Usually the *shura* members are the most influential and powerful people in villages and can cause many problems if not properly and openly consulted.

Recommendations during Planning Stages

It is highly recommended that existing community structures be used during planning and design of rural water supply and sanitation projects. In many parts of Afghanistan there are community-based structures. Therefore, they should be used or enhanced to take on the responsibility for operation and maintenance of new facilities. In other cases, the establishment of a small water supply and sanitation committee must be facilitated. Development of a management framework that includes the establishment of viable systems for operation and maintenance of facilities by the community is essential for the sustainability of the water supply projects.

Simple technology that can be maintained by rural communities must be used in water supply schemes, and local technicians (caretaker, pump mechanics) must be trained in maintenance of water supply facilities and paid. This is very important to facilitate private sector development in service delivery, maintenance, stocks and supplies; and to promote proven, locally appropriate technology, based on best practices that are best suited for local conditions and that can provide safe drinking water on a continuous basis. These technologies include: dug wells and bore wells with hand pumps; *karezes* systems that are maintained and/or rehabilitated, protected springs; and gravity pipe schemes.

Water supply systems cannot be operated or maintained by the local community if the facilities are high-tech. That is why no motorized pumps were used in the areas I studied, but clearly they would have even more problems than the simple hand pumps, which also suffered from a lack of locally available parts. Only pumps of proven quality that have spare parts readily available through the private sector should be used in the water supply schemes. Wherever the local conditions permit, bore wells should be established rather than dug wells to assure long-term operation and service of the wells.

Recommendations during Implementation Stages

More coordination is required between NGOs working in the water sector. I have noticed that a number of NGOs are doing the same job in one village, due to lack of coordination and harmonization. NGOs should prepare implementation guidelines for a coherent development approach through stakeholder consultancies. They also should develop and strengthen effective and viable facilitating partners and should establish effective and transparent monitoring and evaluation systems that direct sector-wide implementation.

MOPH and NGOs needs to watch over operation and maintenance on a district level and evaluate the private sector on a national and regional basis to identify capacity gaps that need to be addressed in relation to the policy framework for the rural water supply and sanitation sector. It is very important to provide technical capacity in project proposal preparation, planning, surveys, construction supervision and quality control. Equally important is the facilitation and development of cadre of well-trained and motivated community development and health & hygiene education workers. The local care-takers have to be paid; you cannot expect them to stay and take care of pumps without pay. They are probably the most intelligent and mobile folks in the village and will of course move to opportunities elsewhere.

The provision of water supply and sanitation facilities, i.e. filters, hand pumps, toiletries, without adequate and appropriate hygiene education can result in the mismanagement of these equipment and supplies and even increase the risks of disease outbreaks rather than reduce them. Hygiene education involves much more than the transfer of knowledge, and must focus on total behavior change of all members of a family and community if it is to be effective in reducing diseases. When combined with the water and sanitation components of the program, it will enable children and communities to adopt improved behaviors. It is possible that in some locations the wells might not be contaminated yet the rate of waterborne disease will still remain high. The basic cause here will be the luck of hygiene practices and proper sanitation. Therefore, there is an ongoing need for hygiene education that should include water and food hygiene such as sound water handling and food preparation practices.

An important policy for Afghanistan is to assist internally and externally displaced persons in moving back to their place of origin. It is critical that the issues of displacement, high population densities, and the redistribution of the population be addressed in order to avoid overwhelming local water supplies and waste absorbing capacities.

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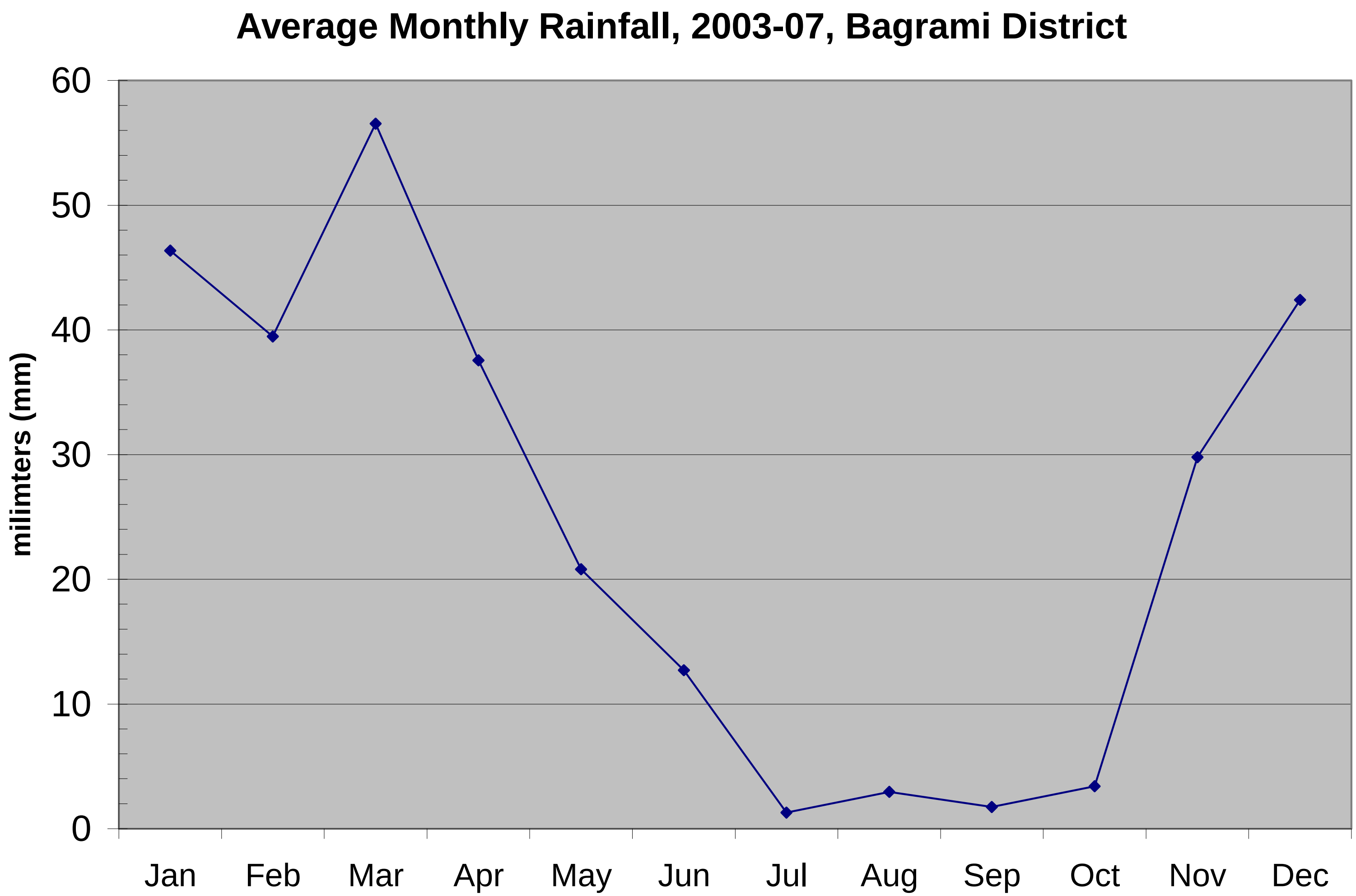
APPENDIX A

Monthly and Annual Rainfall Amounts in Bagrami, 2003-2007*

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year Total	Status
2003	6.3	22	47.8	28	5	0	0	0	0	4	7	7	127.1	Below Average
2004	23	21	0	47.7	32	2	0	0	2.7	5	8.5	50	191.4	Below Average
2005	93	45	54	32.5	60	15	0	0	0	0	22.5	0	322	Average
2006	110	84.4	99.4	58.6	0	0	2	13.3	6	8	111	138	600	Above Average
2007	0	25	81.5	21	7	47	4.5	1.5	0	0	0	17	199.5	Below Average

* Source: USGS, date. Rainfall measured in millimetres


Average Monthly Rainfall, 2003-07, Bagrami District
milimters (mm)
60
50
40
30
20
10
0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec

APPENDIX B

Total Cases and Percent Changes in the Number of Cases of Waterborne Disease by Village, 2003 to 2007
(includes diarrhea, dysentery, typhoid , amoebiasis and cholera)
Source: First Phase, Bagrami Water Purification Project -OWSS

No	Name of Village	2003	2004	2005	2006	2007	2003-04 % Change	2004-05 % Change	2005-06 % Change	2006-07 % Change	2003-07 % Change
1	Adam khan	29	39	42	46	45	34.5%	7.7%	9.5%	-2.2%	55.2%
2	Alo khail	35	42	41	56	25	20.0%	-2.4%	36.6%	-55.4%	-28.6%
3	Butkhak	20	40	48	58	44	100.0%	20.0%	20.8%	-24.1%	120.0%
4	Char khab	21	51	44	61	47	142.9%	-13.7%	38.6%	-23.0%	123.8%
5	Dahi yaqoub	41	54	39	52	49	31.7%	-27.8%	33.3%	-5.8%	19.5%
6	Gard kol qoul	35	49	48	68	54	40.0%	-2.0%	41.7%	-20.6%	54.3%
7	Gosfand dara	40	25	48	60	45	-16.7%	92.0%	25.0%	-25.0%	12.5%
8	Gul buta	22	10	32	46	39	-54.5%	220.0%	43.8%	-15.2%	77.3%
9	Hussain khail	33	22	19	63	47	-33.3%	-13.6%	231.6%	-25.4%	42.4%
10	Kamari	26	41	21	56	30	57.7%	-48.8%	166.7%	-46.4%	15.4%
11	Mamozai	23	45	20	51	23	95.7%	-55.6%	155.0%	-54.9%	0.0%
12	Markaz wolluswali	16	24	20	54	20	50.0%	-16.7%	170.0%	-63.0%	25.0%
13	Meya khail	32	37	19	49	38	15.6%	-48.6%	157.9%	-22.4%	18.8%
14	No burja	24	42	32	52	34	75.0%	-23.8%	62.5%	-34.6%	41.7%
15	Qala ahmad khan	41	29	42	76	36	-29.3%	44.8%	81.0%	-52.6%	-12.2%
16	Qala noman	48	37	21	72	35	32.1%	-43.2%	242.9%	-51.4%	-27.1%
17	Qala ahmadzai-qala jaji ha	46	26	43	26	16	-43.5%	65.4%	-39.5%	-38.5%	-65.2%
18	Qala bakar	37	21	41	45	32	-43.2%	95.2%	9.8%	-28.9%	-13.5%
19	Qala hassan khan hulya	37	46	22	26	43	24.3%	-52.2%	18.2%	65.4%	16.2%
20	Qala hassan khan payen	42	34	17	39	43	-19.0%	-50.0%	129.4%	10.3%	2.4%
21	Qala jabar khan	37	18	42	43	14	-51.4%	133.3%	2.4%	-67.4%	-62.2%
22	Qala khandari	58	20	23	30	38	-65.5%	15.0%	30.4%	26.7%	-34.5%

No	Name of Village	2003	2004	2005	2006	2007	2003-04 % Change	2004-05 % Change	2005-06 % Change	2006-07 % Change	2003-07 % Change
23	Qala mohsen		0	0	0	0					
24	Qala neyazi	38	28	33	21	41	-26.3%	17.9%	-36.4%	95.2%	7.9%
25	Qala pakhchak dowlat zai	23	29	20	30	57	26.1%	-31.0%	50.0%	90.0%	147.8%
26	Qala rabaz	38	55	20	72	24	44.7%	-63.6%	260.0%	-66.7%	-36.8%
27	Qala sar abyan	42	30	55	54	56	-28.6%	83.3%	-1.8%	3.7%	33.3%
28	Qala zan abad	18	41	45	49	19	127.8%	9.8%	8.9%	-61.2%	5.6%
29	Qala zard	27	38	47	35	20	40.7%	23.7%	-25.5%	-42.9%	-25.9%
30	Sayfuddin	29	43	66	51	40	48.3%	53.5%	-22.7%	-21.6%	37.9%
31	Seya beni	19	26	23	13	20	36.8%	-11.5%	-43.5%	53.8%	5.3%
32	Shena	22	51	27	20	48	131.8%	-47.1%	-25.9%	140.0%	118.2%
33	Shewaki	21	25	21	45	41	19.0%	-16.0%	114.3%	-8.9%	95.2%
34	Suhak	32	22	52	63	18	0.0%	136.4%	21.2%	-71.4%	-43.8%
35	Wollayate hulya	26	32	26	77	33	23.1%	-18.8%	196.2%	-57.1%	26.9%
36	Wollayate sulfa	26	31	23	34	45	19.2%	-25.8%	47.8%	32.4%	73.1%
37	Yakh dara kariz bala	37	37	43	20	46	0.0%	16.2%	-53.5%	130.0%	24.3%
	TOTAL	1141	1240	1225	1713	1305	6624	n/a	n/a	n/a	n/a
	NUMBER/PERCENT > 0	36	36	36	36	36	22	16	28	10	25
	AVERAGE	30.8	33.5	33.1	46.3	35.3	179.0	20.0%	11.7%	59.9%	-9.4%
	MEDIAN	32	34	32	49	38	175	21.5%	-7.0%	35.0%	-23.5%
	MAXIMUM	58	55	66	77	57	254	142.9%	220.0%	260.0%	140.0%
	MINIMUM	0	0	0	0	0	0	-65.5%	-63.6%	-53.5%	-71.4%

APPENDIX C

Well Testing Results before Chlorination in 17 Villages Served by the Bagrami District Water Purification Project
(also indicates which wells were chlorinated and where filters were distributed)

SOURCES: Ministry of Public Health 2008; Boost Laboratory 2007, 2008; WHO 2006[†]

[†] Used for *E. coli* nitrite, nitrate and lead drinking water guidelines. Nitrite levels is for short-term exposure (level for long-tern exposure is 0.2 mg/l)
* Denotes villages where samples were taken by Mumtaz Ahmad

Village	Well No	Date Sampled	Well Depth	Water Temp	pH	Total coli-form	E coli	Nitrite	Nitrate	Lead	Well Chlori nated	Filter Distri-buted
Unit of measurement			Feet	°C		Colonies/ 100 ml	Colonies /100 ml	mg/l (ppm)	mg/l (ppm)	mg/l (ppm)		
Detection limit			n/a	n/a	n/a	1	1	0.004	0.03	0.04		
WHO drinking water quality guideline			n/a	n/a	None	0	0	3	50	0.01		
AloKhail*	SPLD-166	1/11/08	80	15.4	7.2	27	<1	0.03	4.67	<0.04	Yes	Yes
AloKhail*	SPLD-167	1/11/08	110	14.5	7.5	<1	<1	0	2	<0.04	Yes	Yes
Arzanqimat	2007-10	11/2/07	17.6	18.4	7	<1	<1	0	2	<0.04	Yes	Yes
Adam Khan	2007-1	11/2/07	65	14.3	6	18	8	0.04	2.94	0.08	Yes	Yes
Adam Khan	2007-2	11/2/07	57	14	7.4	1	<1	0.03	3.38	0.29	Yes	Yes
Adam Khan	2007-3	11/2/07	61.7	13.9	7.2	<1	<1	<0.004	3.16	0.08	Yes	Yes
Adam Khan	2007-4	11/2/07	64.8	13.3	7.7	4	<1	<0.004	2.95	0.75	Yes	Yes
Adam Khan	2007-5	11/2/07	75	14.8	7.5	2	<1	0.05	3.31	2.02	Yes	Yes
Adam Khan	2007-6	11/2/07	30	12.7	7	>200	>200	0.02	4.45	0.07	No	No
Adam Khan	2007-7	11/2/07	10	14.3	7.3	8	<1	0.005	2.96	0.08	Yes	Yes
Adam Khan	2007-8	11/2/07	99.8	13.8	7.5	0	<1	0.01	4.55	0.13	No	No
Adam Khan	2007-9	11/2/07	60	14.7	8.4	>200	2	0.01	2.46	0.07	Yes	Yes
But Khak	2007-11	11/5/07	70	17.4	7.4	78	<1	0.55	10.35	13.1	No	Yes
But Khak	2007-12	11/5/07	21	14.7	7.1	118	>1	0.02	2.08	<0.04	Yes	Yes
But Khak	2007-13	11/5/07	83	12.9	7.2	0	<1	<0.004	4.16	0.04	Yes	Yes

Village	Well No	Date Sampled	Well Depth	Water Temp	pH	Total coli-form	E coli	Nitrite	Nitrate	Lead	Well Chlori nated	Filter Distri-buted
But Khak	2007-14	11/5/07	20	14.7	7.3	411	1	0.03	7.08	<0.04	Yes	Yes
But Khak	2007-15	11/5/07	65	14.3	7.3	18	8	0.04	2.94	0.08	Yes	Yes
But Khak	2007-16	11/5/07	57	15	7.4	1	<1	0.03	3.38	0.29	Yes	Yes
Charkhab	2007-17	11/5/07	61.7	13.9	7.2	0	<1	<0.004	3.16	0.08	Yes	Yes
Charkhab	2007-18	11/5/07	39.8	15.5	7.3	1	<1	0.004	7.61	0.53	Yes	Yes
Charkhab	2007-19	11/5/07	69.5	14.8	7.2	2	<1	<0.004	7	0.23	Yes	Yes
Charkhab	2007-20	11/5/07	109.4	14.8	8.1	2	<1	0.02	1.71	0.25	Yes	Yes
Charkhab	2007-21	11/5/07	21.4	14.9	7.4	>200	9	0.04	4.56	<0.04	Yes	Yes
Dahi Yaqub	2007-22	11/7/07	60	14.5	7.3	1	<1	0.006	3.74	0.09	Yes	Yes
Gard kor quol	2007-23	11/7/07	26	14	7.3	>200	165	0.01	0.74	1.28	Yes	Yes
Gard kor quol	2007-24	11/7/07	60	14.5	7.3	1	<1	0.006	3.74	0.09	Yes	Yes
Gard kor quol	2007-25	11/7/07	11.6	15.6	7.7	1	<1	<0.004	3.62	0.06	Yes	Yes
Gard kor quol	2007-26	11/7/07	24.3	16.1	8	0		0.02		<0.04	Yes	Yes
Gard kor quol	2007-27	11/7/07	25	14.3	7.6	>200	<1	0.06	4.93	2.35	Yes	Yes
Gard kor quol	2007-28	11/7/07	39.2	16.4	7	0		0.02		<0.04	Yes	Yes
Gusfand Dara	2007-29	11/7/07	64.8	13.3	7.7	4	<1	<0.004	2.95	0.75	Yes	Yes
Gusfand Dara	2007-30	11/7/07	75	14.8	7.5	2	<1	0.05	3.31	2.02	Yes	Yes
Gusfand Dara	2007-31	11/7/07	30	12.7	7	>200	>200	0.02	4.45	0.07	No	Yes
Gusfand Dara	2007-32	11/7/07	10	14.3	7.3	8	<1	0.005	2.96	0.08	Yes	Yes
Gusfand Dara	2007-33	11/8/07	99.8	13.8	7.5	0	<1	0.01	4.55	0.13	Yes	Yes
Gusfand Dara	2007-34	11/8/07	60	14.7	8.4	>200	2	0.01	2.46	0.07	Yes	Yes
Gusfand Dara	2007-35	11/8/07	70	17.4	7.4	78	<1	0.55	10.35	13.1	Yes	Yes
Hussain Khail	2007-36	11/8/07	34.3	15.8	7.2	12	<1	0.007	23.99	0.74	Yes	Yes
Hussain Khail	2007-37	11/8/07	60	14.8	7.7	1	<1	0.007	8.45	0.1	Yes	Yes
Hussain Khail	Not sampled											Yes
Hussain Khail	Not sampled											Yes
Hussain Khail	2007-38	11/8/07	40	16.7	7	0	<1	0.02	0	<0.04	Yes	Yes
Hussain Khail	2007-39	11/8/07	35	15.6	7.1	5	<1	0.004	15.6	0.43	Yes	Yes

Village	Well No	Date Sampled	Well Depth	Water Temp	pH	Total coli-form	E coli	Nitrite	Nitrate	Lead	Well Chlori nated	Filter Distri-buted
Hussain Khail	2007-40	11/8/07	39.4	15.5	6.9	2	<1	<0.004	3.93	0.54	Yes	Yes
Hussain Khail	2007-41	11/8/07	25.1	15.9	7	2	<1	<0.004	144	0.27	Yes	Yes
Hussain Khail	2007-42	11/8/07	26.3	13.1	7.8	219	<1	0.01	3.88	1.73	Yes	Yes
Mamoozai	2007-43	11/10/07	28.5	11.9	7.8	20	<1	<0.004	<0.03	<0.04	Yes	Yes
Mamoozai	2007-44	11/10/07	99.7	13.8	7.8	109	3	<0.004	3.92	<0.04	Yes	Yes
Mamoozai	Not sampled											Yes
Mamoozai	Not sampled											Yes
Mamoozai	2007-45	11/10/07	20	14.1	7.8	>2420	6	0.04	4.91	0.53	Yes	Yes
Mamoozai	2007-46	11/10/07	18	15.2	7.5	<1	<1	<0.004	15.8	0.12	Yes	Yes
Mamoozai	2007-47	11/10/07	52	13.3	7.7	<1	<1	0.16	9.15	7.88	Yes	Yes
Mamoozai	2007-48	11/10/07	85	17	7.7	<1	<1	<0.004	0.26	0.54	Yes	Yes
Mamoozai	2007-49	11/10/07	47	16.4	8.1	10	<1	0.006	12.89	<0.04	Yes	Yes
Mamoozai	2007-50	11/10/07	25	16.1	7	>200	1	<0.004	29.5	<0.04	Yes	Yes
Mamoozai	2007-51	11/10/07	15	16.6	7.1	0	<1	<0.004	5.64	<0.04	Yes	Yes
Mamoozai	2007-52	11/10/07	43	16.2	6.9	2	<1	<0.004	9.97	0.07	Yes	Yes
Mia Khil	2007-53	12/1/07	57	15	7.4	1	<1	0.03	3.38	0.29	Yes	Yes
Mia Khil	2007-54	12/1/07	61.7	13.9	7.2	0	<1	<0.004	3.16	0.08	Yes	Yes
Mia Khil	2007-55	12/1/07	39.8	15.5	7.3	1	<1	0.004	7.61	0.53	Yes	Yes
Mia Khil	2007-56	12/1/07	69.5	14.8	7.2	2	<1	<0.004	7	0.23	Yes	Yes
Mia Khil	2007-57	12/1/07	109.4	14.8	8.1	2	<1	0.02	1.71	0.25	Yes	Yes
Mia Khil	2007-58	12/1/07	21.4	14.9	7.4	>200	9	0.04	4.56	<0.04	Yes	Yes
Mia Khil	2007-59	12/1/07	60	14.5	7.3	1	<1	0.006	3.74	0.09	Yes	Yes
Mia Khil	2007-60	12/1/07	26	14	7.3	>200	165	0.01	0.74	1.28	Yes	Yes
Mia Khil	2007-61	12/1/07	60	14.5	7.3	1	<1	0.006	3.74	0.09	Yes	Yes
Mia Khil	2007-62	12/1/07	25	14.2	7.5	3	>1	0.009	3.64	0.04	Yes	Yes
Mia Khil	2007-63	12/1/07	30	15.5	7.3	3	>1	0.03	2.17	0.36	Yes	Yes
Mia Khil	2007-64	12/1/07	70	18.5	7.8	>200	>1	<0.004	3.06	0.38	Yes	Yes
Mia Khil	2007-65	12/1/07	70	18	7.7	0	>1	<0.004	3.71	0.16	Yes	Yes

Village	Well No	Date Sampled	Well Depth	Water Temp	pH	Total coli-form	E coli	Nitrite	Nitrate	Lead	Well Chlori nated	Filter Distri-buted
Mia Khil	2007-66	12/1/07	30	15.9	7.5	>2420	>1	0.04	11.56	<0.04	Yes	Yes
Mia Khil	2007-67	12/1/07	53.2	18.6	8	>200	>1	0.02	3.68	0.06	Yes	Yes
Mia Khil	2007-68	12/1/07	39.3	17.3	7.3	0	1	0.01	2.71	0.06	Yes	Yes
Markaz-e-W.	2007-69	12/2/07	49.8	16	7.8	488	<1	0.06	11.24	7.66	Yes	Yes
Markaz-e-W.	2007-70	12/2/07	26	14.3	7.2	>200	<1	0.07	6.32	0.08	Yes	Yes
Markaz-e-W.	2007-71	12/2/07	22	13.7	7.5	36	<1	0.03	1.11	0.13	Yes	Yes
Markaz-e-W.	Not sampled											Yes
Markaz-e-W.	2007-72	12/2/07	25	14.2	7.5	3	0	0.009	3.64	0.04	Yes	Yes
Markaz-e-W.	2007-73	12/2/07	30	15.5	7.3	3	>1	0.03	2.17	0.36	Yes	Yes
Markaz-e-W.	2007-74	12/2/07	70	18.5	7.8	>200	>1	<0.004	3.06	0.38	Yes	Yes
Markaz-e-W.	2007-75	12/2/07	70	18	7.7	<1	>1	<0.004	3.71	0.16	Yes	Yes
Markaz-e-W.	2007-76	12/2/07	30	15.9	7.5	>2420	>1	0.04	11.56	<0.04	Yes	Yes
Markaz-e-W.	2007-77	12/2/07	53.2	18.6	8	>200	>1	0.02	3.68	0.06	Yes	Yes
No Burja	2007-78	12/5/07	39.3	17.3	7.3	<1	1	0.01	2.71	0.06	Yes	Yes
No Burja	2007-79	12/5/07	159.5	17.3	7.8	517	<1	0.19	1.73	6.63	Yes	Yes
No Burja	2007-80	12/5/07	24.7	14.6	7.5	12	<1	0.01	2.27	0.14	Yes	Yes
No Burja	2007-81	12/5/07	48	15.4	8	<1	<1	0	2	<0.04	Yes	Yes
No Burja	2007-82	12/5/07	7	15.6	7.3	161	6	0.18	16.42	<0.04	Yes	Yes
No Burja	2007-83	12/5/07	34.5	18.2	7.8	24	<1	0.24	35.36	4.66	Yes	Yes
No Burja	2007-84	12/5/07	16	14.7	7	0	<1		0	<0.04	Yes	Yes
No Burja	2007-85	12/5/07	30	15.5	7.3	3	>1	0.03	2.17	0.36	Yes	Yes
No Burja	2007-86	12/5/07	70	18.5	7.8	>200	>1	<0.004	3.06	0.38	Yes	Yes
Pole Charkhi	2007-87	12/5/07	70	18	7.7	0	>1	<0.004	3.71	0.16	Yes	Yes
Pole Charkhi	2007-88	12/5/07	20.1	18.3	7.4	50	>1	0.05	7.8	0.13	Yes	Yes
Pole Charkhi	2007-89	12/5/07	38.5	17.5	8		<1	0	3	<0.04	Yes	Yes
Pole Charkhi	2007-90	12/5/07	112.5	16.6	9	200	<1	<0.004	<0.03	<0.04	Yes	Yes
Pole Charkhi	2007-91	12/5/07	35	16.4	7.8	8	<1	0.01	1.64	<0.04	Yes	Yes
Pole Charkhi	2007-92	12/5/07	26	16	7.7	19	<1	<0.004	2.66	0.1	Yes	Yes

Village	Well No	Date Sampled	Well Depth	Water Temp	pH	Total coli-form	E coli	Nitrite	Nitrate	Lead	Well Chlori nated	Filter Distri-buted
Qala Jabar	2007-93	12/6/07	60	16.1	7.3	0	>2	<0.004	8.52	<0.04	Yes	Yes
Qala Jabar	2007-94	12/6/07	50	16.7	7.8	2	1	<0.004	0.64	0.15	Yes	Yes
Qala Jabar	2007-95	12/6/07	74	17.4	7.6	101	>1	0.01	3.24	0.08	Yes	Yes
Qala Jabar	2007-96	12/6/07	45	16.1	7.3	0	>1	0	4	<0.04	Yes	Yes
Qala Jabar	2007-97	12/6/07	25	16.5	7.6	11	>1	<0.004	2.44	0.37	Yes	Yes
Qala Mohsin	2007-98	12/6/07	30	14.4	7.3	>200	2	0.02	4.21	0.15	Yes	Yes
Qala Mohsin	2007-99	12/6/07	34.6	17.9	7.6	3	<1	0.008	2.49	0.23	Yes	Yes
Qala Mohsin	2007-100	12/6/07	63.7	13.3	7.5	0	<1	<0.004	2.3	0.1	Yes	Yes
Qala Mohsin	2007-101	12/6/07	35	13.9	7	74	2	0.02	3.7	0.09	Yes	Yes
Qala Mohsin	2007-102	12/6/07	19.2	14.4	7.4	0	<1	<0.004	3.37	0.05	Yes	Yes
Qala Mohsin	2007-103	12/8/07	34.3	13.9	7.4	1	<1	0.004	3.37	0.13	Yes	Yes
Qala Mohsin	2007-104	12/8/07	81.7	14.9	8.2	3	>1	0.03	2.17	0.36	Yes	Yes
Qala Mohsin	2007-105	12/8/07	59.7	18.9	7.3	>200	>1	<0.004	3.06	0.38	Yes	Yes
Qala mughul	2007-106	12/8/07	53	16.8	7.6	<1	>1	<0.004	3.06	<0.04	Yes	Yes
Qala mughul	2007-107	12/8/07	100	20.2	7.5	<1	>1	<0.004	<0.03	<0.04	Yes	Yes
Qala mughul	2007-108	12/8/07	60	15.5	7	<1	1	0.08	1.16	0.27	Yes	Yes
Qala mughul	2007-109	12/10/07	11.4	14.6	7.4	<1	1.7	0	0	<0.04	Yes	Yes
Qala mughul	2007-110	12/10/07	75	16	7.4	<1	1	0	0	<0.04	Yes	Yes
Qala mughul	2007-111	12/10/07	700	15	7.4	1	1.5	<0.004	0.28	<0.04	Yes	Yes
Qala mughul	2007-112	12/10/07	30	15.5	7.3	3	>1	0.03	2.17	0.36	Yes	Yes
Qala mughul	2007-113	12/10/07	70	18.5	7.8	>200	>1	<0.004	3.06	0.38	Yes	Yes
Qala mughul	2007-114	12/10/07	70	18	7.7	0	>1	<0.004	3.71	0.16	Yes	Yes
Qala mughul	2007-115	12/10/07	30	15.9	7.5	>2420	>1	0.04	11.56	<0.04	Yes	Yes
Qala mughul	2007-116	12/10/07	53.2	18.6	8	>200	>1	0.02	3.68	0.06	Yes	Yes
Qala mughul	2007-117	12/10/07	39.3	17.3	7.3	0	1	0.01	2.71	0.06	Yes	Yes
Qala Pakhchak	2007-118	12/11/07	159.5	17.3	7.8	517	<1	0.19	1.73	6.63	Yes	Yes
Qala Pakhchak	2007-119	12/11/07	24.7	14.6	7.8	12	<1	0.01	2.27	0.14	Yes	Yes
Qala Pakhchak	2007-120	12/11/07	48	15.4		0	<1	0.2	2	<0.04	Yes	Yes

Village	Well No	Date Sampled	Well Depth	Water Temp	pH	Total coli-form	E coli	Nitrite	Nitrate	Lead	Well Chlori nated	Filter Distri-buted
Qala Pakhchak	2007-121	12/11/07	7	15.6	7.4	161	6	0.18	16.42	<0.04	Yes	Yes
Qala Pakhchak	2007-122	12/11/07	34.5	18.2	7.6	24	<1	0.24	35.36	4.66	Yes	Yes
Qala Pakhchak	2007-123	12/11/07	16	14.7	7.5	0	<1	0.2	0	<0.04	Yes	Yes
Qala Sarabyan*	SPLD-168	1/19/08	44	13.5	7.5	0	<1	0.2	0	<0.04	Yes	Yes
Qala Sarabyan*	SPLD-169	1/19/08	23.1	13.5	7.9	>200	>1	0.02	2.79	<0.04	Yes	Yes
Qala Sarabyan*	SPLD-170	1/19/08	45	14.4	7.3	>200	>1	<0.004	5	0.14	Yes	Yes
Qala Sarabyan*	SPLD-171	1/19/08	60	17.1	7.6	<1	>1	<0.004	5.9	0.16	Yes	Yes
Qala Sarabyan*	SPLD-172	1/19/08	88	15.6	7.3	0	>1	0.02	2.96	0.2	Yes	Yes
Qala Sarabyan*	SPLD-173	1/19/08	90	14	7.3	2	1	0.2	2	<0.04	Yes	Yes
Qala Zan Abad	2007-124	12/11/07	80	14.9	7.4	5	<1	<0.004	6.35	0.21	Yes	Yes
Qala Zan Abad	2007-125	12/11/07	82	15.4	7.3	0	<1	0.004	1.87	0.54	Yes	Yes
Qala Zan Abad	2007-126	12/11/07	60	16.8	7.4	5	<1	0 .4	1.2	<0.04	Yes	Yes
Qala Zan Abad	2007-127	12/11/07	48.1	15.8	7.8	2	1	0.004	1.64	<0.04	Yes	Yes
Qala Zan Abad	2007-128	12/11/07	40	14.3	7.5	>200	3	<0.004	2.97	<0.04	Yes	Yes
Qala Zan Abad	2007-129	12/11/07	44.7	16.1	7.5	82	<1	0.004	1.64	<0.04	Yes	Yes
Qala Zan Abad	2007-130	13/11/07	37.8	17	7.9	22	<1	<0.004	2.97	<0.04	Yes	Yes
Qala Zan Abad	2007-131	13/11/07	39	16.7	7.3	3	<1	<0.004	2.77	0.31	Yes	Yes
Qala Zan Abad	2007-132	13/11/07	32	15.8	7.6	82	<1	0.02	10.08	0.04	Yes	Yes
Qala Zan Abad	2007-133	13/11/07	9	15.5	7.3	22	<1	<0.004	3.91	<0.04	Yes	Yes
Qala Zan Abad	2007-134	13/11/07	17.6	15.8	7.5	613	<1	0.007	1.78	<0.04	Yes	Yes
Qala Zan Abad	2007-135	13/11/07	63	15.5	7.8	>2420	11	1.4	41.1	<0.12	Yes	Yes
Qala Zan Abad	2007-136	13/11/07	32	16.3	7.7	10	0	<0.004	8.51	0.17	Yes	Yes
Qala Zard*	SPLD-174	1/11/08	50	15.3	7.4	32	<1	0.004	6.01	0.06	Yes	Yes
Qala Zard*	SPLD-175	1/11/08	59.5	15.2	7.3	0	<1	<0.004	18.3	0.11	Yes	Yes
Qala Zard*	SPLD-176	1/11/08	35	14.9	7.7	19	1	0.004	4.04	0.14	Yes	Yes
Qala Zard*	SPLD-177	1/11/08	18	15.5	7.5	82	<1	0.02	10.08	0.04	Yes	Yes
Qala Zard*	SPLD-178	1/12/08	60	18.3	7.9	22	<1	<0.004	3.91	<0.04	Yes	Yes
Qala Zard*	SPLD-179	1/12/08	50	15.4	7.8	613	<1	0.007	1.78	<0.04	Yes	Yes

Village	Well No	Date Sampled	Well Depth	Water Temp	pH	Total coli-form	E coli	Nitrite	Nitrate	Lead	Well Chlori nated	Filter Distri-buted
Qala Zard*	SPLD-180	1/12/08	8	10.9	8.1	>2420	11	1.4	41.1	<0.12	Yes	Yes
Qala Zard*	SPLD-181	1/12/08	60	14.9	7.4	10	<1	<0.004	8.51	0.17	Yes	Yes
Qala Zard*	SPLD-182	1/12/08	60	14.6	7.5	82	<1	0.007	0	<0.04	Yes	Yes
Qala Zard*	SPLD-183	1/12/08	51.6	14	7.8	0	<1	1.4	2.05	0.09	Yes	Yes
Qala Zard*	SPLD-184	1/12/08	48	16.2	6.9	1046	<1	<0.004	0	<0.04	Yes	Yes
Qala Zard*	SPLD-185	1/12/08	43	14.9	7.8	4	<1	0.007	0	<0.04	Yes	Yes
Qala Zard*	SPLD-186	1/12/08	19.7	16.3	7.4	4	0	<0.004	3.61	0.13	Yes	Yes
Shena*	SPLD-187	1/14/08	50	13.7	7.5	>200	118	0.02	5.09	<0.04	Yes	Yes
Shena*	SPLD-188	1/14/08	40	14.7	7.5	0	<1	<0.004	2.11	0.73	Yes	Yes
Shena*	SPLD-189	1/14/08	86	17.6	7.6	0	<1	0.007	0	<0.04	Yes	Yes
Shena*	SPLD-190	1/14/08	40	17.8	7.7	78	<1	1.4	4.33	0.93	Yes	Yes
Shena*	SPLD-191	1/14/08	50	17	7.2	12	<1	<0.004	2.93	0.06	Yes	Yes
Shena*	SPLD-192	1/14/08	52	18.2	6.9	1046	1	0.005	3.88	0.17	Yes	Yes
Shewaki*	SPLD-193	1/14/08	38	15.6	7.8	4	<1	<0.004	3.75	0.11	Yes	Yes
Shewaki*	SPLD-194	1/17/08	40	15.5	7.4	<1	<1	<0.004	9.43	<0.04	Yes	Yes
Shewaki*	SPLD-195	1/17/08	45	16.1	7.6	<1	<1	<0.004	1.78	<0.04	Yes	Yes
Shewaki*	SPLD-196	1/17/08	50	15.4	7.7	<1	<1	<0.004	6.06	0.14	Yes	Yes
Shewaki*	SPLD-197	1/17/08	50	15.4	7.5	<1	<1	<0.004	1.78	<0.04	Yes	Yes
Shewaki*	SPLD-198	1/17/08	50	15.1	7.5	<1	<1	<0.004	1.78	<0.04	Yes	Yes
Shewaki*	SPLD-199	1/17/08	40	16	7.6	<1	<1	<0.004	1.78	<0.04	Yes	Yes
Shewaki*	SPLD-200	1/18/08	48	14.5	7.7	<1	<1	<0.004	2.79	0.47	Yes	Yes
Shewaki*	SPLD-201	1/18/08	70	15.5	7.7	<1	<1	<0.004	3.09	0.04	Yes	Yes
Shewaki*	SPLD-202	1/18/08	125	19.5	7.7	<1	<1	0.2	2	<0.04	Yes	Yes
Shewaki*	SPLD-203	1/18/08	100	18.3	7.8	<1	<1	0.02	7.02	0.06	Yes	Yes
Shewaki*	SPLD-204	1/18/08	95	19.7	7.8	<1	<1	<0.004	9.89	0.04	Yes	Yes
Sayfudin	2007-137	12/19/07	39	16.7	7.3	3	<1	<0.004	2.77	0.31	Yes	Yes
Sayfudin	2007-138	12/19/07	32	15.8	7.6	82	<1	0.02	10.08	0.04	Yes	Yes
Sayfudin	2007-139	12/19/07	9	15.5	7.3	22	<1	<0.004	3.91	<0.04	Yes	Yes

Village	Well No	Date Sampled	Well Depth	Water Temp	pH	Total coli-form	E coli	Nitrite	Nitrate	Lead	Well Chlori nated	Filter Distri-buted
Sayfudin	2007-140	12/19/07	17.6	15.8	7.5	613	<1	0.007	1.78	<0.04	Yes	Yes
Sayfudin	2007-141	12/19/07	63	15.5	7.8	>2420	11	1.4	41.1	<0.12	Yes	Yes
Sayfudin	2007-142	12/19/07	32	16.3	7.7	10	<1	<0.004	8.51	0.17	Yes	Yes
Sayfudin	2007-143	12/19/07	50	15.3	7.4	32	<1	0.004	6.01	0.06	Yes	Yes
Sayfudin	2007-144	12/19/07	59.5	15.2	7.3	0	<1	<0.004	18.3	0.11	Yes	Yes
Sayfudin	2007-145	12/19/07	35	14.9	7.7	19	1	0.004	4.04	0.14	Yes	Yes
Sayfudin	2007-146	12/19/07	18	15.5	7.5	82	<1	0.02	10.08	0.04	Yes	Yes
Yakh Dara, Kariz Bala	2007-147	12/20/07	60	18.3	7.9	22	<1	<0.004	3.91	<0.04	Yes	Yes
Yakh Dara, Kariz Bala	2007-148	12/20/07	50	15.4	7.8	613	<1	0.007	1.78	<0.04	Yes	Yes
Yakh Dara, Kariz Bala	2007-149	12/20/07	8	10.9	8.1	>2420	11	1.4	41.1	<0.12	Yes	Yes
Yakh Dara, Kariz Bala	2007-150	12/20/07	60	14.9	7.4	10	0	<0.004	8.51	0.17	Yes	Yes
Yakh Dara, Kariz Bala	2007-151	12/20/07	55	14.6	7.3	0	0	0.4	2	0.01	Yes	Yes
Yakh Dara, Kariz Bala	2007-152	12/20/07	51.6	14	7.8	0	0	<0.004	2.05	0.09	Yes	Yes
Yakh Dara, Kariz Bala	2007-153	12/21/07	59.5	15.2	7.3	0	0	<0.004	18.3	0.11	Yes	Yes
Yakh Dara, Kariz Bala	2007-154	12/21/07	35	14.9	7.7	19	1	0.004	4.04	0.14	Yes	Yes
Yakh Dara, Kariz Bala	2007-155	12/21/07	18	15.5	7.5	82	<1	0.02	10.08	0.04	Yes	Yes
Yakh Dara, Kariz Bala	2007-156	12/21/07	60	18.3	7.9	22	<1	<0.004	3.91	<0.04	Yes	Yes
Wollayate sulfa	2007-157	12/21/07	50	15.4	7.8	613	<1	0.007	1.78	<0.04	Yes	Yes
Wollayate sulfa	2007-158	12/21/07	25.6	14.2	7.4	0	1	0.02	3.83	<0.04	Yes	Yes
Wollayate sulfa	2007-159	12/21/07	49.6	13.6	7.5	>200	1	<0.004	2.14	0.09	Yes	Yes
Wollayate sulfa	2007-160	12/21/07	10.6	13.5	7	0	0	0	2	0	Yes	Yes
Wollayate sulfa	2007-161	12/21/07	18.3	11.6	7.7	>200	41	0.02	2.87	<0.04	Yes	Yes
Wollayate sulfa	2007-162	12/21/07	49.3	14	7.8	2	<1	0.02	1.04	0.06	Yes	Yes
Wollayate sulfa	2007-163	12/21/07	102	15.1	7.8	<1	<1	0	2.3	0	Yes	Yes
Wollayate sulfa	2007-164	12/21/07	179.7	14.7	7.8	<1	<1	0.04	1.7	2.14	Yes	Yes
Wolayat Hulya	2007-165	12/21/07	35	14.9	7.7	19	1	0.004	4.04	0.14	Yes	Yes

Village	Well No	Date Sampled	Well Depth	Water Temp	pH	Total coli-form	E coli	Nitrite	Nitrate	Lead	Well Chlori nated	Filter Distri-buted
# of wells exceeding WHO guideline							**72**	**0**	**0**	**136**		
% of wells exceeding WHO guideline							**35.3%**	**0.0%**	**0.0%**	**66.7%**	**204**	**207**