

**DETERMINATION AND MAPPING OF ARSENIC IN
GROUNDWATER OF LAHORE, AND ESTIMATING
THE HEALTH RISK ASSESSMENT**

By

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ABSTRACT

This study was carried out to investigate the concentration of arsenic in ground water of Lahore and to determine the health impacts that are associated with this contamination. Moreover, the study also aimed to understand the relationship between the depth of the tube well and the concentration of Arsenic. For this purpose, initially 477 samples of ground water were collected using appropriate sampling protocols and then the concentration of As was determined using AAS. Later these concentrations were compared with WHO and NEQs guidelines. Results showed that 98% samples were exceeding WHO limits and 5% were exceeding NEQs limits. For the purpose of developing a relationship between depth of tube well and concentration of As in ground water SPSS 20.0 was used to carry out a Pearson Correlation Test which confirmed the presence of a negative linear relationship between the two variables. In order to study the health risks of the As contamination of ground water a model designed by USEPA was used to carry out a Human Health Risk Assessment (HHRA). This model revealed that for now, there is moderate potential health risk on the population of Lahore for contamination in the underground water reservoirs. Therefore, this study is just in time for the authorities to act immediately, as groundwater quality of Lahore is gradually deteriorating with time and influence of anthropogenic sources.

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TABLE OF CONTENTS

ABSTRACT.....	ii
ACKNOWLEDGEMENTS	iii
TABLE OF CONTENTS	iv
LIST OF TABLES	v
LIST OF FIGURES	vi
LIST OF ABBREVIATIONS	vii
CHAPTER ONE	8
INTRODUCTION	8
1.1 Ground water and its trend around the world	
1.2 Ground water Contamination	
1.3 Arsenic	
1.4 Introduction to Study Area	
AIMS AND OBJECTIVES	18
CHAPTER TWO	19
LITERATURE REVIEW	19
CHAPTER THREE	24
METHODOLOGY	24
3.1 Secondary Data Collection	
3.2 Sample Size	
3.3 Sampling	
3.4 Determination of Arsenic	
3.5 Statistical Analysis	
3.6 Human Health Risk Assessment (HHRA)	
3.7 Comparison with NEQs and WHO standards	
3.8 Mapping	
CHAPTER FOUR	44
RESULTS	44

4.1 Concentration of Arsenic	
4.2 Statistical Analysis	
4.3 Human Health Risk Assessment	
CHAPTER FIVE	102
DISCUSSION	102
CONCLUSION	107
RECOMMENDATIONS	108
REFERNCES	109

LIST OF TABLES

Table No.	Topic	Page No.
Table 3.1	Name and location of Sampling Sites along with GPS coordinates and sample codes	17
Table 4.1	Concentration of Arsenic in collected water samples	33
Table 4.2	Descriptive Statistics for depth and Arsenic	44
Table 4.3	Linear co-relation between As levels and depth of tube wells	44
Table 4.4	Exposure Dose values for Arsenic	45
Table 4.5	Hazard Quotient values for Arsenic	56
Table 4.6	Cancer Risk values for Arsenic	68

LIST OF FIGURE

Figure 1.1	Natural and anthropogenic sources of Groundwater Contamination	6
Figure 1.2	Location Map of Lahore with all sampling sites marked	10
Figure 3.1	Flow diagram of methodology	16
Figure 4.1	Concentration of As in collected samples	79
Figure 4.2	Cancer Risks associated with collected water samples	80
Figure 4.3	Hazard Quotient Values for collected water samples	81
Figure 4.4	Map of Lahore depicting the risk of As contamination in underground water in different areas of the city according to WHO	82
Figure 4.5	Map of Lahore depicting the risk of As contamination in underground water in different areas of the city according to NEQs	83

LIST OF ABBREVIATIONS

AAS	Atomic Absorption Spectroscopy
As	Arsenic
ADI	Average Daily Intake
AT	Average lifetime
BW	Body weight
Ca	Calcium
CSF	Cancer Slope Factor
Cu	Copper
Cr	Chromium
DHA	Defence Housing Authority
ED	Exposure Dose
EF	Exposure frequency
HHRA	Human Health Risk Assessment
HQ	Hazard Quotient
IR	Intake rate
LDA	Lahore Development Authority
MCL	Maximum Contaminant limit
NEQS	National environmental quality Standards
Pb	Lead
PCRWR	Pakistan council for research in Water Resources
RfD	Reference dose
USEPA	United State environmental protection agency
WASA	Water and Sanitation Agency
WHO	World health Organization

CHAPTER ONE

INTRODUCTION

The most essential element that plants, animals and other living organisms including mankind require in order to sustain life on earth is Water. It is among the most critical and important requisites which nature provides us. An individual's everyday life depends on this resource of nature, which makes it the primary priority of a man's life. According to a United Nations research, a human body is 75% water. The study further reveals that an individual requires almost 20-50 liters of water to carry out every day routine. Out of this 20-50 liters, only 2-4 liters is required for drinking purposes (UN, 2010).

Nearly 70% of the Earth's area is occupied by water which is present in lakes, rivers, oceans and ground water aquifers. Out of this 70% only 1% of fresh water is accessible to humans for their everyday use (Javed, 2005). This fresh water that is accessible to humans is mainly classified into two categories, one is surface water, and the other is ground water. Water that flows across the land is termed as surface water which includes all the rivers, springs, streams, streamlets, seas, lakes and ponds. Whereas ground water exists in the underground water reservoirs from where it is extracted through appropriate technologies (Ali et al., 2012).

Although both of these sources of water are of equal importance but ground water being the resource that constitutes major fraction of that 1% fresh water, and widely used by humans for drinking and washing purposes takes a slight edge. It contains 90% of the fresh water and is considered the most important resource when it comes to human's daily life (Sirajudeen et al., 2014).

1.1 GROUNDWATER & ITS TREND AROUND THE WORLD

Groundwater being a critical and important source of potable water has managed to gain attention of many geologists and environmentalists over the past decade. As the

name indicates, groundwater exists below the ground that cannot percolate the rocks or sediment anymore leading to the accumulation of water. The rock or sediment that retains this water makes up an aquifer from which the water is withdrawn later by application of proper engineering design and equipment. This constitutes 98% of the planet's fresh water supply.

This resource of water in many regions of the world has gained a lot of importance and is being utilized at a rapid pace because of economic pressures that are faced by the surface water bodies, which resultantly cause water scarcity in such regions. Many countries of the world have now completely shifted from surface water bodies to groundwater supplies which was once abundant, in order to meet their daily requirements (Morris et al., 2003).

Since the beginning of 20th century, extraction of groundwater has increased tremendously. This abstraction was initially caused by population explosion and then many other factors such as technological progress, economic development and modern irrigation acted as a driving force for it. This boom in the ground water extraction is now known as "silent boom" which started in some of the developed countries including USA, Mexico and Italy. Currently, according to a study conducted by UNESCO, the extracted ground water is used to fulfill half of the drinking water needs of the world, whereas, 43% of it is used for irrigation globally. On one hand if this silent boom benefited the economic development of a nation, it is somehow also responsible for the ground water degradation of that area (Van der Gun, 2012).

Some countries of the world still believe that ground water is a stable and sustainable form of natural resource and are still on their way of exploiting it. This abundant and apparently persistent supply of groundwater made people believe that it's a renewable resource that has a very fast natural renewal rate. This belief led to the excessive use of the resource. A study revealed that perennially average amount of ground water

recharge is just about 14,000 km³/ year. This makes it a very precious renewable resource (Gleeson et al, 2012).

Despite being such a globally valuable and important renewable resource, it is improperly managed. There are a number of threats that this resource is currently facing including increase in population and per capita use of water, increasing need of water due to increased irrigation and penetration of hazardous chemicals into the aquifers. Most of these threats once again stem from the “Abstraction” or “Exploitation” of ground water aquifers.

According to a recent report published by the NGWA, the ground water association, on the global consumption of groundwater resources it has clearly been made evident that underground aquifers are being utilized and then emptied at a very rapid pace. The figures that were estimated by the research experts is that about 982km³ of groundwater is extracted from the aquifers in one year all around the world, 60% of which is used by the agricultural sector and the rest in domestic and industrial sector. Pakistan currently stands at fourth place with a withdrawal rate of 64.82 km³/year (NGWA, 2016).

Another research presented in 2012 revealed that the global groundwater footprint is approximately 3.5 times more than the actual size of aquifers. Atleast 1.7 billion individuals are living in localities where groundwater aquifers are under immense threat (Wada et al., 2012).

The reason behind this intense pressure on groundwater aquifers is population explosion and urbanization, and this doesn't only affect the quantity of groundwater but also deteriorates its quality. With the current practices the quality of ground water is being largely compromised thereby causing health problems to its consumers. Scientifically speaking, the world's water aquifers are being contaminated at a rapid pace.

1.2 GROUND WATER CONTAMINATION

Ground water contamination should be one of the most pressing concerns of modern era but unfortunately very few people have an understanding of the phenomena.

Ground water contamination takes place when different byproducts of industrialization, mechanized farming and urbanization find their way to the underground aquifers and make it unsuitable for drinking and other purposes. These chemicals can either be of natural origin or can be a waste product of any anthropogenic activity, for example pesticides and fertilizers from farming or other toxic substances from mining activity (Einarson et al., 2001).

The question that needs to be addressed at this point is how the underground reservoirs are contaminated in the first place. A study conducted by Environmental Protection Agency (EPA) reveals that aquifers can be contaminated by two sources either natural or anthropogenic. Whatever the source is once a contaminant is released into the underground aquifer it follows either the same pattern of transportation as ground water or it changes its movement depending on its physico-chemical and biological properties (Babiker et al., 2004).

1.2.1 Sources of Contamination

As mentioned earlier, the ground water is contaminated through various sources broadly classified into two categories:

1. Natural Sources
2. Anthropogenic Sources

Natural sources include the substances found in rocks and soils depending upon the locality. Whereas, anthropogenic sources are the hazardous chemicals that are released into the ground water aquifers as a result of human activities (Pye et al., 1984).

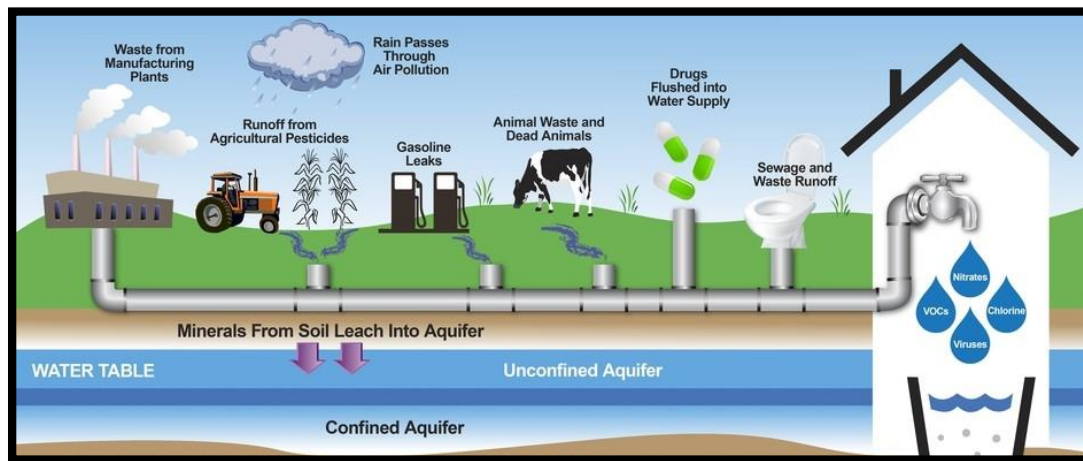


Figure 1.1 Natural and anthropogenic Sources of Groundwater Contamination (Pye et al., 1984)

The figure above sums up almost all the possible natural and anthropogenic sources of ground water pollution. The minerals found in rocks and soil vary from area to area.

Over the past decade ground water contamination around the world has become a major concern, and that's because of the many reported health issues that people have been experiencing, which either directly or indirectly relate to the quality of water that's been used in the area.

As discussed earlier, the water quality alters when it passes through the distribution network mostly, regardless of the source of the contaminant. Absence of certain precautionary measures lead to deterioration of the entire underground aquifer thereby, increasing the risk of water borne diseases in people (Shakya et al., 2008).

With the increasing trend of contamination of ground water aquifers, unfortunately the rate of these water-borne diseases is exceeding too. Many studies have been reported that prove that ground water is being contaminated at a very rapid pace by various chemicals. Some of the health risks that are mostly associated with ground water pollution are hepatitis, dysentery, poisoning and sometimes even cancer depending on the type of pollutant (Ng et al., 2003).

Although there are many pollutants that are held responsible for causing groundwater degradation but one class of pollutants that stands out among this list is heavy metals. Although, these metals are a constituent of natural waters induced into it through the process of weathering and erosion, but at a very low concentration. If at higher concentrations, these heavy metals can be very detrimental to the health of the water body (Duruibe et al., 2007).

The above fact has been proven by a research done in China by the global times, where 80% of the groundwater is contaminated and found to be unsuitable for drinking due to the presence of heavy metals. According to the legislation of Quality Standards for Groundwater, passed in China the water resource has been classified in 5 major categories, and if any water body falls under the class 5 category that means that specific water body isn't suitable for drinking. After the study, it was found that 994 wells or 47.3% of the groundwater is classified under class 5 (Foster et al., 2003).

Other than heavy metals, another category of pollutants that greatly contributes to the contamination of ground water is metalloids. Metalloids are elements that share the properties of both metals and non-metals. The most common metalloids are arsenic, silicon, germanium, antimony and tellurium. Although all of these can cause the contamination of groundwater but the most problematic metalloid on which different studies have been done is arsenic.

1.3 ARSENIC

Arsenic has an atomic weight of 74.92 and belongs to Group V of the periodic table. Being a metalloid, it shares the properties of both a metal and a non-metal, due to which it has a complex chemistry as compared to other elements and the compounds it forms are numerous and more stable (Yu, 1998).

This metalloid originates from natural sources such as weathering and erosion or from anthropogenic sources such as petroleum refining, the use of wood preservatives, and use of pesticides, dyes, soaps and semi-conductors (Yu, 1998).

Arsenic being a natural and anthropogenic constituent has different routes of exposure, it might be in the food, or inhaled through smoking. But on the top of all these pathways is water. Different studies have already proven that in most parts of the world where groundwater is the primary source of drinking water, arsenic is the main component or reason of pollution. Some of these countries are China, Bangladesh, West Bengal, Pakistan etc (Huang et al., 2015).

1.3.1 ARSENIC AND GROUND WATER POLLUTION TRENDS

As mentioned above like other metals and metalloids, arsenic is also required by a human body in minute quantities. The permissible limit set by EPA and WHO for arsenic to be present in drinking water is about 10ppb to a maximum of 50 ppb. But unfortunately, for the past few decades these values are being compromised greatly due to anthropogenic activities (Gecol et al., 2004).

According to a study, it has been confirmed that more than 70 countries in the world are facing the problem of water contamination by arsenic and most of these countries belong to South Asia or South East Asia and all these countries use groundwater as their main source of drinking water. On daily basis about 150 million people are being impacted by the consumption of arsenic which is present in their drinking water. Studies on South Asian countries also reveal that they have been facing severe health problems due to this worsened quality of drinking water (Smedley and Kinniburgh, 2002).

In Pakistan, the groundwater trends show almost the same story as in the rest of the world. Being a developing country Pakistan is facing a serious threat in supply of clean and safe potable water. A study revealed that 70% of the population relies on ground water as their primary source of drinking water in Pakistan and in spite of that the resource is being poorly managed by the government. This improper and un monitored management has made the resource vulnerable to a number of threats such as secondary

salinization and sodification and exceeding levels of arsenic in the ground water aquifers.

Another study revealed that in cities like Lahore and Kasur, arsenic contaminated water is becoming a threat to the well-being of its people. In fact in some parts of the countries like Sindh, the concentration of this metalloid has increased 4 folds compared to other provinces and is still showing an increasing trend. Other than that, the values of As recorded in cities like Muzaffargarh, DG Khan, Multan and Tharparker are higher than 50 µg/L (Farooqi *et al.*2007).

This exceeding concentration of arsenic further causes many problems to a human body when they are exposed to it, such as, disorders of urinary bladder, liver and kidney cancers and skin lesions (Yadolph, 2015).

As far as the health status of these cities is concerned, most of the work that's been done to assess the risk to human health associated with As contaminated water consumption is based on limited data. In order to identify, estimate and characterize the potential risks of arsenic pollution on human health a method widely used is known as Human Health Risk Assessment (HHRA). This method has been employed in the current study to overcome this discrepancy.

1.4 INTRODUCTION TO THE STUDY AREA

The area selected for this study is the metropolitan Lahore, Punjab Pakistan.

1.4.1 LOCATION DESCRIPTION

Lahore is a rapidly growing city lying between latitudes 31°20' and 31°50' N and longitudes 74°05' and 74°37' E in the province of Punjab, Pakistan. Both the temperature and rainfall vary greatly from season to season with a mean temperature that ranges from 34°C in June to 12°C in January and an average rainfall of 575mm year⁻¹, which can vary from 300 to 1200mm.

Lahore being a developed city and the 2nd largest metropolitan area of Pakistan holds a great deal of importance in sustainability of Pakistan. Sustainability mainly ruled by three indicators namely, economic, social and environmental, is being threatened and the main indicator that's been bringing an imbalance to the situation is environment. Lahore's been facing serious environmental problems such as noise pollution, air pollution and water quality degradation (Hayder et al., 2016).

Recently many researchers have established that the poor water quality of Asian countries might be because of the presence of Arsenic in groundwater. Proper measures must be taken to reduce the environmental and health implications of this metalloid.

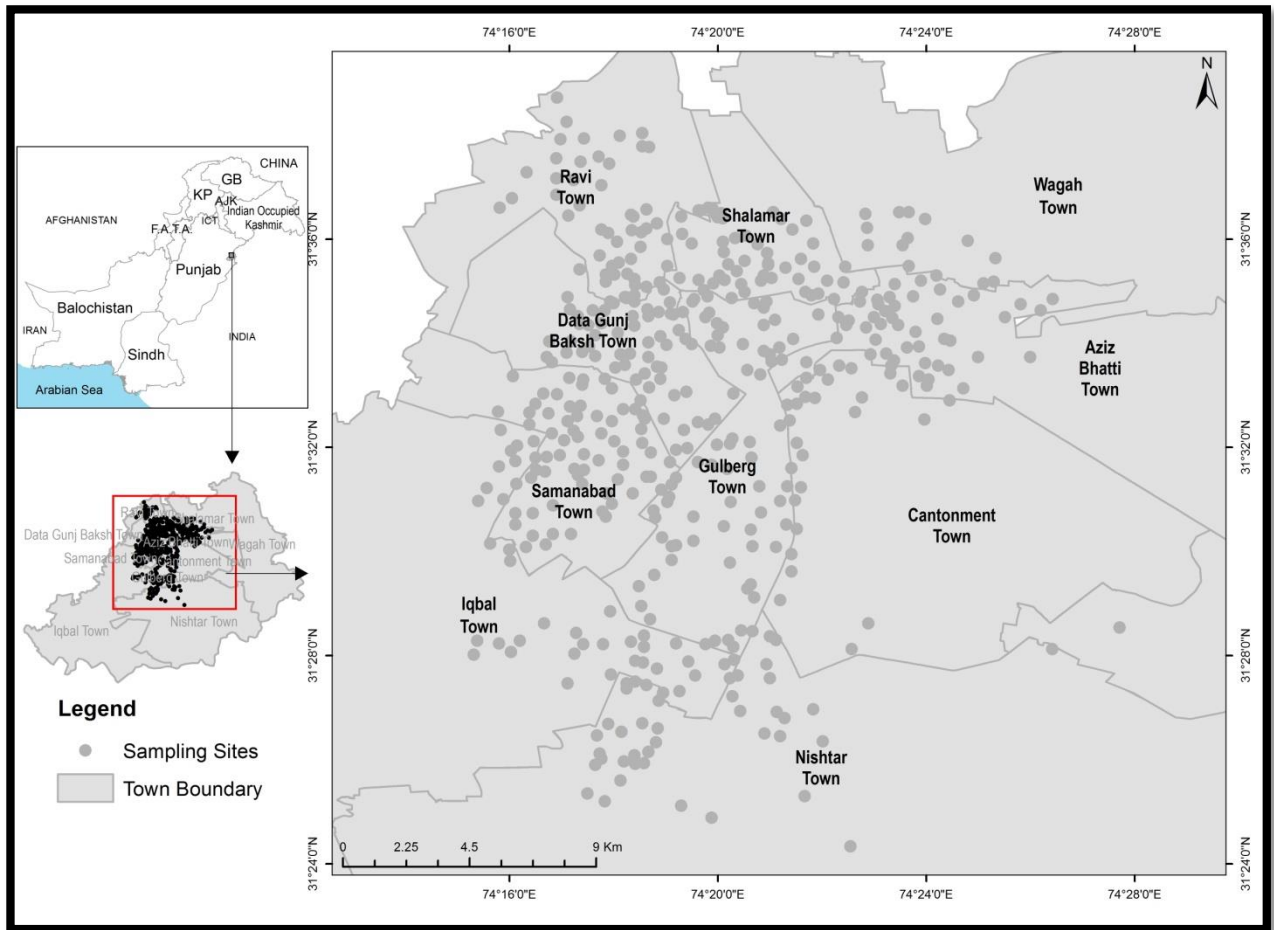


Figure 1.2 Location map of Lahore with all the sampling sites marked

Samples were taken from all the tube wells installed by Lahore Development Authority (LDA) under Water and Sanitation Agency (WASA) within the the city. Covering the area from one end of Lahore to the other end i.e., from River Ravi to Defence Housing Authority (DHA). This area covers a total of 10 towns; namely Ravi Town, Shalamar Town, Wagah Town, Data Gunj Baksh Town, Aziz Bhatti Town, Samanabad Town, Gulberg Town, Cantonment Town, Iqbal Town, Nishtar Town.

AIMS AND OBJECTIVES

The basic objectives of this study were:

- ✚ To study the concentration of arsenic in the groundwater of Lahore, and develop its correlation with the depth of the tube wells.
- ✚ To calculate the health risk index of arsenic for the population that is being exposed to it by using a standard procedure.

CHAPTER TWO

LITERATURE REVIEW

It is a well known fact that human beings require drinking water for their survival. The adequate supply of clean drinking water is the main component leading to decreased mortality and improved socio-economic conditions in developing countries. But now a days, with the increased amount of ground water pollution this need is being largely compromised (Simeonov et al. 2002).

There is a vast literature that proves that groundwater contamination is becoming a grave concern for the people as well as the governments of the developing nations with every passing day. The contaminants that pollute this ground water are quite diverse but heavy metals' being on the top of this list prove to be the most hazardous components. Studies suggest that the presence of heavy metals in the ground water not only cause economic and environmental problems but also pose serious health risks to population (Muhammad et al., 2011).

A study was conducted Nowshera District, Khyber Pakhtunkhwa to assess the drinking water quality and the health risks associated with it. Sampling was done from the local sources and then physico-chemical analysis was done. Tests were carried out to evaluate the amount of heavy metals present in the groundwater samples using Atomic Absorption Spectrometry (AAS). The results revealed that the samples showed critically high values of Chromium (Cr), Cadmium (Cd) Lead (Pb), Nickel (Ni) and Arsenic (As). Afterwards these values were further used to calculate the chronic risk of these contaminants on the exposed population by determining factors like daily intake (ADI) and hazard quotient (HQ). These values were again quite high due to which this research strongly suggested to employ suitable treatment measures for the provision of safe drinking water (Sardar et al., 2015).

Just like heavy metals there are certain other contaminants that contribute to the pollution of groundwater aquifers to a great extent. These pollutants are metals and metalloids. One such metalloid that's been causing lot of harm for quite some time now is Arsenic (As). Over the past decade a lot of research has been done which shows that arsenic is contaminating the reservoirs of ground water and is also detrimental for the health of the people (Nordstrom, 2002).

Arsenic is quite soluble in water and is responsible for groundwater pollution in many countries. Solubility depends upon their pH, temperature, solution composition and redox conditions. This study further revealed that natural atmospheric conditions and geology of the location plays a very important role in the amount of arsenic present in ground water. The areas where black shale and young basalts were present had more arsenic contamination. These areas include Kamchatka, New Zealand, Japan, Alaska, California, and Wyoming. Moreover the study recommends that in order to minimize the groundwater pollution risk microbiological, hydro geochemical and geochemical expertise must be incorporated in the decision making process and a monitoring system must be established that investigates the underground water conditions on regular basis (Nordstrom, 2002).

Arsenic is considered as a poison in most parts of the world due to which nations have been forced to alter their regulations to reduce the amount of arsenic contamination in the ground water.

A study performed by Arizona Geological Survey, shows that groundwater which is the main source of drinking water in the state has arsenic ranging from 1 to 50 parts per billion (ppb). Whereas, in 2000, under the amendments of Safe Drinking Water Act the maximum contaminant limit (MCL) was lowered to 5 ppb. Hence it was shown that since Arizona's groundwater is highly contaminated therefore it needs expensive and thorough treatments so that the health of the aquifer and public isn't compromised (Spencer 2000).

Ground water pollution by arsenic being a worldwide problem is also impacting a developing country like Pakistan. Many studies conducted in different regions of Pakistan have succeeded in proving that arsenic is lately becoming a main contributor of ground water pollution in Pakistan. Some of these studies are discussed as a part of this research.

A study conducted in Muzaffargarh District of south-western Punjab, indicates that the groundwater contamination in the region is chiefly governed by the presence of arsenic compounds in it. A total of 49 samples were collected from the same vicinity and were tested using AAS. The results showed that 58% of the samples exceeded the safe concentrations of arsenic set by the World Health Organization (WHO) and United States Environmental Protection Agency (USEPA) i.e. $10\mu\text{ L}^{-1}$. This study further concluded that the reasons for these high concentrations is mostly the industrialization and using unconventional methods of agriculture (Nickson et al., 2005).

Another study done in Kalalanwala, a small village in the east Punjab, in which about 147 samples of ground water were collected and were passed through the spectrometer. Out of these samples 91% were outside the MCL set by WHO. The highest value of arsenic ($2400\mu\text{g/L}$) was found 30 meters from the surface. The arsenic found in ground water was in As^{V} form. The results also indicated that a negative correlation exists between arsenic and pH. The contamination occurred in the presence of oxidizing and alkaline conditions of the groundwater. Therefore again this study shows that contamination of ground water by the presence of arsenic is becoming serious concern for Pakistan (Farooqi et al., 2007).

Lahore being the heart of Pakistan has managed to gain the attention of many researchers. A city with a vast population of 121 million has become a subject of study for the environmentalists. The city is dependent on the ground water to fulfill its daily water needs. The distribution of arsenic in the groundwater was determined by the geostatistics analysis technique and concentration variation was estimated by using

ANOVA. The study was done for two years (2010 and 2012). The results indicated that As concentrations were as high as 67.8 $\mu\text{g/L}$ and 69.3 $\mu\text{g/L}$ for the years 2010 and 2012 respectively. The study suggested that urgent steps must be taken in order to ensure ground water preservation for the future (Akhtar et al., 2015).

The increasing concentration of arsenic in the ground water is leading to different consequences one of them are the number of health problems associated with the arsenic contaminated water that many nations are being exposed to. Arsenic is historically well known metalloid that in modern world is considered as a poison. Different researches have proved the fact that ingestion of even minute amount of arsenic can increase the vulnerability to different kinds of cancers including lung, bladder, kidney and liver. These researches were mostly done on the population that had a daily exposure to As (Nguyen et al., 2009).

Cancer being the top of the list of health problems caused by ingestion of arsenic holds a great deal of importance. USEPA has categorized inorganic As a group A human carcinogen. A study was conducted in order to assess the risks of internal cancers due to the exposure to arsenic in Bangladesh. The lifetime risk estimation was made for liver, bladder and lung cancers using death probabilities, cancer death rates and amount of exposure to the contaminant from Bangladesh and from Taiwan dose-specific relative risk estimation was taken. Results specified at least a doubling of lifetime death risk from liver, bladder, and lung cancers (229.6 vs 103.5 per 100 000 population) in Bangladesh due to arsenic in drinking water (Chen et al., 2004).

Arsenic has different routes for entering the human body thus causing toxicity. It might enter the body through gastrointestinal tract (ingestion), through lungs (inhalation) or even through skin (dermal route). A study carried out in this regard showed that no matter from where arsenic enters its effects would be the same. It was a cross sectional study that was performed on the children of two age groups. Arsenic levels in their scalp hair were analyzed using electro thermal AAS. The samples were collected from

three different areas based on the concentration of As in water namely, Faiz Gunj, Thari Mirwag and Gambat. They were categorized as less, medium and highly contaminated areas. The results indicated that the range of As concentration in scalp hair samples of children of age 1–5 and 6–10 years was 0.21–3.88 and 0.32–3.63 $\mu\text{g/g}$, respectively. Therefore, it is likely that children were constantly exposed to As through drinking groundwater, suggesting that there is an imperative need to take immediate steps, especially in the Gambat sub-district where average arsenic concentrations were observed the highest i.e. 98.3 $\mu\text{g/L}$ (Baig et al., 2011).

A comprehensive study of published data shows that arsenic exposure induces cardiovascular diseases, developmental abnormalities, neurologic and neurobehavioral disorders, diabetes, hearing loss, hematologic disorders, and various types of cancer. Although exposure may occur via the dermal and parenteral routes, the main pathways of exposure include ingestion, and inhalation. The severity of adverse health effects is related to the chemical form of arsenic, and is time and dose dependent (Tchounwou et al., 2004).

CHAPTER THREE

METHODOLOGY

A descriptive methodology was adopted for the purpose of completion of this research. The current study was carried out in one of the most important city of Pakistan i.e. Lahore. Initially, all the data regarding the city, its geology and environmental status i.e. condition of ground water resources were collected from the available literature and thoroughly reviewed for any mistakes and shortcomings in the previous researches. This methodology section of the research also highlights the parameters that were tested to check the quality of ground water and the concentration of arsenic in the aquifers. Figure 3.1 illustrates the methodology that was adopted for the purpose of this research.

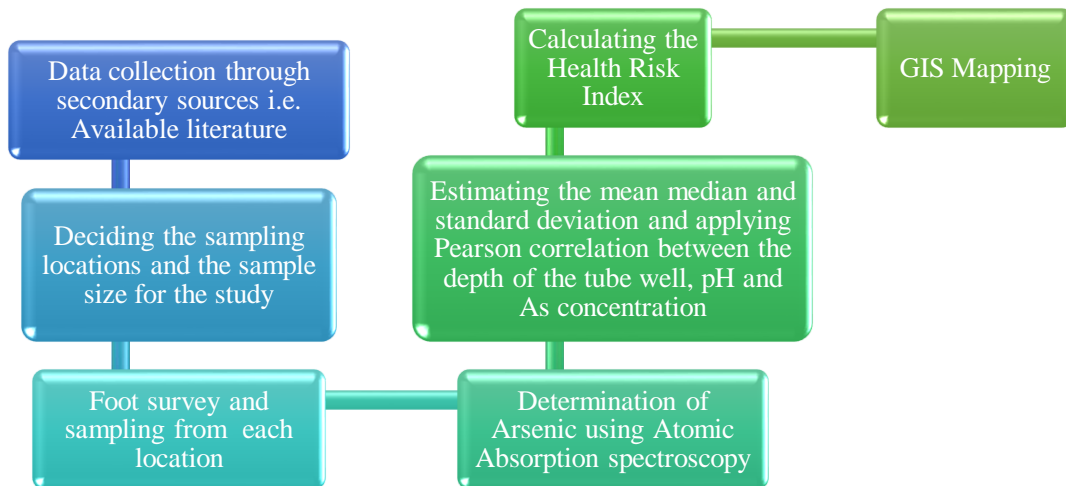


Figure 3.1 Flow sheet diagram of the Methodology

3.1 Secondary Data Collection

Before the collection of primary data, published literature has been thoroughly studied. Existing data was also thoroughly checked. This data was collected from the authentic research papers and published work of the previous researchers.

3.2 Sample Size

After the collection and review of secondary data, the next step was sampling. Since the study is focused on contamination of arsenic in the ground water aquifers of Lahore, therefore all the samples were collected at the source. The city was classified into 498 sampling sites on the basis of the tube wells planted by the LDA. To make the study clutter free these 498 sampling sites were further divided on the basis of ten towns of Lahore whose boundaries have been geographically defined in figure 1.2.

3.3 Sampling

The water was collected in plastic bottles direct by the tube wells and onsite parameters were analyzed in the field. For further analysis of water quality parameters the samples were preserved at 4°C in an ice box and taken to Pakistan Council of Research on Water Resources (PCRWR) laboratory.

Additionally, proper sampling protocols were applied to all the samples. Following information was used for sample identification:

- i. Sample identification number
- ii. Sample source
- iii. Sample date and time
- iv. Analysis required
- v. Sample integrity (sealed, leaks, tagged, iced)

Table 3.1: Name and Location of the Sampling Sites along with GPS Coordinates and Samples Codes

S.#	Location of Tube well	Sample Code	GPS Co-ordinates	
			Longitude	Latitude
1	Tegro Park	LHR001	31.57306	74.33305556
2	Muhammad Nagar	LHR002	31.56639	74.34138889
3	Habibullah Road Baghyshah	LHR003	31.55667	74.34694444
4	Children Park	LHR004	31.56306	74.35
5	Habibullah Road Baghyshah	LHR005	31.55806	74.34277778
6	Scotch Corner/Upper Mall	LHR006	31.54694	74.35555556
7	Mian Meer Pind	LHR007	31.54722	74.35861111
8	Anand road Upper Mall	LHR008	31.54194	74.35638889
9	Garhi Shahu Police Station	LHR009	31.56083	74.35055556
10	Main Bazar Ghazi Mohalla Garhi Shahu	LHR010	31.56417	74.34805556
11	Larex Colony	LHR011	31.56139	74.35388889
12	Zaman Park	LHR012	31.54028	74.35333333
13	Basti syden Shah	LHR013	31.53472	74.35861111
14	Bagh Munshi Ladha	LHR014	31.58889	74.30444444
15	Yaseen Road	LHR015	31.58861	74.2975
16	Umar Park Bilal Ganj	LHR016	31.57944	74.3
17	Mohni Road	LHR017	31.58139	74.30361111
18	Karim Pak Ground Old	LHR018	31.59139	74.29944444
19	Qasor Pura/Ameen colony	LHR019	31.59472	74.29555556
20	New Umer Park	LHR020	31.58000	74.29888889
21	Gulshan-e-Riaz	LHR021	31.57750	74.28611111
22	Ibraheem Road	LHR022	31.57722	74.29333333
23	Sardar Chapal	LHR023	31.57722	74.29722222
24	Munshi Hospital	LHR024	31.57528	74.28861111
25	Main Outfull Road	LHR025	31.57250	74.29194444
26	Karim Park Block 3	LHR026	31.58861	74.30027778
27	National Ravi 2	LHR027	31.60306	74.29611111
28	Bajri Adda	LHR028	31.60194	74.29833333
29	Main Outfull Road New	LHR029	31.57278	74.28916667
30	Ameen Park	LHR030	31.59028	74.28916667
31	Rehmat Flour Road	LHR031	31.59250	74.30166667
32	Allah Wali Mosque	LHR032	31.58639	74.2975
33	Shafiqueabad	LHR033	31.58139	74.28527778
34	Takoni Ground Islam pura	LHR034	31.56250	74.29416667
35	Firdos Park	LHR035	31.57306	74.29611111
36	Chohan Park	LHR036	31.56722	74.28638889
37	DCO Office	LHR037	31.57528	74.30611111
38	Akram Park Band Road	LHR038	31.56222	74.27861111
39	Nehru Park/Afgharn Park	LHR039	31.56917	74.29416667

40	Rafayabad Park	LHR040	31.56722	74.27944444
41	MC High School Sanda	LHR041	31.56389	74.29
42	Ligatabad	LHR042	31.56306	74.30222222
43	Commisioner Office	LHR043	31.57000	74.30138889
44	Ali Park New	LHR044	31.58611	74.31472222
45	G Block Gulshan Ravi	LHR045	31.54444	74.27305556
46	60-Road Shera Kot Babu Sabu	LHR046	31.54056	74.27305556
47	Moon Market Gulshan Ravi	LHR047	31.55028	74.28194444
48	Jaffiria colony	LHR048	31.53778	74.28027778
49	Rustam Park	LHR049	31.54333	74.28833333
50	Umer Park Sodiwal Quarder	LHR050	31.53667	74.28861111
51	Naunarian	LHR051	31.54167	74.28527778
52	Nawa Kot WASA Colony	LHR052	31.54667	74.28944444
53	Dhop Sari Malik Munir Road	LHR053	31.55556	74.28583333
54	E Block Gulshan Ravi	LHR054	31.55056	74.2775
55	Zubair Park Gulshan Ravi	LHR055	31.54722	74.275
56	Firdos Colony	LHR056	31.54417	74.27916667
57	Usman Park F Block Gulshana Ravi	LHR057	31.556675	74.277662
58	Sikandria colony	LHR058	31.53556	74.28416667
59	Babu Sabu School	LHR059	31.53889	74.26388889
60	Near WASA Complaint Center	LHR060	31.53861	74.28722222
61	Riwaz Garden Markeet	LHR061	31.55972	74.30361111
62	Takkia Mehmood Shah,Sanda Road Rahat Street	LHR062	31.56361	74.285
63	Bilal Park, Raj Garh	LHR063	31.55528	74.29722222
64	Riifle Range, New Chlazji	LHR064	31.55222	74.29944444
65	Ghulam Hussain colony Across Bund road, Main Street Bazar, Imam Din road	LHR065	31.54472	74.26305556
66	Patwar Khana,Grave yard Sanda Road	LHR066	31.56056	74.28027778
67	Jahangir Town	LHR067	31.557928	74.320139
68	A Block gulshan-e-ravi	LHR068	31.54639	74.28611111
69	Bund Road UC84	LHR069	31.55611	74.26777778
70	Zubair Road Rajgarh	LHR070	31.55500	74.29027778
71	Muslim Park Rajgarh	LHR071	31.55889	74.30055556
72	B Block Gulshan e Ravi, Qazafi Park	LHR072	31.55333	74.29
73	Park P Block, Sabza zar Opp Malik Yasir House	LHR073	31.51667	74.26472222
74	D Block Main Park Off Fezan-e-Rasool Road	LHR074	31.53222	74.26722222
75	A Block Park on main road	LHR075	31.52361	74.27361111
76	shah Fared Takani Park, Shah Fareed Markeet	LHR076	31.52556	74.27805556
77	Masroor Ahmad	LHR077	31.52722	74.26333333
78	Takoni Ground Off Grave Yard	LHR078	31.52611	74.27527778
79	Near Park, H block	LHR079	31.51222	74.26861111

80	Takin Chowk Main Bazar Khardk	LHR080	31.50861	74.26861111
81	Liaqat Chowk, Asad Plaza Markeet	LHR081	31.52167	74.26888889
82	Kasar Block Jinnah Block/Awan town	LHR082	31.50250	74.26055556
83	Main Park One Head Tank,K Block	LHR083	31.52028	74.25944444
84	Main Park N Block near Qalza Masjid	LHR084	31.51611	74.25666667
85	E-1 Block Fcc Katchi abadi Gulbug III	LHR085	31.51583	74.3375
86	H Block Gulbarg III	LHR086	31.50167	74.34444444
87	Makka Colony Street 22, Gulbarg III	LHR087	31.49917	74.35694444
88	B-1 Block Gulberg III	LHR088	31.51611	74.35333333
89	Railway line,Jinna Park Gulburg II	LHR089	31.52056	74.36
90	Back side Ferdous Markeet, J Block Gulberg II/ K-Block G-III	LHR090	31.50139	74.35194444
91	Nala 27 Manzab Pace Town, Q block Gulberg II New	LHR091	31.52667	74.35694444
92	Over Head Tank, B-Block/T-block gulberg II New	LHR092	31.52083	74.35555556
93	Nisar Art Press gulberg II	LHR093	31.51639	74.35805556
94	Near Sui Gas Main Office (Ploice Post Gulberg market	LHR094	31.50722	74.35861111
95	Ghalab Markeet, Guru Manget A-II	LHR095	31.50861	74.35527778
96	saint Merry Colony Gulberg-III	LHR096	31.50806	74.33527778
97	Opposite Lahore cantt Raalway Station, Qurban Line Gulberg-II	LHR097	31.53083	74.36055556
98	The Pind Furdous Markeet C-1	LHR098	31.50694	74.34388889
99	Syed Mubsam Ali Rizvi	LHR099	31.51250	74.34722222
100	New Railway Line (Walton Acadmy), New Makka colony	LHR100	31.49361	74.35694444
101	M Block, Henry K Gulberg-III	LHR101	31.48806	74.34277778
102	G Block Wasa Complant Center	LHR102	31.53000	74.34416667
103	Opposite Shalimar Towar hotel, Zafar Ali road/Jail road	LHR103	31.53500	74.34361111
104	Park Back site X PM parvaz Elahi, Fcc block, Gulberg sub Dev	LHR104	31.52639	74.33638889
105	Jamiya Masjid Abu bakar Siddique, Khan colony Gulberg III	LHR105	31.49639	74.33722222
106	Social Security hospital, main Feroz pur road, nawaz Shareef colony Feroz pur.	LHR106	31.47444	74.34444444
107	Green Belt P block, Ghulab Devi Hospital, Gopal Nagar	LHR107	31.48528	74.345
108	Main Bazar Bilal Nagar, Henry Katchi Abadi Gulberg III	LHR108	31.48944	74.34388889
109	Govt. Islamia College for Boys, Iqbal Park	LHR109	31.55944	74.38888889
110	Athar Abbas ParkTajpura Pind	LHR110	31.55806	74.40722222
111	A Block Tajpura	LHR111	31.56028	74.39972222

112	Main Park Tajpura, Data Park	LHR112	31.55500	74.40083333
113	D Block Main Park	LHR113	31.55611	74.39777778
114	Al Madina Colony. A Block Tajpura	LHR114	31.55944	74.40388889
115	Al Faisal Town, Burgi No. 9	LHR115	31.55306	74.40027778
116	Soling Road, Tajpura	LHR116	31.55306	74.3925
117	Graveyard Ghaziabad Bus stop No.2	LHR117	31.55694	74.38861111
118	SDO Office, DO North Tajpura	LHR118	31.56111	74.38972222
119	DLR Office, Chubacha Phatik	LHR119	31.55806	74.36611111
120	Gulshan Colony Walton	LHR120	31.47167	74.35194444
121	LDA Quarter Walton	LHR121	31.47278	74.35
122	Ghosia colony	LHR122	31.48444	74.35333333
123	Gulshan colony Mustafa Abad	LHR123	31.55500	74.36861111
124	Infentory colony	LHR124	31.54917	74.36444444
125	Canal Bridge	LHR125	31.55278	74.35888889
126	Mian Meer Darbar	LHR126	31.54944	74.36138889
127	Tariq colony, Walton	LHR127	31.55944	74.37222222
128	Dry Port, Mughalpura	LHR128	31.55861	74.37611111
129	Canal Bank, Ahata Makhan Sing	LHR129	31.55556	74.36166667
130	Chubacha Phatik, DLR Office, Mustafaabad Sub Division	LHR130	31.55806	74.36611111
131	Punj Peer Lal pull, Canal Bank, Fateh Garh Sub Div.	LHR131	31.56556	74.39777778
132	Jahangir Road, Main Chowk Mughal pura Canal Bank, Sub Div. Mughal pura	LHR132	31.56306	74.38222222
133	Fayaz Park, Canal Bank, Mughal pura Sub. Division	LHR133	31.56333	74.38722222
134	Maskeenpura, Golden Gate School, Canal Bank, Fateh Garh Division	LHR134	31.56528	74.39388889
135	Fateh Garh Pull, City District Girls High School, Fateh Garh Div.	LHR135	31.56806	74.40583333
136	Kotli Ghasi, Govt Boys Primary Scool, Fateh Garh Div.	LHR136	31.58083	74.44055556
137	Qalandarpura, Fateh garh sub division	LHR137	31.57917	74.43027778
138	Gawala Colony Herbanspura, Ring road, Faeteh garh sub division	LHR138	31.57722	74.43666667
139	Iftikhar Park, Harbanspura Park, Fateh garh div.	LHR139	31.57500	74.42527778
140	Ishfaq Chowk/ Shaoq Chowk, Van Stand Al-Kareem Chowk, Tajpura Sub Div.	LHR140	31.55222	74.41194444
141	Tajbagh Scheme, Gulshan-e-Rehman, Tajpura Division	LHR141	31.56222	74.41666667
142	Jore Pull, Tajpura sub Div.	LHR142	31.54833	74.4075
143	C Block Al-faisal town Baharshah, Tajpura Sub. Div.	LHR143	31.54222	74.39944444

144	Canal Bank, Muslim abad, Fateh Garh	LHR144	31.56750	74.40777778
145	Peer Naseer, Mughal pura Sub. Div.	LHR145	31.56222	74.43333333
146	Slamatpura Takkia, Fateh garh Sub Div.	LHR146	31.58194	74.41527778
147	Gulshan Park, Fateh garh Sub Div.	LHR147	31.57028	74.39666667
148	Nadia Ghee Mill, Fateh garh Sub Div.	LHR148	31.58167	74.39583333
149	Dars Bary Mian/ Mujahidabad,	LHR149	31.57167	74.38083333
150	Salamat Pura 5, Fateh garh Sub Div.	LHR150	31.58583	74.41833333
151	Shah Din Park, Fateh garh Sub Div.	LHR151	31.58389	74.40444444
152	Kotli Pir Abdul Rehman, Mughalpura Sub. Div.	LHR152	31.57861	74.39
153	dispensary Road Fateh Garh, Fateh garh Sub Div.	LHR153	31.57444	74.40361111
154	Faisal Park/ Children Park	LHR154	31.57250	74.39111111
155	Sahuwari Sani View Park, Mughalpura	LHR155	31.57278	74.38555556
156	Qadir Buksh Park,	LHR156	31.57472	74.38916667
157	Maskeenpura	LHR157	31.58139	74.38833333
158	Karim Nagar Salamat pura no. 3	LHR158	31.58639	74.42166667
159	New Shalimar Scheme Salamat Pura	LHR159	31.58000	74.41027778
160	Sahuwari Takkia Old	LHR160	31.57500	74.38333333
161	Goshaya Angori	LHR161	31.58056	74.38444444
162	Shah Kamal Road	LHR162	31.56778	74.38388889
163	Milap Street	LHR163	31.58306	74.37944444
164	Sansi Quarder	LHR164	31.57500	74.37194444
165	Anguri Bagh Scheme No. 2	LHR165	31.57917	74.38472222
166	Baja Line	LHR166	31.56806	74.3575
167	Pakistan Mint New	LHR167	31.58556	74.39
168	Lal School, Dars Baray Mian	LHR168	31.40556	74.37583333
169	Masjid Taj din	LHR169	31.56056	74.36166667
170	Parashoot Colony	LHR170	31.57250	74.34805556
171	Baghechi Sethah Wali New	LHR171	31.57250	74.37444444
172	Azeem Ground	LHR172	31.57389	74.37527778
173	B.T.H Drain	LHR173	31.57694	74.38694444
174	Achant Garh	LHR174	31.57417	74.35166667
175	Baba Beri Peer	LHR175	31.56833	74.37138889
176	Jamilabad	LHR176	31.57583	74.36555556
177	Saher Road	LHR177	31.58000	74.37888889
178	Shah Gohar Abad	LHR178	31.60028	74.39416667
179	Memood Booti Well Centre II	LHR179	31.60861	74.39444444
180	Mehmood Booti Well centere III	LHR180	31.60861	74.39138889
181	Dobi Ghat	LHR181	31.58667	74.39833333
182	Rohri Per Darbar	LHR182	31.60639	74.39972222
183	Madhulal Hussain	LHR183	31.58611	74.37361111
184	Suraya Jabeen Park	LHR184	31.58083	74.37055556
185	Tiba Qilla Khazana	LHR185	31.59806	74.3925
186	Ahma Town	LHR186	31.59944	74.41333333

187	Gulshan-e-Shalimar	LHR187	31.59806	74.38138889
188	Memempura	LHR188	31.59389	74.42222222
189	Baba Ghandi Shah	LHR189	31.58833	74.40333333
190	Saad Ghee Mill	LHR190	31.59139	74.39444444
191	Deputy Yaqoob Colony	LHR191	31.59111	74.37416667
192	Alia Town	LHR192	31.60361	74.38111111
193	Near Mehmood booti disposal	LHR193	31.60806	74.38055556
194	Garden Town	LHR194	31.50444	74.31555556
195	Garden Town	LHR195	31.50333	74.32555556
196	B Block New Faisal town	LHR196	31.493629	74.376294
197	Garden Town	LHR197	31.49722	74.31861111
198	Garden Town	LHR198	31.50194	74.32
199	M block Model town extension	LHR199	31.48250	74.30888889
200	Abu Bakar block	LHR200	31.51111	74.32555556
201	D block Faisal Town	LHR201	31.46944	74.30972222
202	L Block model town Extension	LHR202	31.48889	74.30805556
203	Tariq block	LHR203	31.49250	74.31305556
204	N Block Model Town Extension	LHR204	31.47833	74.31166667
205	P-Block Model Town Ext.	LHR205	31.47306	74.30972222
206	C Block Faisal Town	LHR206	31.47111	74.30555556
207	N Block, Samnabad	LHR207	31.53528	74.30027778
208	Dholanwal Near Dispensary, Samnabad	LHR208	31.53028	74.27861111
209	Zubiada Park, Samnabad	LHR209	31.53111	74.29055556
210	Jhugian Shahabdin, Samnabad	LHR210	31.53000	74.275
211	choudhary Colony/Khizra Mosque, Dhoongi Ground	LHR211	31.53194	74.30305556
212	Peer budhan shah, Samnabad	LHR212	31.53083	74.28277778
213	Bakar Mandi, Samnabad	LHR213	31.53389	74.26916667
214	Nawan Kot More Samanabad	LHR214	31.54333	74.29472222
215	Paki Thathi, Samnabad	LHR215	31.52917	74.29527778
216	Katcha Umer Park/Jinah colony, Samnabad	LHR216	31.53778	74.29611111
217	Ghulam Nabi colony, Samnabad	LHR217	31.54167	74.29944444
218	Mushtaq Town, Samnabad	LHR218	31.53528	74.27444444
219	C Block Sabzazar, Samnabad	LHR219	31.52889	74.26861111
220	Chah junian Wala/Paki Thathi, Samnabad	LHR220	31.52611	74.29055556
221	Itehad colony, Samnabad	LHR221	31.52639	74.2875
222	Pak block, Iqbal Town Sub Division	LHR222	31.51861	74.29777778
223	Jahanzeb Block, Iqbal Town Sub Division	LHR223	31.52444	74.28861111
224	college block, Iqbal Town Sub Division	LHR224	31.51111	74.2975
225	Karim Block-1, Iqbal Town Sub Division	LHR225	31.50556	74.28055556
226	Asif Block, Iqbal Town Sub Division	LHR226	31.51528	74.29944444

227	F & V Market 2, Iqbal Town Sub Division	LHR227	31.49694	74.26694444
228	New Chinab Block 2, Overhead Tank Park, Iqbal Town Sub Division	LHR228	31.52083	74.34666667
229	Nishtar Block 2, Graveyard, Iqbal Town Sub Division	LHR229	31.50500	74.27416667
230	Cliton Colony, Backside Girls Pilot School, Iqbal Town Sub Division	LHR230	31.51861	74.30611111
231	Ravi Block New, Main Multan Road, Kharak TW, Iqbal Town Sub Division	LHR231	31.51222	74.27416667
232	Mehran Block New, Main Multan Road, F & V Market, Iqbal Town Sub Division	LHR232	31.50056	74.26666667
233	Huma Block, Rahim Store Iqbal Town Sub Division	LHR233	31.52167	74.29
234	Raza Block, Children Park, Iqbal Town Sub Division	LHR234	31.50556	74.28638889
235	Kamran Block, Malik Sultan Children Park	LHR235	31.50139	74.27194444
236	Nelam Block, Small Park, Iqbal Town Sub Division	LHR236	31.52306	74.30138889
237	Nargis Block, Children Park Small Market, Iqbal Town Sub Division	LHR237	31.51472	74.28055556
238	Hunza Block, Children Park, Iqbal Town Sub Division	LHR238	31.51278	74.29638889
239	Kareem Block 2, Steet Jamia Masjid Allah Wali, Graveyard, Iqbal Town Sub Division	LHR239	31.50222	74.27833333
240	Islampura, Complaint Center WASA, Ravi Road Sub Division	LHR240	31.56556	74.29222222
241	Awa Phari Queen Road	LHR241	31.50167	74.31861111
242	Shadman Market	LHR242	31.54056	74.33027778
243	Rehmania Park Shadman	LHR243	31.54139	74.32694444
244	Hamoon Shah Park	LHR244	31.54361	74.30944444
245	Mason Road	LHR245	31.55111	74.32333333
246	Ahata Mool Chand-1	LHR246	31.53889	74.3225
247	Kot Abdullah Shah	LHR247	31.55917	74.31388889
248	Mian Aslam Iqbal Park	LHR248	31.54556	74.30694444
249	Lyton Road	LHR249	31.55694	74.31
250	Apwa College	LHR250	31.54250	74.3325
251	Aibak Park	LHR251	31.55500	74.30722222
252	Waris Road	LHR252	31.55000	74.31944444
253	Patiala House Children Complex	LHR253	31.55056	74.33833333
254	Faeeh Road	LHR254	31.54556	74.30305556
255	Roza abu Ishaq	LHR255	31.55528	74.315

256	Saadi Park	LHR256	31.55250	74.31138889
257	Shah Jamal	LHR257	31.52861	74.32694444
258	Bagh gul Begum	LHR258	31.54833	74.30861111
259	Ahata Mool Chand-2	LHR259	31.53306	74.32361111
260	Doungi Ground Fazlia Colony	LHR260	31.52778	74.33138889
261	Shadman Ganda Nala	LHR261	31.53611	74.33805556
262	Shadman Mental Hospital Tanki	LHR262	31.53444	74.33722222
263	Aisha Park Shadman	LHR263	31.53417	74.33305556
264	H-3 Block	LHR264	31.47056	74.26333333
265	G-4 Block Centre Park Reservior	LHR265	31.47139	74.27
266	E-I Block Opposite LGS School/C-II Block	LHR266	31.47028	74.29027778
267	J Block Park	LHR267	31.47139	74.25638889
268	L Block Near Police Choki	LHR268	31.46778	74.26722222
269	Beer Pind	LHR269	31.46056	74.29916667
270	Shah De Khoi, Near Johar Banquet	LHR270	31.48083	74.29888889
271	G-I Block Opposite LGS School	LHR271	31.47694	74.27777778
272	E Block Park	LHR272	31.47028	74.29666667
273	D-II Block Park	LHR273	31.45778	74.28527778
274	Campus View Near Moon Heights	LHR274	31.46722	74.2875
275	Oppsite Jamiya Masjid Muhammamdi, Muhammadi Park, Johar town Sub Division	LHR275	31.46694	74.25527778
276	Hanif Park Tunda Phatak	LHR276	31.60333	74.31055556
277	Hanif Park Street no.6	LHR277	31.60500	74.31388889
278	siddique Pura	LHR278	31.60000	74.31722222
279	Shad Bagh No.3	LHR279	31.60694	74.33333333
280	Hyssain Park	LHR280	31.60167	74.32194444
281	Qadafi colony	LHR281	31.60722	74.32166667
282	Khokhar road-3	LHR282	31.60917	74.32777778
283	Ali Pura Lift Station	LHR283	31.60944	74.31055556
284	Reheempura Park	LHR284	31.58833	74.33388889
285	Khokhar road-1	LHR285	31.61000	74.33027778
286	Khokhar road-2	LHR286	31.60972	74.33166667
287	Kohlu Ghar	LHR287	31.58694	74.32722222
288	Chah Motian Wala	LHR288	31.59861	74.325
289	Khakhar Road no.4, Band Road (Ring Road)	LHR289	31.60917	74.32722222
290	Mozang Ada	LHR290	31.55889	74.31527778
291	Cattle Park	LHR291	31.57528	74.31111111
292	Royal Park	LHR292	31.56639	74.325
293	Qilla Gujar Singh/Nisar Scheme	LHR293	31.56917	74.33333333
294	Landa Bazar	LHR294	31.58167	74.33
295	Usmania Colony	LHR295	31.56528	74.33388889
296	Lady Mclegan	LHR296	31.56333	74.30527778

297	Railway Road	LHR297	31.57639	74.33055556
298	Guru Agreen Nagar/Circular Road shah Alam	LHR298	31.57583	74.31916667
299	Pathi Ground/Rashi Bhawan	LHR299	31.57500	74.32944444
300	Nisbat Road Mohalla Gawalan	LHR300	31.57083	74.32083333
301	Nasir Bagh	LHR301	31.57222	74.30666667
302	Katcha Nisbat Road	LHR302	31.56806	74.32305556
303	Patiala Ground	LHR303	31.56611	74.31694444
304	Napier Road	LHR304	31.56889	74.315
305	Fareed Kot House	LHR305	31.56222	74.31111111
306	Ada Crown Bus	LHR306	31.57667	74.32222222
307	Haji Camp	LHR307	31.57167	74.335
308	Dhobi Mandi	LHR308	31.56694	74.31111111
309	Abdul Kareem road/Mela Ram Park	LHR309	31.56583	74.33111111
310	Takkia Khusrian Wala	LHR310	31.62972	74.30916667
311	G.T Road	LHR311	31.62472	74.28944444
312	Floor Mill Near WAPDA Power Palant	LHR312	31.63222	74.29055556
313	majeed Park	LHR313	31.63306	74.30194444
314	Saeed Park	LHR314	31.61722	74.29611111
315	Shahdra Twon	LHR315	31.62417	74.29861111
316	Qaiser Town	LHR316	31.47389	74.28805556
317	Qazi Park	LHR317	31.62639	74.29527778
318	Begum Da Bagh	LHR318	31.63389	74.30916667
319	Rave Cricket Ground	LHR319	31.62944	74.31138889
320	Latif chowk Wandala road	LHR320	31.63194	74.28305556
321	Yousaf Park	LHR321	31.62139	74.27222222
322	Shaokat Colony	LHR322	31.61306	74.2675
323	Gulshan-E-Hayat Colony	LHR323	31.61889	74.28722222
324	Kamran Park	LHR324	31.61083	74.28916667
325	Begum Kot New	LHR325	31.61000	74.26361111
326	Aziz colony	LHR326	31.62583	74.28166667
327	Farkhabad Nala	LHR327	31.60750	74.28555556
328	Match Factory	LHR328	31.63750	74.285
329	Farakhabad Disposal	LHR329	31.61417	74.28166667
330	Faisal Park/children Park	LHR330	31.64528	74.28194444
331	Jia Musa	LHR331	31.61944	74.28166667
332	D Block Gujarpura	LHR332	31.59111	74.36416667
333	Ablock Gujarpura	LHR333	31.60583	74.36166667
334	Kot khawaja Saeed Khan Je house	LHR334	31.60306	74.35722222
335	Jamil Park china Scheme	LHR335	31.59361	74.36
336	Sultan Pura New	LHR336	31.58667	74.34722222
337	Ahata Thanidaran chah meran	LHR337	31.58556	74.34083333
338	Usman Park Singpura	LHR338	31.58194	74.36333333
339	Chemra Mandi School	LHR339	31.58111	74.33777778
340	Kot khawaja Saeed Khan Je house	LHR340	31.58722	74.35916667

341	Tezab Ahata New	LHR341	31.57944	74.345
342	Shah Badar Dewan	LHR342	31.58306	74.36138889
343	Jinnah Park	LHR343	31.5218734	74.3561894
344	Begumpora Mehmodabad	LHR344	31.586088	74.361978
345	Own Wali Building	LHR345	31.58583	74.33194444
346	Jamshed Park/Singhpura	LHR346	31.58250	74.36555556
347	Bhogiwal New	LHR347	31.58667	74.36833333
348	Swami Nagar (Submersible)	LHR348	31.58000	74.34888889
349	Sultani Park	LHR349	31.58306	74.34194444
350	Shuja Colony Sawami Nagar	LHR350	31.57806	74.34805556
351	Gujar Pura B Block china Scheme	LHR351	31.59861	74.36388889
352	Yasrab Colony	LHR352	31.56528	74.35305556
353	Akramabad Park	LHR353	31.60111	74.34222222
354	Hamad colony	LHR354	31.59833	74.34611111
355	Lady Sofia Park	LHR355	31.59222	74.34944444
356	Nabi Baksh Park	LHR356	31.59917	74.335
357	Peeran Wala	LHR357	31.58972	74.33944444
358	Lady Sofia Park Old	LHR358	31.59167	74.34944444
359	Chah Meran Old	LHR359	31.58833	74.34805556
360	Well Centre 1	LHR360	31.60833	74.33444444
361	Well Centre 2	LHR361	31.60833	74.3325
362	Well Centre 4	LHR362	31.60667	74.335
363	Tajpura Ground	LHR363	31.59194	74.33666667
364	Ilahi Park	LHR364	31.58694	74.33555556
365	Chah Meran New	LHR365	31.58750	74.35055556
366	naoshahi road Bhagatpura/Ahmad Park	LHR366	31.60861	74.35111111
367	Shah Stadium	LHR367	31.59083	74.355
368	Shamshed Park	LHR368	31.59306	74.34194444
369	Khuda Buksh Park	LHR369	31.60639	74.35361111
370	Children Park	LHR370	31.60028	74.33888889
371	Wasan Pura Scheme	LHR371	31.59556	74.34916667
372	Nazimabad Shad Bagh	LHR372	31.59583	74.33527778
373	Old Ravi Well Centre III	LHR394	31.60778	74.30555556
374	Old Ravi Well Centre IV	LHR395	31.60722	74.30638889
375	Sheran Wala	LHR396	31.58722	74.30666667
376	Shah Alam Gate	LHR397	31.57611	74.31833333
377	Akbari Gate (Old)	LHR398	31.58000	74.32527778
378	Bhati Gate	LHR399	31.58000	74.30666667
379	Iqbal Park Fort	LHR400	31.58389	74.31611111
380	Shesh Mohal Road Bhati Gate	LHR401	31.58139	74.30388889
381	Mori Gate New	LHR402	31.57750	74.31083333
382	F&V Market Sabzi Mandi	LHR403	31.60222	74.30888889
383	Main Bazar Qila Mohammadi	LHR404	31.59361	74.30555556
384	Chumala	LHR405	31.58194	74.30666667
385	Masti Gate	LHR406	31.476119	74.275878

386	Lorry Ada Badami Bagh	LHR407	31.59139	74.31722222
387	Shah Alam Market	LHR408	31.57972	74.31805556
388	New Tehsil Garden	LHR409	31.58472	74.31055556
389	Yaki Gate New	LHR410	31.58361	74.32888889
390	Timber Market	LHR411	31.59917	74.30111111
391	Akbari Gate	LHR412	31.58083	74.32583333
392	Nawaz Sharef Park	LHR413	31.59750	74.30861111
393	Lohari Gate New	LHR414	31.57667	74.31444444
394	Texali Gate	LHR415	31.58528	74.30694444
395	Kashmiri Gate	LHR416	31.58750	74.32111111
396	Al Madad Park	LHR417	31.60278	74.30583333
397	Windsor Park/Altakeen Road	LHR418	31.53667	77.16833333
398	A Block Muslim Town	LHR419	31.51306	74.31277778
399	Nadeem Park	LHR420	31.52778	74.30305556
400	Rasool Park	LHR421	31.54250	74.31
401	New LOS Chaudhary colony	LHR422	31.54250	74.31611111
402	Qubra Mosque	LHR423	31.53472	74.30916667
403	A Block Rehman Pura	LHR424	31.52361	74.32
404	C Block Muslim Town	LHR425	31.51583	74.31722222
405	Mehbob Park	LHR426	31.52861	74.31805556
406	Wahdat Colony	LHR427	31.51750	74.31777778
407	Shah Kamal/Ganda Nala	LHR428	31.52389	74.31194444
408	Punj Peer Road	LHR429	31.53917	74.30888889
409	Karnalpura/Alhamd colony	LHR430	31.52389	74.31055556
410	Bukhari Market	LHR431	31.51972	74.31527778
411	New Ayubia Market	LHR432	31.51083	74.31333333
412	Ichra Moe New	LHR433	31.53250	74.32
413	New Takkia Lehri Shah	LHR434	31.53167	74.31194444
414	Kramabad Rehmanpura	LHR435	31.52139	74.31861111
415	Gawala Colony-1	LHR436	31.41861	74.32166667
416	2 D I	LHR437	31.44500	74.30916667
417	2-C-II	LHR438	31.44111	74.29472222
418	1-B-II (Old)	LHR439	31.45611	74.30416667
419	3-D-I	LHR440	31.577279	74.3624780
420	4-C-2	LHR441	31.43528	74.29555556
421	5-D-I	LHR442	31.43889	74.31361111
422	3-D-II	LHR443	31.43472	74.30666667
423	13-B-I	LHR444	31.45833	74.30694444
424	11-B-2	LHR445	31.46444	74.30944444
425	Bhata No. 1&2	LHR446	31.42667	74.30222222
426	Keer Kalan Pind	LHR447	31.44333	74.31416667
427	Bagrian Pind	LHR448	31.42250	74.29166667
428	4-D-II	LHR449	31.43583	74.31111111
429	I-D-II	LHR450	31.43278	74.30333333
430	5-C-II	LHR451	31.43361	74.29611111

431	1 C-I	LHR452	31.44472	74.29833333
432	Gawala Colony 3	LHR453	31.41472	74.33138889
433	1 B-II New	LHR454	31.45778	74.30416667
434	5-D-II New	LHR455	31.43222	74.30972222
435	Aoqaf Colony	LHR456	31.43167	74.29416667
436	Hakim Town	LHR457	31.42000	74.29722222
437	3-C-I Green Town	LHR458	31.44222	74.3025
438	2 B-I Township	LHR459	31.46250	74.31388889
439	6-B-I	LHR460	31.45722	74.31055556
440	16-B-I/Pathanewala	LHR461	31.46500	74.30694444
441	5 D-2 Old	LHR462	31.43194	74.30694444
442	Q Block Near Police Station	LHR463	31.47028	74.32944444
443	R Block	LHR464	31.47139	74.3325
444	S Block Model Town	LHR465	31.47167	74.33666667
445	Pindi stop	LHR466	31.46028	74.32611111
446	Albadar Hospital	LHR467	31.46528	74.33861111
447	R Block New	LHR468	31.476119	74.275878
448	Nasrat Road	LHR469	31.46944	74.33833333
449	Bhati Colony Model Town	LHR470	31.47056	74.32
450	Nadeem Park/Rahat Park	LHR471	31.45944	74.33722222
451	Pindi Rajputan	LHR472	31.46472	74.32388889
452	Akbar Sheed Road	LHR473	31.46389	74.33555556
453	Ittefaq Hospital Cricket Ground	LHR474	31.47472	74.34083333
454	Block 4 Sector A-II Township	LHR475	31.45472	74.31583333
455	Baba Fareed Colony Near Jail	LHR476	31.44889	74.34055556
456	Bank Stop/Mian Fazal Haq Colony	LHR477	31.44083	74.35333333
457	Nishter colony Near Police Station	LHR478	31.42167	74.36111111
458	Nishter Colony Near Tanky	LHR479	31.43917	74.36694444
459	Block 6 Sector A-II Township	LHR480	31.45528	74.32111111
460	Qanchi Stop	LHR481	31.46389	74.34888889
461	Itefaq Colony	LHR482	31.46028	74.33972222
462	Sitara Colony	LHR483	31.44944	74.36388889
463	Katcha Jail road/Irigation Colony	LHR484	31.44861	74.35222222
464	Awami Colony	LHR485	31.45944	74.35
465	Ghulam Hussain Bhati Colony UC 129	LHR486	31.44167	74.34833333
466	Baba Fareed Colony Near PECO	LHR487	31.45361	74.33805556
467	Chungi Amarsadhu Near Shell Pump	LHR488	31.44667	74.35472222
468	Block 2 Sector A-II Township	LHR489	31.45222	74.31444444
469	K-Block Phase VI Avenue-1 Tank-1	DHA-01	31.4756	74.4619
470	A-Block Phase VI Avenue-4 Lahore, Pakistan	DHA-02	31.4687	74.4404
471	St-17, Sector Y, Phase-3 Lahore.	DHA-03	31.4687	74.3762
472	St-16, Sector Z Phase-3 Lahore, Pakistan	DHA-04	74.3815	31.477
473	Allama Iqbal Road Lahore.	Cantt-01	31.5493	74.3795

474	Sarwar Road, Lahore.	Cantt-02	31.5446	74.3773
475	C.M.H Hospital, Lahore.	Cantt-03	40.394	16.716
476	Zarar Shaheed Road	Cantt-04	24.641	11.813
477	Askhri Flat -01 Tufail Road Sadder	Cantt-05	25.981	16.113

3.4 Determination of Arsenic

The concentration of arsenic in the collected ground water samples was determined using Atomic absorption Spectroscopy.

3.5 Statistical Analysis

Statistical Analysis and data processing was conducted with the help of Microsoft Excel and SPSS 20.0. The estimations that were deduced include mean, median, standard deviation and Pearson Coefficient Correlation to calculate the linear correlation between the As concentration in groundwater and depth and pH of the water from the underground reservoirs.

3.6 Human Health Risk Assessment (HHRA)

Once the linear correlation between pH, depth and concentration of ground water is determined the next step was to carry out a Human Health Risk Assessment (HHRA). This technique helped in the identification of the potential health effects of As. It is basically defined as

“HHRA is a procedure that is used to determine the nature and likelihood of health effects in humans due to their exposure to certain chemicals present in the environment. This technique can estimate these adverse effects now and in the near future (Cunningham et al., 2009).”

This HHRA was further used to determine carcinogenic risks of As in the study area. The HHRA process was carried out by estimating the following:

3.6.1 Exposure Dose (ED)

The exposure dose as the name implies is the amount of the pollutant that a human being is exposed to at a certain point. Exposure Dose for As was calculated by the following formula devised by Hu in 2011:

$$ED = C * IR * ED * EF / BW * AT \dots (1)$$

Where,

C = Arsenic concentration in water (mg/l)

IR = Intake rate (2L/day)

ED = Exposure duration (assumed for 67 years)

EF = Exposure frequency (365 days/year)

BW = Body weight (72 kg)

AT = Average lifetime (24,455 days)

3.6.2 Hazard Quotient (HQ)

The next estimation of HHRA was hazard quotient. The HQ is the ratio between the potential exposure to a substance and the point at which no harmful impacts are expected (Hu et al., 2011). In case of As the HQ was estimated by:

$$HQ = ED / RfD \dots (2)$$

Where, reference dose for arsenic is 0.0003 mg/kg/day. If the HQ value for a given sample was ≥ 1 that water sample was regarded as a health risk to human making it unsuitable for drinking.

3.6.3 Cancer Risk

The cancer risk of As for the given samples was determined by the following formula:

$$CR = ED * CSF \dots (3)$$

Where,

CSF = Cancer Slope Factor for As = 1.5 mg/kg/day

3.7 Comparison with NEQs and WHO Standards

After the laboratory analysis of the collected samples and the interpretation of data, the obtained values were compared with NEQs (National Environmental quality Standards) and WHO (World Health Organization) standard for As that is 50 ppb and 10 ppb respectively.

The samples that were within the permissible limits of both standards were considered safe and those that were exceeding the limits were considered harmful and non suitable of drinking purposes.

3.7 GIS Mapping

Once all the required information was collected the areas with extreme levels of arsenic contamination were marked using the ARCGIS 10.3 software. For the purpose, of mapping two different sets of risk categories were defined on the basis of the two standards that were used as a part of this study.

3.7.1 Risk Categorization for Mapping

The two standards that were used for categorizing the risks associated with the level of contamination of As, one was a limit set by World Health Organization (WHO) and the other was the limit set by National Environmental Quality Standards (NEQs). The reason for using two standards is that one of them is an international standard (WHO) and the other one is a national standard (NEQs).

The first set of risk category was defined according to WHO, in this category there were three classes which define the risks that are associated with the amount of arsenic that is present in the collected water sample. First class is of low risk (0-10 ppb), second

is of moderate risk (10-30) and the third class is of high risk (30-115 ppb). The standard set by WHO is 10 ppb so anything that falls within the first class poses no or a very low risk to human health and water quality, whereas anything that falls within the second category of moderate risk has a lot of potential to degrade the water quality thereby making it unsuitable for drinking and other purposes. Lastly, high risk clearly shows that any sample that is a part of this class is already highly polluted that it could endanger the population's health that is consuming it.

Since, the international limit set by WHO is so stringent i.e., 10 ppb and it's very hard for the developing nations to imply to therefore, the other standards that was used to categorize the risk was the National Environmental Quality Standards (NEQs). The limit set for As by NEQs is 50 ppb. Therefore, the classes of risk that were defined included, low risk (0-10 ppb), moderate risk (10-50 ppb) and high risk (50-115 ppb).

CHAPTER FOUR

RESULTS

As stated already, this research was conducted to determine the As level in the underground water of Lahore which further establishes a relationship between these levels and depth of tubewell. Another purpose of this research was to carry out an HHRA and to determine the kind and level of diseases which are caused in population residing in these areas due to excessive As pollution.

4.1 CONCENTRATION OF ARSENIC IN WATER SAMPLES

For this purpose, a total of 498 water samples were collected and analyzed to determine the concentration of arsenic. The technique that was employed for this purpose was Atomic Absorption Spectroscopy. The results that were obtained through laboratory analysis are shown below. These results were then further compared with PCRWR and WHO standards.

Table 4.1 Concentration of Arsenic in the collected water samples

S.#	Sample Code	Location of Tube well	Arsenic Concentration (ppb)
1	LHR001	Tegro Park	47.83
2	LHR002	Muhammad Nagar	32.09
3	LHR003	Habibullah Road Baghyshah	57.45
4	LHR004	Children Park	40.62
5	LHR005	Habibullah Road Baghyshah	41.50
6	LHR006	Scotch Corner/Upper Mall	25.50
7	LHR007	Mian Meer Pind	62.40
8	LHR008	anand road Upper Mall	53.24
9	LHR009	Garhi Shahu Police Station	38.45
10	LHR010	Main Bazar Ghazi Mohalla Garhi Shahu	36.60
11	LHR011	Larex Colony	36.45
12	LHR012	Zaman Park	40.23
13	LHR013	Basti syden Shah	40.80
14	LHR014	Bagh Munshi Ladha	34.60
15	LHR015	Yaseen Road	28.50
16	LHR016	Umar Park Bilal Ganj	24.80
17	LHR017	Mohni Road	28.50

18	LHR018	Karim Pak Ground Old	38.50
19	LHR019	Qasor Pura/Ameen colony	36.60
20	LHR020	New Umer Park	25.45
21	LHR021	Gulshan-e-Riaz	23.70
22	LHR022	Ibraheem Road	26.60
23	LHR023	Sardar Chapal	24.70
24	LHR024	Munshi Hospital	24.90
25	LHR025	Main Outfull Road	30.85
26	LHR026	Karim Park Block 3	32.00
27	LHR027	National Ravi 2	36.20
28	LHR028	Bajri Adda	29.75
29	LHR029	Main Outfull Road New	23.00
30	LHR030	Ameen Park	31.50
31	LHR031	Rehmat Flour Road	34.90
32	LHR032	Allah Wali Mosque	22.05
33	LHR033	Shafiqueabad	28.95
34	LHR034	Takoni Ground Islam pura	90.10
35	LHR035	Firdos Park	32.80
36	LHR036	Chohan Park	17.75
37	LHR037	DCO Office	25.00
38	LHR038	Akram Park Band Road	46.10
39	LHR039	Nehru Park/Afgharn Park	23.52
40	LHR040	Rafayabad Park	22.95
41	LHR041	MC High School Sanda	30.75
42	LHR042	Liqatabad	45.25
43	LHR043	Commisioner Office	23.30
44	LHR044	Ali Park New	23.90
45	LHR045	G Block Gulshan Ravi	31.65
46	LHR046	60-Road Shera Kot Babu Sabu	16.80
47	LHR047	Moon Market Gulshan Ravi	18.45
48	LHR048	Jaffiria colony	26.20
49	LHR049	Rustam Park	27.15
50	LHR050	Umer Park Sodiwal Quarder	22.60
51	LHR051	Naunarian	26.70
52	LHR052	Nawa Kot WASA Colony	24.36
53	LHR053	Dhop Sari Malik Munir Road	22.95
54	LHR054	E Block Gulshan Ravi	30.35
55	LHR055	Zubair Park Gulshan Ravi	15.96
56	LHR056	Firdos Colony	22.20
57	LHR057	Usman Park F Block Gulshana Ravi	20.50
58	LHR058	Sikandria colony	26.50
59	LHR059	Babu Sabu School	20.70
60	LHR060	Near WASA Complaint Center	18.72
61	LHR061	Riwaz Garden Markeet	26.85

62	LHR062	Takkia Mehmood Shah,Sanda Road Rahat Street	24.91
63	LHR063	Bilal Park, Raj Garh	31.10
64	LHR064	Riifle Range, New Chlazji	26.80
65	LHR065	Ghulam Hussain colony Across Bund road, Main Street Bazar, Imam Din road	41.40
66	LHR066	Patwar Khana,Grave yard Sanda Road	39.45
67	LHR067	Jahangir Town	38.35
68	LHR068	A Block gulshan-e-ravi	28.50
69	LHR069	Bund Road UC84	30.04
70	LHR070	Zubair Road Rajgarh	48.30
71	LHR071	Muslim Park Rajgarh	39.55
72	LHR072	B Block Gulshan e Ravi, Qazafi Park	20.45
73	LHR073	Park P Block, Sabza zar Opp Malik Yasir House	35.70
74	LHR074	D Block Main Park Off Fezan-e-Rasool Road	25.70
75	LHR075	A Block Park on main road	36.50
76	LHR076	shah Fared Takani Park, Shah Fareed Markeet	31.65
77	LHR077	Masroor Ahmad	42.50
78	LHR078	Takoni Ground Off Grave Yard	32.55
79	LHR079	Near Park, H block	35.40
80	LHR080	Takin Chowk Main Bazar Khardk	34.55
81	LHR081	Liaqat Chowk, Asad Plaza Markeet	30.55
82	LHR082	Kasar Block Jinnah Block/Awan town	36.45
83	LHR083	Main Park One Head Tank,K Block	29.50
84	LHR084	Main Park N Block near Qalza Masjid	61.35
85	LHR085	E-1 Block Fcc Katchi abadi Gulbug III	35.85
86	LHR086	H Block Gulbarg III	28.65
87	LHR087	Makka Colony Street 22, Gulbarg III	35.55
88	LHR088	B-1 Block Gulberg III	45.05
89	LHR089	Railway line,Jinna Park Gulburg II	49.10
90	LHR090	Back side Ferdous Markeet, J Block Gulberg II/ K-Block G-III	27.50
91	LHR091	Nala 27 Manzab Pace Town, Q block Gulberg II New	19.40
92	LHR092	Over Head Tank, B-Block/T-block gulberg II New	41.95
93	LHR093	Nisar Art Press gulberg II	45.45
94	LHR094	Near Sui Gas Main Office (Ploice Post Gulberg market	35.00
95	LHR095	Ghalab Markeet, Guru Manget A-II	35.20
96	LHR096	saint Merry Colony Gulberg-III	38.05
97	LHR097	Opposite Lahore cantt Raalway Station, Qurban Line Gulberg-II	38.45

98	LHR098	The Pind Furdous Markeet C-1	39.60
99	LHR099	Syed Mubsam Ali Rizvi	38.75
100	LHR100	New Railway Line (Walton Acadmy), New Makka colony	29.70
101	LHR101	M Block, Henry K Gulberg-III	36.75
102	LHR102	G Block Wasa Complant Center	40.90
103	LHR103	Opposite Shalimar Towar hotel, Zafar Ali road/Jail road	34.65
104	LHR104	Park Back site X PM parvaz Elahi, Fcc block, Gulberg sub Dev	55.35
105	LHR105	Jamiya Masjid Abu bakar Siddique, Khan colony Gulberg III	45.10
106	LHR106	social Security hospital, main Feroz pur road, nawaz Shareef colony Feroz pur.	29.15
107	LHR107	Green Belt P block, Ghulab Devi Hospital, Gopal Nagar	35.40
108	LHR108	Main Bazar Bilal Nagar, Henry Katchi Abadi Gulberg III	37.35
109	LHR109	Govt. Islamia College for Boys, Iqbal Park	29.25
110	LHR110	Athar Abbas ParkTajpura Pind	31.55
111	LHR111	A Block Tajpura	48.49
112	LHR112	Main Park Tajpura, Data Park	32.95
113	LHR113	D Block Main Park	29.50
114	LHR114	Al Madina Colony. A Block Tajpura	35.40
115	LHR115	Al Faisal Town, Burgi No. 9	28.35
116	LHR116	Soling Road, Tajpura	27.45
117	LHR117	Graveyard Ghaziabad Bus stop No.2	31.30
118	LHR118	SDO Office, DO North Tajpura	32.75
119	LHR119	DLR Office, Chubacha Phatik	
120	LHR120	Gulshan Colony Walton	31.45
121	LHR121	LDA Quarter Walton	26.20
122	LHR122	Ghosia colony	31.17
123	LHR123	Gulshan colony Mustafa Abad	29.10
124	LHR124	Infentory colony	30.05
125	LHR125	Canal Bridge	29.75
126	LHR126	Mian Meer Darbar	28.85
127	LHR127	Tariq colony, Walton	36.90
128	LHR128	Dry Port, Mughalpura	29.55
129	LHR129	Canal Bank, Ahata Makhan Sing	32.04
130	LHR130	Chubacha Phatik, DLR Office, Mustafaabad Sub Division	
131	LHR131	Punj Peer Lal pull, Canal Bank, Fateh Garh Sub Div.	26.44
132	LHR132	Jahangir Road, Main Chowk Mughal pura Canal Bank, Sub Div. Mughal pura	23.38

133	LHR133	Fayaz Park, Canal Bank, Mughal pura Sub. Division	24.56
134	LHR134	Maskeenpura, Golden Gate School, Canal Bank, Fateh Garh Division	26.16
135	LHR135	Fateh Garh Pull, City District Girls High School, Fateh Garh Div.	24.64
136	LHR136	Kotli Ghasi, Govt Boys Primary School, Fateh Garh Div.	28.84
137	LHR137	Qalandarpura, Fateh garh sub division	31.50
138	LHR138	Gawala Colony Herbanapura, Ring road, Faeteh garh sub division	28.32
139	LHR139	Iftikhar Park, Harbanapura Park, Fateh garh div.	24.94
140	LHR140	Ishfaq Chowk/ Shaoq Chowk, Van Stand Al-Kareem Chowk, Tajpura Sub Div.	23.32
141	LHR141	Tajbagh Scheme, Gulshan-e-Rehman, Tajpura Division	34.25
142	LHR142	Jore Pull, Tajpura sub Div.	28.60
143	LHR143	C Block Al-faisal town Baharshah, Tajpura Sub. Div.	26.50
144	LHR144	Canal Bank, Muslim abad, Fateh Garh	27.00
145	LHR145	Peer Naseer, Mughal pura Sub. Div.	26.62
146	LHR146	Slamatpura Takkia, Fateh garh Sub Div.	32.05
147	LHR147	Gulshan Park, Fateh garh Sub Div.	35.35
148	LHR148	Nadia Ghee Mill, Fateh garh Sub Div.	30.80
149	LHR149	Dars Bary Mian/ Mujahidabad,	27.05
150	LHR150	Salamat Pura 5, Fateh garh Sub Div.	47.65
151	LHR151	Shah Din Park, Fateh garh Sub Div.	29.55
152	LHR152	Kotli Pir Abdul Rehman, Mughalpura Sub. Div.	27.05
153	LHR153	Dispensary Road Fateh Garh, Fateh garh Sub Div.	35.40
154	LHR154	Faisal Park/ Children Park	29.70
155	LHR155	Sahuwari Sani View Park, Mughalpura	35.10
156	LHR156	Qadir Buksh Park,	37.40
157	LHR157	Maskeenpura	40.05
158	LHR158	Karim Nagar Salamat pura no. 3	43.20
159	LHR159	New Shalimar Scheme Salamat Pura	30.15
160	LHR160	Sahuwari Takkia Old	31.40
161	LHR161	Goshaya Angori	30.25
162	LHR162	Shah Kamal Road	25.75
163	LHR163	Milap Street	31.15
164	LHR164	Sansi Quarder	37.95
165	LHR165	Anguri Bagh Scheme No. 2	30.15
166	LHR166	Baja Line	35.50

167	LHR167	Pakistan Mint New	48.10
168	LHR168	Lal School, Dars Baray Mian	49.15
169	LHR169	Masjid Taj din	28.95
170	LHR170	Parashoot Colony	23.30
171	LHR171	Baghechi Sethah Wali New	35.90
172	LHR172	Azeem Ground	29.10
173	LHR173	B.T.H Drain	27.00
174	LHR174	Achant Garh	31.00
175	LHR175	Baba Beri Peer	39.15
176	LHR176	Jamilabad	20.04
177	LHR177	Saher Road	50.10
178	LHR178	Shah Gohar Abad	33.40
179	LHR179	Memood Booti Well Centre II	40.05
180	LHR180	Mehmood Booti Well centere III	34.25
181	LHR181	Dobi Ghat	36.65
182	LHR182	Rohri Per Darbar	43.25
183	LHR183	Madhulal Hussain	38.75
184	LHR184	Suraya Jabeen Park	36.50
185	LHR185	Tiba Qilla Khazana	42.90
186	LHR186	Ahma Town	42.35
187	LHR187	Gulshan-e-Shalimar	36.25
188	LHR188	Memenpura	44.70
189	LHR189	Baba Ghandi Shah	38.75
190	LHR190	Saad Ghee Mill	37.25
191	LHR191	Deputy Yaqoob Colony	40.10
192	LHR192	Alia Town	42.00
193	LHR193	Near Mehmood booti disposal	33.90
194	LHR194	Garden Town	30.76
195	LHR195	Garden Town	44.80
196	LHR196	B Block New Faisal town	24.48
197	LHR197	Garden Town	30.50
198	LHR198	Garden Town	30.20
199	LHR199	M block Model town extension	34.50
200	LHR200	Garden Town	34.00
201	LHR201	D block Faisal Town	25.68
202	LHR202	L Block model town Extension	24.24
203	LHR203	Tariq block	25.62
204	LHR204	N Block Model Town Extension	24.62
205	LHR205	P-Block Model Town Ext.	32.20
206	LHR206	C Block Faisal Town	24.56
207	LHR207	N Block, Samnabad	26.52
208	LHR208	Dholanwal Near Dispensary, Samnabad	27.76
209	LHR209	Zubiada Park, Samnabad	22.52
210	LHR210	Jhugian Shahabdin, Samnabad	24.30

211	LHR211	choudhary Colony/Khizra Mosque, Dhoongi Ground	25.56
212	LHR212	Peer budhan shah, Samnabad	25.76
213	LHR213	Bakar Mandi, Samnabad	22.74
214	LHR214	Nawan Kot More Samanabad	24.68
215	LHR215	Paki Thathi, Samnabad	24.38
216	LHR216	Katcha Umer Park/Jinah colony, Samnabad	28.84
217	LHR217	Ghulam Nabi colony, Samnabad	26.64
218	LHR218	Mushtaq Town, Samnabad	22.46
219	LHR219	C Block Sabzazar, Samnabad	22.40
220	LHR220	Chah junian Wala/Paki Thathi, Samnabad	23.70
221	LHR221	Itehad colony, Samnabad	24.32
222	LHR222	Pak block, Iqbal Town Sub Division	23.66
223	LHR223	Jahanzeb Block, Iqbal Town Sub Division	24.84
224	LHR224	college block, Iqbal Town Sub Division	24.98
225	LHR225	Karim Block-1, Iqbal Town Sub Division	25.88
226	LHR226	Asif Block, Iqbal Town Sub Division	25.46
227	LHR227	F & V Market 2, Iqbal Town Sub Division	23.38
228	LHR228	New Chinab Block 2, Overhead Tank Park, Iqbal Town Sub Division	24.78
229	LHR229	Nishtar Block 2, Graveyard, Iqbal Town Sub Division	20.24
230	LHR230	Cliton Colony, Backside Girls Pilot School, Iqbal Town Sub Division	26.56
231	LHR231	Ravi Block New, Main Multan Road, Kharak TW, Iqbal Town Sub Division	26.42
232	LHR232	Mehran Block New, Main Multan Road, F & V Market, Iqbal Town Sub Division	24.26
233	LHR233	Huma Block, Rahim Store Iqbal Town Sub Division	25.44
234	LHR234	Raza Block, Children Park, Iqbal Town Sub Division	23.94
235	LHR235	Kamran Block, Malik Sultan Children Park	23.86
236	LHR236	Nelam Block, Small Park, Iqbal Town Sub Division	30.02
237	LHR237	Nargis Block, Children Park Small Market, Iqbal Town Sub Division	29.38
238	LHR238	Hunza Block, Children Park, Iqbal Town Sub Division	27.08
239	LHR239	Kareem Block 2, Steet Jamia Masjid Allah Wali, Graveyard, Iqbal Town Sub Division	23.94
240	LHR240	Islampura, Complaint Center WASA, Ravi Road Sub Division	27.06
241	LHR241	Awa Phari Queen Road	26.20
242	LHR242	Shadman Market	31.55

243	LHR243	Rehmania Park Shadman	29.05
244	LHR244	Hamoon Shah Park	28.55
245	LHR245	Mason Road	28.90
246	LHR246	Ahata Mool Chand-1	22.35
247	LHR247	Kot Abdullah Shah	24.70
248	LHR248	Mian Aslam Iqbal Park	28.30
249	LHR249	Lyton Road	24.10
250	LHR250	Apwa College	27.55
251	LHR251	Aibak Park	33.55
252	LHR252	Waris Road	32.30
253	LHR253	Patiala House Children Complex	29.90
254	LHR254	Faeeh Road	31.05
255	LHR255	Roza abu Ishaq	29.70
256	LHR256	Saadi Park	38.35
257	LHR257	Shah Jamal	38.30
258	LHR258	Bagh gul Begum	23.40
259	LHR259	Ahata Mool Chand-2	21.50
260	LHR260	Doungi Ground Fazlia Colony	26.20
261	LHR261	Shadman Ganda Nala	24.90
262	LHR262	Shadman Mental Hospital Tanki	25.15
263	LHR263	Aisha Park Shadman	24.25
264	LHR264	H-3 Block	26.90
265	LHR265	G-4 Block Centre Park Reservoir	24.20
266	LHR266	E-I Block Opposite LGS School/C-II Block	29.00
267	LHR267	J Block Park	9.19
268	LHR268	L Block Near Police Choki	8.49
269	LHR269	Beer Pind	26.50
270	LHR270	Shah De Khoi, Near Johar Banquet	26.20
271	LHR271	G-I Block Opposite LGS School	8.36
272	LHR272	E Block Park	26.90
273	LHR273	D-II Block Park	23.75
274	LHR274	Campus View Near Moon Heights	23.50
275	LHR275	Opposite Jamiya Masjid Muhammad, Muhammad Park, Johar town Sub Division	28.45
276	LHR276	Hanif Park Tunda Phatak	40.90
277	LHR277	Hanif Park Street no.6	43.05
278	LHR278	Siddique Pura	36.05
279	LHR279	Shad Bagh No.3	29.54
280	LHR280	Hyssain Park	48.85
281	LHR281	Qadafi colony	42.55
282	LHR282	Khokhar road-3	41.25
283	LHR283	Ali Pura Lift Station	27.90
284	LHR284	Reheempura Park	22.90
285	LHR285	Khokhar road-1	47.20
286	LHR286	Khokhar road-2	42.70

287	LHR287	Kohlu Ghar	31.74
288	LHR288	Chah Motian Wala	44.25
289	LHR289	Khakhar Road no.4, Band Road (Ring Road	42.50
290	LHR290	Mozang Ada	27.70
291	LHR291	Cattle Park	24.95
292	LHR292	Royal Park	23.80
293	LHR293	Qilla Gujar Singh/Nisar Scheme	40.60
294	LHR294	Landa Bazar	38.60
295	LHR295	Usmania Colony	28.45
296	LHR296	Lady Mclegan	38.05
297	LHR297	Railway Road	24.95
298	LHR298	Guru Agreeen Nagar/Circular Road shah Alam	10.96
299	LHR299	Pathi Ground/Rashi Bhawan	12.90
300	LHR300	Nisbat Road Mohalla Gawalan	16.40
301	LHR301	Nasir Bagh	62.00
302	LHR302	Katcha Nisbat Road	24.60
303	LHR303	Patiala Ground	10.89
304	LHR304	Napier Road	27.96
305	LHR305	Fareed Kot House	26.16
306	LHR306	Ada Crown Bus	24.14
307	LHR307	Haji Camp	24.32
308	LHR308	Dhobi Mandi	27.00
309	LHR309	Abdul Kareem road/Mela Ram Park	24.06
310	LHR310	Takkia Khusrian Wala	47.20
311	LHR311	G.T Road	46.90
312	LHR312	Floor Mill Near WAPDA Power Palant	53.85
313	LHR313	majeed Park	78.25
314	LHR314	Saeed Park	35.15
315	LHR315	Shahdra Twon	41.35
316	LHR316	Qaiser Town	114.90
317	LHR317	Qazi Park	53.25
318	LHR318	Begum Da Bagh	66.10
319	LHR319	Rave Cricket Ground	37.90
320	LHR320	Latif chowk Wandala road	44.85
321	LHR321	Yousaf Park	61.70
322	LHR322	Shaokat Colony	36.07
323	LHR323	Gulshan-E-Hayat Colony	33.15
324	LHR324	Kamran Park	33.65
325	LHR325	Begum Kot New	57.85
326	LHR326	Aziz colony	67.75
327	LHR327	Farkhabad Nala	28.45
328	LHR328	Match Factory	44.25
329	LHR329	Farakhabad Disposal	45.65
330	LHR330	Faisal Park/children Park	30.35

331	LHR331	Jia Musa	55.20
332	LHR332	D Block Gujarpura	26.26
333	LHR333	Ablock Gujarpura	24.72
334	LHR334	Kot khawaja Saeed Khan Je house	24.68
335	LHR335	Jamil Park china Scheme	23.88
336	LHR336	Sultan Pura New	23.80
337	LHR337	Ahata Thanidaran chah meran	23.68
338	LHR338	Usman Park Singpura	24.88
339	LHR339	Chemra Mandi School	24.72
340	LHR340	Kot khawaja Saeed Khan Je house	24.88
341	LHR341	Tezab Ahata New	26.01
342	LHR342	Shah Badar Dewan	24.20
343	LHR343	Jinah Park	25.80
344	LHR344	Begumpora Mehmodabad	27.76
345	LHR345	Own Wali Building	27.52
346	LHR346	Jamshed Park/Singhpura	27.14
347	LHR347	Bhogiwal New	23.1
348	LHR348	Swami Nagar (Submersible)	0
349	LHR349	Sultani Park	22.98
350	LHR350	Shuja Colony Sawami Nagar	22.18
351	LHR351	Gujar Pura B Block china Scheme	30.06
352	LHR373	Yasrab Colony	29.40
353	LHR374	Akramabad Park	27.05
354	LHR375	Hamad colony	31.10
355	LHR376	Lady Sofia Park	30.45
356	LHR377	Nabi Baksh Park	23.40
357	LHR378	Peeran Wala	31.17
358	LHR379	Lady Sofia Park Old	24.74
359	LHR380	Chah Meran Old	25.05
360	LHR381	Well Centre 1	34.05
361	LHR382	Well Centre 2	49.65
362	LHR383	Well Centre 4	30.70
363	LHR384	Tajpura Ground	34.25
364	LHR385	Ilahi Park	28.50
365	LHR386	Chah Meran New	29.10
366	LHR387	Naoshahi road Bhagatpura/Ahmad Park	27.30
367	LHR388	Shah Stadium	30.65
368	LHR389	Shamshed Park	28.70
369	LHR390	Khuda Buksh Park	28.15
370	LHR391	Children Park	34.35
371	LHR392	Wasan Pura Scheme	-
372	LHR393	Nazimabad Shad Bagh	34.20
373	LHR394	Old Ravi Well Centre III	26.02
374	LHR395	Old Ravi Well Centre IV	30.36
375	LHR396	Sheran Wala	21.78

376	LHR397	Shah Alam Gate	22.40
377	LHR398	Akbari Gate (Old)	19.58
378	LHR399	Bhati Gate	30.52
379	LHR400	Iqbal Park Fort	22.16
380	LHR401	Shesh Mohal Road Bhati Gate	28.82
381	LHR402	Mori Gate New	37.20
382	LHR403	F&V Market Sabzi Mandi	32.92
383	LHR404	Main Bazar Qila Mohammadi	13.68
384	LHR405	Chumala	18.58
385	LHR406	Masti Gate	13.70
386	LHR407	Lorry Ada Badami Bagh	13.56
387	LHR408	Shah Alam Market	21.75
388	LHR409	New Tehsil Garden	39.40
389	LHR410	Yaki Gate New	18.20
390	LHR411	Timber Market	32.35
391	LHR412	Akbari Gate	22.85
392	LHR413	Nawaz Sharef Park	27.70
393	LHR414	Lohari Gate New	30.85
394	LHR415	Texali Gate	32.70
395	LHR416	Kashmiri Gate	25.25
396	LHR417	Al Madad Park	36.75
397	LHR418	Windsor Park/Altakeen Road	32.45
398	LHR419	A Block Muslim Town	28.90
399	LHR420	Nadeem Park	45.60
400	LHR421	Rasool Park	29.70
401	LHR422	New LOS Chaudhary colony	28.05
402	LHR423	Qubra Mosque	35.15
403	LHR424	A Block Rehman Pura	28.95
404	LHR425	C Block Muslim Town	31.85
405	LHR426	Mehbob Park	38.25
406	LHR427	Wahdat Colony	47.80
407	LHR428	Shah Kamal/Ganda Nala	33.10
408	LHR429	Punj Peer Road	33.05
409	LHR430	Karnalpora/Alhamd colony	25.95
410	LHR431	Bukhari Market	34.35
411	LHR432	New Ayubia Market	26.75
412	LHR433	Ichra Mor New	28.90
413	LHR434	New Takkia Lehri Shah	27.60
414	LHR435	Kramabad Rehmanpura	45.10
415	LHR436	Gawala Colony-1	22.28
416	LHR437	2 D I	29.72
417	LHR438	2-C-II	26.74
418	LHR439	1-B-II (Old)	35.02
419	LHR440	3-D-I	26.32
420	LHR441	4-C-2	26.38

421	LHR442	5-D-I	27.90
422	LHR443	3-D-II	23.40
423	LHR444	13-B-I	26.92
424	LHR445	11-B-2	24.74
425	LHR446	Bhata No. 1&2	24.42
426	LHR447	Keer Kalan Pind	28.62
427	LHR448	Bagrian Pind	21.98
428	LHR449	4-D-II	23.04
429	LHR450	I-D-II	23.98
430	LHR451	5-C-II	24.44
431	LHR452	1 C-I	26.26
432	LHR453	Gawala Colony 3	23.50
433	LHR454	1 B-II New	31.06
434	LHR455	5-D-II New	26.94
435	LHR456	Aoqaf Colony	28.00
436	LHR457	Hakim Town	21.80
437	LHR458	3-C-I Green Town	30.18
438	LHR459	2 B-I Township	24.00
439	LHR460	6-B-I	24.34
440	LHR461	16-B-I/Pathanewala	25.06
441	LHR462	5 D-2 Old	25.20
442	LHR463	Q Block Near Police Station	20.40
443	LHR464	R Block	21.30
444	LHR465	S Block Model Town	23.16
445	LHR466	Pindi stop	23.04
446	LHR467	Albadar Hospital	25.88
447	LHR468	R Block New	26.62
448	LHR469	Nasrat Road	24.36
449	LHR470	Bhati Colony Model Town	24.50
450	LHR471	Nadeem Park/Rahat Park	22.24
451	LHR472	Pindi Rajputan	23.94
452	LHR473	Akbar Sheed Road	24.74
453	LHR474	Ittefaq Hospital Cricket Ground	22.24
454	LHR475	Block 4 Sector A-II Township	25.38
455	LHR476	Baba Fareed Colony Near Jail	21.60
456	LHR477	Bank Stop/Mian Fazal Haq Colony	26.62
457	LHR478	Nishter colony Near Police Station	25.80
458	LHR479	Nishter Colony Near Tanky	21.72
459	LHR480	Block 6 Sector A-II Township	23.14
460	LHR481	Qanchi Stop	26.84
461	LHR482	Itefaq Colony	23.26
462	LHR483	Sitara Colony	20.44
463	LHR484	Katcha Jail road/Irigation Colony	24.24
464	LHR485	Awami Colony	25.68
465	LHR486	Ghulam Hussain Bhati Colony UC 129	25.40

466	LHR487	Baba Fareed Colony Near PECO	26.18
467	LHR488	Chungi Amarsadhu Near Shell Pump	22.34
468	LHR489	Block 2 Sector A-II Township	25.94
469	DHA-01	K-Block Phase VI Avenue-1 Tank-1	17.03
470	DHA-02	A-Block Phase VI Avenue-4 Lahore, Pakistan	17.7
471	DHA-03	St-17, Sector Y, Phase-3 Lahore.	17.07
472	DHA-04	St-16, Sector Z Phase-3 Lahore, Pakistan	13.95
473	Cantt-01	Allama Iqbal Road Lahore.	15.74
474	Cantt-02	Sarwar Road, Lahore.	17.98
475	Cantt-03	C.M.H Hospital, Lahore.	18.14
476	Cantt-04	Zarar Shaheed Road	18.1
477	Cantt-05	Askari Flat -01 Tufail Road Sadder	18.05

4.2 STATISTICAL ANALYSIS

Besides the determination of As in the groundwater aquifers of Lahore this study also had another objective that it needed to fulfill that was to establish a correlation of those As levels with depth of the tube well. For this purpose, statistical analysis was done using SPSS 20.0 to calculate the Pearson Coefficient Correlation and establish a linear correlation between the As concentration in groundwater and depth of the tube well. In addition to this, it was also used to deduce the mean, minimum, maximum values and standard deviation of those arsenic levels for a thorough study.

Table 4.2 shows the descriptive statistics for As levels and depth of the tube well.

Table 4.2 Descriptive Statistics for Depth and Arsenic

Serial No	Parameters	Mean	Minimum	Maximum	Standard Deviation
1	Arsenic	30.63	Nil	115	10.293
2	Depth	238.11	26	1200	86.209

Table 4.3 establishes a linear correlation between depth of the tube well and the As contamination levels found in underground aquifers.

Table 4.3 Linear Correlations between As levels and depth of tube well

		Arsenic	Depth
Arsenic	Pearson Correlation	1	-.180**
	Sig. (2-tailed)		.000
	N	494	487
Depth	Pearson Correlation	-.180**	1
	Sig. (2-tailed)	.000	
	N	487	491

** . Correlation is significant at the 0.01 level (2-tailed).

4.3 Human Health Risk Assessment

Once the statistical analysis was performed and relationship between depth and arsenic levels was established it was followed by Human Health Risk Assessment (HHRA). This process as already described in methodology is further divided in subsequent parts.

4.3.1 Exposure Dose

Initially, by performing suitable calculations (equation 1), the exposure doses (ED) for arsenic levels were determined. Table below summarize the results for exposure doses for all the arsenic levels.

Table 4.4 Exposure Dose values for Arsenic

EXPOSURE DOSE			
S. No	Sample Code	Location of tube well	Exposure Dose(mg/kg/day)
1	LHR001	Tegro Park	0.001328611
2	LHR002	Muhammad Nagar	0.000891389
3	LHR003	Habibullah Road Baghyshah	0.001595833
4	LHR004	Children Park	0.001128333
5	LHR005	Habibullah Road Baghyshah	0.001152778
6	LHR006	Scotch Corner/Upper Mall	0.000708333
7	LHR007	Mian Meer Pind	0.001733333
8	LHR008	anand road Upper Mall	0.001478889
9	LHR009	Garhi Shahu Police Station	0.001068056
10	LHR010	Main Bazar Ghazi Mohalla Garhi Shahu	0.001016667
11	LHR011	Larex Colony	0.0010125
12	LHR012	Zaman Park	0.0011175
13	LHR013	Basti syden Shah	0.001133333

14	LHR014	Bagh Munshi Ladha	0.000961111
15	LHR015	Yaseen Road	0.000791667
16	LHR016	Umar Park Bilal Ganj	0.000688889
17	LHR017	Mohni Road	0.000791667
18	LHR018	Karim Pak Ground Old	0.001069444
19	LHR019	Qasor Pura/Ameen colony	0.001016667
20	LHR020	New Umer Park	0.000706944
21	LHR021	Gulshan-e-Riaz	0.000658333
22	LHR022	Ibraheem Road	0.000738889
23	LHR023	Sardar Chapal	0.000686111
24	LHR024	Munshi Hospital	0.000691667
25	LHR025	Main Outfull Road	0.000856944
26	LHR026	Karim Park Block 3	0.000888889
27	LHR027	National Ravi 2	0.001005556
28	LHR028	Bajri Adda	0.000826389
29	LHR029	Main Outfull Road New	0.000638889
30	LHR030	Ameen Park	0.000875
31	LHR031	Rehmat Flour Road	0.000969444
32	LHR032	Allah Wali Mosque	0.0006125
33	LHR033	Shafiqueabad	0.000804167
34	LHR034	Takoni Ground Islam pura	0.002502778
35	LHR035	Firdos Park	0.000911111
36	LHR036	Chohan Park	0.000493056
37	LHR037	DCO Office	0.000694444
38	LHR038	Akram Park Band Road	0.001280556
39	LHR039	Nehru Park/Afgharn Park	0.000653333
40	LHR040	Rafayabad Park	0.0006375
41	LHR041	MC High School Sanda	0.000854167
42	LHR042	Liqatabad	0.001256944
43	LHR043	Commisioner Office	0.000647222
44	LHR044	Ali Park New	0.000663889
45	LHR045	G Block Gulshan Ravi	0.000879167
46	LHR046	60-Road Shera Kot Babu Sabu	0.000466667
47	LHR047	Moon Market Gulshan Ravi	0.0005125
48	LHR048	Jaffiria colony	0.000727778
49	LHR049	Rustam Park	0.000754167
50	LHR050	Umer Park Sodiwal Quarder	0.000627778
51	LHR051	Naunarian	0.000741667
52	LHR052	Nawa Kot WASA Colony	0.000676667
53	LHR053	Dhop Sari Malik Munir Road	0.0006375
54	LHR054	E Block Gulshan Ravi	0.000843056
55	LHR055	Zubair Park Gulshan Ravi	0.000443333
56	LHR056	Firdos Colony	0.000616667
57	LHR057	Usman Park F Block Gulshana Ravi	0.000569444
58	LHR058	Sikandria colony	0.000736111

59	LHR059	Babu Sabu School	0.000575
60	LHR060	Near WASA Complaint Center	0.00052
61	LHR061	Riwaz Garden Markeet	0.000745833
62	LHR062	Takkia Mehmood Shah,Sanda Road Rahat Street	0.000691944
63	LHR063	Bilal Park, Raj Garh	0.000863889
64	LHR064	Riifle Range, New Chlazji	0.000744444
65	LHR065	Ghulam Hussain colony Across Bund road, Main Street Bazar, Imam Din road	0.00115
66	LHR066	Patwar Khana,Grave yard Sanda Road	0.001095833
67	LHR067	Jahangir Town	0.001065278
68	LHR068	A Block gulshan-e-ravi	0.000791667
69	LHR069	Bund Road UC84	0.000834444
70	LHR070	Zubair Road Rajgarh	0.001341667
71	LHR071	Muslim Park Rajgarh	0.001098611
72	LHR072	B Block Gulshan e Ravi, Qazafi Park	0.000568056
73	LHR073	Park P Block, Sabza zar Opp Malik Yasir House	0.000991667
74	LHR074	D Block Main Park Off Fezan-e-Rasool Road	0.000713889
75	LHR075	A Block Park on main road	0.001013889
76	LHR076	Shah Fared Takani Park, Shah Fareed Market	0.000879167
77	LHR077	Masroor Ahmad	0.001180556
78	LHR078	Takoni Ground Off Grave Yard	0.000904167
79	LHR079	Near Park, H block	0.000983333
80	LHR080	Takin Chowk Main Bazar Khardk	0.000959722
81	LHR081	Liaqat Chowk, Asad Plaza Markeet	0.000848611
82	LHR082	Kasar Block Jinnah Block/Awan town	0.0010125
83	LHR083	Main Park One Head Tank,K Block	0.000819444
84	LHR084	Main Park N Block near Qalza Masjid	0.001704167
85	LHR085	E-1 Block Fcc Katchi abadi Gulbug III	0.000995833
86	LHR086	H Block Gulbarg III	0.000795833
87	LHR087	Makka Colony Street 22, Gulbarg III	0.0009875
88	LHR088	B-1 Block Gulberg III	0.001251389
89	LHR089	Railway line,Jinna Park Gulburg II	0.001363889
90	LHR090	Back side Ferdous Markeet, J Block Gulberg II/ K-Block G-III	0.000763889
91	LHR091	Nala 27 Manzab Pace Town, Q block Gulberg II New	0.000538889
92	LHR092	Over Head Tank, B-Block/T-block gulberg II New	0.001165278
93	LHR093	Nisar Art Press gulberg II	0.0012625
94	LHR094	Near Sui Gas Main Office (Ploice Post Gulberg market	0.000972222

95	LHR095	Ghalab Markeet, Guru Manget A-II	0.000977778
96	LHR096	saint Merry Colony Gulberg-III	0.001056944
97	LHR097	Opposite Lahore cantt Raalway Station, Qurban Line Gulberg-II	0.001068056
98	LHR098	The Pind Furdous Markeet C-1	0.0011
99	LHR099	Syed Mubsam Ali Rizvi	0.001076389
100	LHR100	New Railway Line (Walton Acadmy), New Makka colony	0.000825
101	LHR101	M Block, Henry K Gulberg-III	0.001020833
102	LHR102	G Block Wasa Complant Center	0.001136111
103	LHR103	Opposite Shalimar Towar hotel, Zafar Ali road/Jail road	0.0009625
104	LHR104	Park Back site X PM parvaz Elahi, Fcc block, Gulberg sub Dev	0.0015375
105	LHR105	Jamiya Masjid Abu bakar Siddique, Khan colony Gulberg III	0.001252778
106	LHR106	social Security hospital, main Feroz pur road, nawaz Shareef colony Feroz pur.	0.000809722
107	LHR107	Green Belt P block, Ghulab Devi Hospital, Gopal Nagar	0.000983333
108	LHR108	Main Bazar Bilal Nagar, Henry Katchi Abadi Gulberg III	0.0010375
109	LHR109	Govt. Islamia College for Boys, Iqbal Park	0.0008125
110	LHR110	Athar Abbas ParkTajpura Pind	0.000876389
111	LHR111	A Block Tajpura	0.001346944
112	LHR112	Main Park Tajpura, Data Park	0.000915278
113	LHR113	D Block Main Park	0.000819444
114	LHR114	Al Madina Colony. A Block Tajpura	0.000983333
115	LHR115	Al Faisal Town, Burgi No. 9	0.0007875
116	LHR116	Soling Road, Tajpura	0.0007625
117	LHR117	Graveyard Ghaziabad Bus stop No.2	0.000869444
118	LHR118	SDO Office, DO North Tajpura	0.000909722
119	LHR119	DLR Office, Chubacha Phatik	0
120	LHR120	Gulshan Colony Walton	0.000873611
121	LHR121	LDA Quarter Walton	0.000727778
122	LHR122	Ghosia colony	0.000865833
123	LHR123	Gulshan colony Mustafa Abad	0.000808333
124	LHR124	Infentory colony	0.000834722
125	LHR125	Canal Bridge	0.000826389
126	LHR126	Mian Meer Darbar	0.000801389
127	LHR127	Tariq colony, Walton	0.001025
128	LHR128	Dry Port, Mughalpura	0.000820833
129	LHR129	Canal Bank, Ahata Makhan Sing	0.00089
130	LHR130	Chubacha Phatik, DLR Office, Mustafaabad Sub Division	0

131	LHR131	Punj Peer Lal pull, Canal Bank, Fateh Garh Sub Div.	0.000734444
132	LHR132	Jahangir Road, Main Chowk Mughal pura Canal Bank, Sub Div. Mughal pura	0.000649444
133	LHR133	Fayaz Park, Canal Bank, Mughal pura Sub. Division	0.000682222
134	LHR134	Maskeenpura, Golden Gate School, Canal Bank, Fateh Garh Division	0.000726667
135	LHR135	Fateh Garh Pull, City District Girls High School, Fateh Garh Div.	0.000684444
136	LHR136	Kotli Ghasi, Govt Boys Primary Scool, Fateh Garh Div.	0.000801111
137	LHR137	Qalandarpura, Fateh garh sub division	0.000875
138	LHR138	Gawala Colony Herbanapura, Ring road, Faeteh garh sub division	0.000786667
139	LHR139	Iftikhar Park, Harbanapura Park, Fateh garh div.	0.000692778
140	LHR140	Ishfaq Chowk/ Shaoq Chowk, Van Stand Al-Kareem Chowk, Tajpura Sub Div.	0.000647778
141	LHR141	Tajbagh Scheme, Gulshan-e-Rehman, Tajpura Division	0.000951389
142	LHR142	Jore Pull, Tajpura sub Div.	0.000794444
143	LHR143	C Block Al-faisal town Baharshah, Tajpura Sub. Div.	0.000736111
144	LHR144	Canal Bank, Muslim abad, Fateh Garh	0.00075
145	LHR145	Peer Naseer, Mughal pura Sub. Div.	0.000739444
146	LHR146	Slamatpura Takkia, Fateh garh Sub Div.	0.000890278
147	LHR147	Gulshan Park, Fateh garh Sub Div.	0.000981944
148	LHR148	Nadia Ghee Mill, Fateh garh Sub Div.	0.000855556
149	LHR149	Dars Bary Mian/ Mujahidabad,	0.000751389
150	LHR150	Salamat Pura 5, Fateh garh Sub Div.	0.001323611
151	LHR151	Shah Din Park, Fateh garh Sub Div.	0.000820833
152	LHR152	Kotli Pir Abdul Rehman, Mughalpura Sub. Div.	0.000751389
153	LHR153	dispensary Road Fateh Garh, Fateh garh Sub Div.	0.000983333
154	LHR154	Faisal Park/ Children Park	0.000825
155	LHR155	Sahuwari Sani View Park, Mughalpura	0.000975
156	LHR156	Qadir Buksh Park,	0.001038889
157	LHR157	Maskeenpura	0.0011125
158	LHR158	Karim Nagar Salamat pura no. 3	0.0012
159	LHR159	New Shalimar Scheme Salamat Pura	0.0008375
160	LHR160	Sahuwari Takkia Old	0.000872222
161	LHR161	Goshaya Angori	0.000840278
162	LHR162	Shah Kamal Road	0.000715278

163	LHR163	Milap Street	0.000865278
164	LHR164	Sansi Quarder	0.001054167
165	LHR165	Anguri Bagh Scheme No. 2	0.0008375
166	LHR166	Baja Line	0.000986111
167	LHR167	Pakistan Mint New	0.001336111
168	LHR168	Lal School, Dars Baray Mian	0.001365278
169	LHR169	Masjid Taj din	0.000804167
170	LHR170	Parashoot Colony	0.000647222
171	LHR171	Baghechi Sethah Wali New	0.000997222
172	LHR172	Azeem Ground	0.000808333
173	LHR173	B.T.H Drain	0.00075
174	LHR174	Achant Garh	0.000861111
175	LHR175	Baba Beri Peer	0.0010875
176	LHR176	Jamilabad	0.000556667
177	LHR177	Saher Road	0.001391667
178	LHR178	Shah Gohar Abad	0.000927778
179	LHR179	Memood Booti Well Centre II	0.0011125
180	LHR180	Mehmood Booti Well centere III	0.000951389
181	LHR181	Dobi Ghat	0.001018056
182	LHR182	Rohri Per Darbar	0.001201389
183	LHR183	Madhulal Hussain	0.001076389
184	LHR184	Suraya Jabeen Park	0.001013889
185	LHR185	Tiba Qilla Khazana	0.001191667
186	LHR186	Ahma Town	0.001176389
187	LHR187	Gulshan-e-Shalimar	0.001006944
188	LHR188	Memempura	0.001241667
189	LHR189	Baba Ghandi Shah	0.001076389
190	LHR190	Saad Ghee Mill	0.001034722
191	LHR191	Deputy Yaqoob Colony	0.001113889
192	LHR192	Alia Town	0.001166667
193	LHR193	Near Mehmood booti disposal	0.000941667
194	LHR194	Garden Town	0.000854444
195	LHR195	Garden Town	0.001244444
196	LHR196	B Block New Faisal town	0.00068
197	LHR197	Garden Town	0.000847222
198	LHR198	Garden Town	0.000838889
199	LHR199	M block Model town extension	0.000958333
200	LHR200	Garden Town	0.000944444
201	LHR201	D block Faisal Town	0.000713333
202	LHR202	L Block model town Extension	0.000673333
203	LHR203	Tariq block	0.000711667
204	LHR204	N Block Model Town Extension	0.000683889
205	LHR205	P-Block Model Town Ext.	0.000894444
206	LHR206	C Block Faisal Town	0.000682222
207	LHR207	N Block, Samnabad	0.000736667

208	LHR208	Dholanwal Near Dispensary, Samnabad	0.000771111
209	LHR209	Zubiada Park, Samnabad	0.000625556
210	LHR210	Jhugian Shahabdin, Samnabad	0.000675
211	LHR211	choudhary Colony/Khizra Mosque, Dhoongi Ground	0.00071
212	LHR212	Peer budhan shah, Samnabad	0.000715556
213	LHR213	Bakar Mandi, Samnabad	0.000631667
214	LHR214	Nawan Kot More Samanabad	0.000685556
215	LHR215	Paki Thathi, Samnabad	0.000677222
216	LHR216	Katcha Umer Park/Jinah colony, Samnabad	0.000801111
217	LHR217	Ghulam Nabi colony, Samnabad	0.00074
218	LHR218	Mushtaq Town, Samnabad	0.000623889
219	LHR219	C Block Sabzazar, Samnabad	0.000622222
220	LHR220	Chah junian Wala/Paki Thathi, Samnabad	0.000658333
221	LHR221	Itehad colony, Samnabad	0.000675556
222	LHR222	Pak block, Iqbal Town Sub Division	0.000657222
223	LHR223	Jahanzeb Block, Iqbal Town Sub Division	0.00069
224	LHR224	college block, Iqbal Town Sub Division	0.000693889
225	LHR225	Karim Block-1, Iqbal Town Sub Division	0.000718889
226	LHR226	Asif Block, Iqbal Town Sub Division	0.000707222
227	LHR227	F & V Market 2, Iqbal Town Sub Division	0.000649444
228	LHR228	New Chinab Block 2, Overhead Tank Park, Iqbal Town Sub Division	0.000688333
229	LHR229	Nishtar Block 2, Graveyard, Iqbal Town Sub Division	0.000562222
230	LHR230	Cliton Colony, Backside Girls Pilot School, Iqbal Town Sub Division	0.000737778
231	LHR231	Ravi Block New, Main Multan Road, Kharak TW, Iqbal Town Sub Division	0.000733889
232	LHR232	Mehran Block New, Main Multan Road, F & V Market, Iqbal Town Sub Division	0.000673889
233	LHR233	Huma Block, Rahim Store Iqbal Town Sub Division	0.000706667
234	LHR234	Raza Block, Children Park, Iqbal Town Sub Division	0.000665
235	LHR235	Kamran Block, Malik Sultan Children Park	0.000662778
236	LHR236	Nelam Block, Small Park, Iqbal Town Sub Division	0.000833889
237	LHR237	Nargis Block, Children Park Small Market, Iqbal Town Sub Division	0.000816111
238	LHR238	Hunza Block, Children Park, Iqbal Town Sub Division	0.000752222
239	LHR239	Kareem Block 2, Steet Jamia Masjid Allah Wali, Graveyard, Iqbal Town Sub Division	0.000665

240	LHR240	Islampura, Complaint Center WASA, Ravi Road Sub Division	0.000751667
241	LHR241	Awa Phari Queen Road	0.000727778
242	LHR242	Shadman Market	0.000876389
243	LHR243	Rehmania Park Shadman	0.000806944
244	LHR244	Hamoon Shah Park	0.000793056
245	LHR245	Mason Road	0.000802778
246	LHR246	Ahata Mool Chand-1	0.000620833
247	LHR247	Kot Abdullah Shah	0.000686111
248	LHR248	Mian Aslam Iqbal Park	0.000786111
249	LHR249	Lyton Road	0.000669444
250	LHR250	Apwa College	0.000765278
251	LHR251	Aibak Park	0.000931944
252	LHR252	Waris Road	0.000897222
253	LHR253	Patiala House Children Complex	0.000830556
254	LHR254	Faeeh Road	0.0008625
255	LHR255	Roza abu Ishaq	0.000825
256	LHR256	Saadi Park	0.001065278
257	LHR257	Shah Jamal	0.001063889
258	LHR258	Bagh gul Begum	0.00065
259	LHR259	Ahata Mool Chand-2	0.000597222
260	LHR260	Doungi Ground Fazlia Colony	0.000727778
261	LHR261	Shadman Ganda Nala	0.000691667
262	LHR262	Shadman Mental Hospital Tanki	0.000698611
263	LHR263	Aisha Park Shadman	0.000673611
264	LHR264	H-3 Block	0.000747222
265	LHR265	G-4 Block Centre Park Reservior	0.000672222
266	LHR266	E-I Block Opposite LGS School/C-II Block	0.000805556
267	LHR267	J Block Park	0.000255278
268	LHR268	L Block Near Police Choki	0.000235833
269	LHR269	Beer Pind	0.000736111
270	LHR270	Shah De Khoi, Near Johar Banquet	0.000727778
271	LHR271	G-I Block Opposite LGS School	0.000232222
272	LHR272	E Block Park	0.000747222
273	LHR273	D-II Block Park	0.000659722
274	LHR274	Campus View Near Moon Heights	0.000652778
275	LHR275	Oppsite Jamiya Masjid Muhammamdi, Muhammadi Park, Johar town Sub Division	0.000790278
276	LHR276	Hanif Park Tunda Phatak	0.001136111
277	LHR277	Hanif Park Street no.6	0.001195833
278	LHR278	siddique Pura	0.001001389
279	LHR279	Shad Bagh No.3	0.000820556
280	LHR280	Hyssain Park	0.001356944
281	LHR281	Qadafi colony	0.001181944
282	LHR282	Khokhar road-3	0.001145833

283	LHR283	Ali Pura Lift Station	0.000775
284	LHR284	Reheempura Park	0.000636111
285	LHR285	Khokhar road-1	0.001311111
286	LHR286	Khokhar road-2	0.001186111
287	LHR287	Kohlu Ghar	0.000881667
288	LHR288	Chah Motian Wala	0.001229167
289	LHR289	Khakhar Road no.4, Band Road (Ring Road	0.001180556
290	LHR290	Mozang Ada	0.000769444
291	LHR291	Cattle Park	0.000693056
292	LHR292	Royal Park	0.000661111
293	LHR293	Qilla Gujar Singh/Nisar Scheme	0.001127778
294	LHR294	Landa Bazar	0.001072222
295	LHR295	Usmania Colony	0.000790278
296	LHR296	Lady Mclegan	0.001056944
297	LHR297	Railway Road	0.000693056
298	LHR298	Guru Agreen Nagar/Circular Road shah Alam	0.000304444
299	LHR299	Pathi Ground/Rashi Bhawan	0.000358333
300	LHR300	Nisbat Road Mohalla Gawalan	0.000455556
301	LHR301	Nasir Bagh	0.001722222
302	LHR302	Katcha Nisbat Road	0.000683333
303	LHR303	Patiala Ground	0.0003025
304	LHR304	Napier Road	0.000776667
305	LHR305	Fareed Kot House	0.000726667
306	LHR306	Ada Crown Bus	0.000670556
307	LHR307	Haji Camp	0.000675556
308	LHR308	Dhobi Mandi	0.00075
309	LHR309	Abdul Kareem road/Mela Ram Park	0.000668333
310	LHR310	Takkia Khusrian Wala	0.001311111
311	LHR311	G.T Road	0.001302778
312	LHR312	Floor Mill Near WAPDA Power Palant	0.001495833
313	LHR313	majeed Park	0.002173611
314	LHR314	Saeed Park	0.000976389
315	LHR315	Shahdra Twon	0.001148611
316	LHR316	Qaiser Town	0.003191667
317	LHR317	Qazi Park	0.001479167
318	LHR318	Begum Da Bagh	0.001836111
319	LHR319	Rave Cricket Ground	0.001052778
320	LHR320	Latif chowk Wandala road	0.001245833
321	LHR321	Yousaf Park	0.001713889
322	LHR322	Shaokat Colony	0.001001944
323	LHR323	Gulshan-E-Hayat Colony	0.000920833
324	LHR324	Kamran Park	0.000934722
325	LHR325	Begum Kot New	0.001606944
326	LHR326	Aziz colony	0.001881944

327	LHR327	Farkhabad Nala	0.000790278
328	LHR328	Match Factory	0.001229167
329	LHR329	Farakhabad Disposal	0.001268056
330	LHR330	Faisal Park/children Park	0.000843056
331	LHR331	Jia Musa	0.001533333
332	LHR332	D Block Gujarpura	0.000729444
333	LHR333	Ablock Gujarpura	0.000686667
334	LHR334	Kot khawaja Saeed Khan Je house	0.000685556
335	LHR335	Jamil Park china Scheme	0.000663333
336	LHR336	Sultan Pura New	0.000661111
337	LHR337	Ahata Thanidaran chah meran	0.000657778
338	LHR338	Usman Park Singpura	0.000691111
339	LHR339	Chemra Mandi School	0.000686667
340	LHR340	Kot khawaja Saeed Khan Je house	0.000691111
341	LHR341	Tezab Ahata New	0.0007225
342	LHR342	Shah Badar Dewan	0.000672222
343	LHR343	Jinah Park	0.000716667
344	LHR344	Begumpora Mehmodabad	0.000771111
345	LHR345	Own Wali Building	0.000764444
346	LHR346	Jamshed Park/Singhpura	0.000753889
347	LHR347	Bhogiwal New	0.000641667
348	LHR348	Swami Nagar (Submersible)	0
349	LHR349	Sultani Park	0.000638333
350	LHR350	Shuja Colony Sawami Nagar	0.000616111
351	LHR351	Gujar Pura B Block china Scheme	0.000835
352	LHR373	Yasrab Colony	0.000816667
353	LHR374	Akramabad Park	0.000751389
354	LHR375	Hamad colony	0.000863889
355	LHR376	Lady Sofia Park	0.000845833
356	LHR377	Nabi Baksh Park	0.00065
357	LHR378	Peeran Wala	0.000865833
358	LHR379	Lady Sofia Park Old	0.000687222
359	LHR380	Chah Meran Old	0.000695833
360	LHR381	Well Centre 1	0.000945833
361	LHR382	Well Centre 2	0.001379167
362	LHR383	Well Centre 4	0.000852778
363	LHR384	Tajpura Ground	0.000951389
364	LHR385	Ilahi Park	0.000791667
365	LHR386	Chah Meran New	0.000808333
366	LHR387	Naoshahi road Bhagatpura/Ahmad Park	0.000758333
367	LHR388	Shah Stadium	0.000851389
368	LHR389	Shamshed Park	0.000797222
369	LHR390	Khuda Buksh Park	0.000781944
370	LHR391	Children Park	0.000954167
371	LHR392	Wasan Pura Scheme	#VALUE!

372	LHR393	Nazimabad Shad Bagh	0.00095
373	LHR394	Old Ravi Well Centre III	0.000722778
374	LHR395	Old Ravi Well Centre IV	0.000843333
375	LHR396	Sheran Wala	0.000605
376	LHR397	Shah Alam Gate	0.000622222
377	LHR398	Akbari Gate (Old)	0.000543889
378	LHR399	Bhati Gate	0.000847778
379	LHR400	Iqbal Park Fort	0.000615556
380	LHR401	Shesh Mohal Road Bhati Gate	0.000800556
381	LHR402	Mori Gate New	0.001033333
382	LHR403	F&V Market Sabzi Mandi	0.000914444
383	LHR404	Main Bazar Qila Mohammadi	0.00038
384	LHR405	Chumala	0.000516111
385	LHR406	Masti Gate	0.000380556
386	LHR407	Lorry Ada Badami Bagh	0.000376667
387	LHR408	Shah Alam Market	0.000604167
388	LHR409	New Tehsil Garden	0.001094444
389	LHR410	Yaki Gate New	0.000505556
390	LHR411	Timber Market	0.000898611
391	LHR412	Akbari Gate	0.000634722
392	LHR413	Nawaz Sharef Park	0.000769444
393	LHR414	Lohari Gate New	0.000856944
394	LHR415	Texali Gate	0.000908333
395	LHR416	Kashmiri Gate	0.000701389
396	LHR417	Al Madad Park	0.001020833
397	LHR418	Windsor Park/Altakeen Road	0.000901389
398	LHR419	A Block Muslim Town	0.000802778
399	LHR420	Nadeem Park	0.001266667
400	LHR421	Rasool Park	0.000825
401	LHR422	New LOS Chaudhary colony	0.000779167
402	LHR423	Qubra Mosque	0.000976389
403	LHR424	A Block Rehman Pura	0.000804167
404	LHR425	C Block Muslim Town	0.000884722
405	LHR426	Mehbob Park	0.0010625
406	LHR427	Wahdat Colony	0.001327778
407	LHR428	Shah Kamal/Ganda Nala	0.000919444
408	LHR429	Punj Peer Road	0.000918056
409	LHR430	Karnalpura/Alhamd colony	0.000720833
410	LHR431	Bukhari Market	0.000954167
411	LHR432	New Ayubia Market	0.000743056
412	LHR433	Ichra Moe New	0.000802778
413	LHR434	New Takkia Lehri Shah	0.000766667
414	LHR435	Kramabad Rehmanpura	0.001252778
415	LHR436	Gawala Colony-1	0.000618889
416	LHR437	2 D I	0.000825556

417	LHR438	2-C-II	0.000742778
418	LHR439	1-B-II (Old)	0.000972778
419	LHR440	3-D-I	0.000731111
420	LHR441	4-C-2	0.000732778
421	LHR442	5-D-I	0.000775
422	LHR443	3-D-II	0.00065
423	LHR444	13-B-I	0.000747778
424	LHR445	11-B-2	0.000687222
425	LHR446	Bhata No. 1&2	0.000678333
426	LHR447	Keer Kalan Pind	0.000795
427	LHR448	Bagrian Pind	0.000610556
428	LHR449	4-D-II	0.00064
429	LHR450	I-D-II	0.000666111
430	LHR451	5-C-II	0.000678889
431	LHR452	1 C-I	0.000729444
432	LHR453	Gawala Colony 3	0.000652778
433	LHR454	1 B-II New	0.000862778
434	LHR455	5-D-II New	0.000748333
435	LHR456	Aoqaf Colony	0.000777778
436	LHR457	Hakim Town	0.000605556
437	LHR458	3-C-I Green Town	0.000838333
438	LHR459	2 B-I Township	0.000666667
439	LHR460	6-B-I	0.000676111
440	LHR461	16-B-I/Pathanewala	0.000696111
441	LHR462	5 D-2 Old	0.0007
442	LHR463	Q Block Near Police Station	0.000566667
443	LHR464	R Block	0.000591667
444	LHR465	S Block Model Town	0.000643333
445	LHR466	Pindi stop	0.00064
446	LHR467	Albadar Hospital	0.000718889
447	LHR468	R Block New	0.000739444
448	LHR469	Nasrat Road	0.000676667
449	LHR470	Bhati Colony Model Town	0.000680556
450	LHR471	Nadeem Park/Rahat Park	0.000617778
451	LHR472	Pindi Rajputan	0.000665
452	LHR473	Akbar Sheed Road	0.000687222
453	LHR474	Ittefaq Hospital Cricket Ground	0.000617778
454	LHR475	Block 4 Sector A-II Township	0.000705
455	LHR476	Baba Fareed Colony Near Jail	0.0006
456	LHR477	Bank Stop/Mian Fazal Haq Colony	0.000739444
457	LHR478	Nishter colony Near Police Station	0.000716667
458	LHR479	Nishter Colony Near Tanky	0.000603333
459	LHR480	Block 6 Sector A-II Township	0.000642778
460	LHR481	Qanchi Stop	0.000745556
461	LHR482	Itefaq Colony	0.000646111

462	LHR483	Sitara Colony	0.000567778
463	LHR484	Katcha Jail road/Irigation Colony	0.000673333
464	LHR485	Awami Colony	0.000713333
465	LHR486	Ghulam Hussain Bhati Colony UC 129	0.000705556
466	LHR487	Baba Fareed Colony Near PECO	0.000727222
467	LHR488	Chungi Amarsadhu Near Shell Pump	0.000620556
468	LHR489	Block 2 Sector A-II Township	0.000720556
469	DHA-01	K-Block Phase VI Avenue-1 Tank-1	0.000473056
470	DHA-02	A-Block Phase VI Avenue-4 Lahore, Pakistan	0.000491667
471	DHA-03	St-17, Sector Y, Phase-3 Lahore.	0.000474167
472	DHA-04	St-16, Sector Z Phase-3 Lahore, Pakistan	0.0003875
473	Cantt-01	Allama Iqbal Road Lahore.	0.000437222
474	Cantt-02	Sarwar Road, Lahore.	0.000499444
475	Cantt-03	C.M.H Hospital, Lahore.	0.000503889
476	Cantt-04	Zarar Shaheed Road	0.000502778
477	Cantt-05	Askari Flat -01 Tufail Road Sadder	0.000501389

4.3.2 Hazard Quotient (HQ)

Next step was to determine the hazard quotient (HQ) of the arsenic levels again by applying appropriate formulas. These values are of great importance when it comes to HHRA, the value of HQ if above than one then it is not considered drinkable at all.

Table 4.5 represents the HQ values of arsenic for all water samples.

Table 4.5 Hazard Quotient Values of Arsenic

HAZARD QUOTIENT			
S. No	Sample Code	Location of tube well	Hazard Quotient
1	LHR001	Tegro Park	4.428703704
2	LHR002	Muhammad Nagar	2.971296296
3	LHR003	Habibullah Road Baghyshah	5.319444444
4	LHR004	Children Park	3.761111111
5	LHR005	Habibullah Road Baghyshah	3.842592593
6	LHR006	Scotch Corner/Upper Mall	2.361111111
7	LHR007	Mian Meer Pind	5.777777778
8	LHR008	anand road Upper Mall	4.92962963
9	LHR009	Garhi Shahu Police Station	3.560185185
10	LHR010	Main Bazar Ghazi Mohalla Garhi Shahu	3.388888889
11	LHR011	Larex Colony	3.375

12	LHR012	Zaman Park	3.725
13	LHR013	Basti syden Shah	3.777777778
14	LHR014	Bagh Munshi Ladha	3.203703704
15	LHR015	Yaseen Road	2.638888889
16	LHR016	Umar Park Bilal Ganj	2.296296296
17	LHR017	Mohni Road	2.638888889
18	LHR018	Karim Pak Ground Old	3.564814815
19	LHR019	Qasor Pura/Ameen colony	3.388888889
20	LHR020	New Umer Park	2.356481481
21	LHR021	Gulshan-e-Riaz	2.194444444
22	LHR022	Ibraheem Road	2.462962963
23	LHR023	Sardar Chapal	2.287037037
24	LHR024	Munshi Hospital	2.305555556
25	LHR025	Main Outfull Road	2.856481481
26	LHR026	Karim Park Block 3	2.962962963
27	LHR027	National Ravi 2	3.351851852
28	LHR028	Bajri Adda	2.75462963
29	LHR029	Main Outfull Road New	2.12962963
30	LHR030	Ameen Park	2.916666667
31	LHR031	Rehmat Flour Road	3.231481481
32	LHR032	Allah Wali Mosque	2.041666667
33	LHR033	Shafiqueabad	2.680555556
34	LHR034	Takoni Ground Islam pura	8.342592593
35	LHR035	Firdos Park	3.037037037
36	LHR036	Chohan Park	1.643518519
37	LHR037	DCO Office	2.314814815
38	LHR038	Akram Park Band Road	4.268518519
39	LHR039	Nehru Park/Afgharn Park	2.177777778
40	LHR040	Rafayabad Park	2.125
41	LHR041	MC High School Sanda	2.847222222
42	LHR042	Liqatabad	4.189814815
43	LHR043	Commisioner Office	2.157407407
44	LHR044	Ali Park New	2.212962963
45	LHR045	G Block Gulshan Ravi	2.930555556
46	LHR046	60-Road Shera Kot Babu Sabu	1.555555556
47	LHR047	Moon Market Gulshan Ravi	1.708333333
48	LHR048	Jaffiria colony	2.425925926
49	LHR049	Rustam Park	2.513888889
50	LHR050	Umer Park Sodiwal Quarder	2.092592593
51	LHR051	Naunarian	2.472222222
52	LHR052	Nawa Kot WASA Colony	2.255555556
53	LHR053	Dhop Sari Malik Munir Road	2.125
54	LHR054	E Block Gulshan Ravi	2.810185185
55	LHR055	Zubair Park Gulshan Ravi	1.477777778
56	LHR056	Firdos Colony	2.055555556

57	LHR057	Usman Park F Block Gulshana Ravi	1.898148148
58	LHR058	Sikandria colony	2.453703704
59	LHR059	Babu Sabu School	1.916666667
60	LHR060	Near WASA Complaint Center	1.733333333
61	LHR061	Riwaz Garden Markeet	2.486111111
62	LHR062	Takkia Mehmood Shah,Sanda Road Rahat Street	2.306481481
63	LHR063	Bilal Park, Raj Garh	2.87962963
64	LHR064	Riifle Range, New Chlazji	2.481481481
65	LHR065	Ghulam Hussain colony Across Bund road, Main Street Bazar, Imam Din road	3.833333333
66	LHR066	Patwar Khana,Grave yard Sanda Road	3.652777778
67	LHR067	Jahangir Town	3.550925926
68	LHR068	A Block gulshan-e-ravi	2.638888889
69	LHR069	Bund Road UC84	2.781481481
70	LHR070	Zubair Road Rajgarh	4.472222222
71	LHR071	Muslim Park Rajgarh	3.662037037
72	LHR072	B Block Gulshan e Ravi, Qazafi Park	1.893518519
73	LHR073	Park P Block, Sabza zar Opp Malik Yasir House	3.305555556
74	LHR074	D Block Main Park Off Fezan-e-Rasool Road	2.37962963
75	LHR075	A Block Park on main road	3.37962963
76	LHR076	shah Fared Takani Park, Shah Fareed Markeet	2.930555556
77	LHR077	Masroor Ahmad	3.935185185
78	LHR078	Takoni Ground Off Grave Yard	3.013888889
79	LHR079	Near Park, H block	3.277777778
80	LHR080	Takin Chowk Main Bazar Khardk	3.199074074
81	LHR081	Liaqat Chowk, Asad Plaza Markeet	2.828703704
82	LHR082	Kasar Block Jinnah Block/Awan town	3.375
83	LHR083	Main Park One Head Tank,K Block	2.731481481
84	LHR084	Main Park N Block near Qalza Masjid	5.680555556
85	LHR085	E-1 Block Fcc Katchi abadi Gulbug III	3.319444444
86	LHR086	H Block Gulbarg III	2.652777778
87	LHR087	Makka Colony Street 22, Gulbarg III	3.291666667
88	LHR088	B-1 Block Gulberg III	4.171296296
89	LHR089	Railway line,Jinna Park Gulburg II	4.546296296
90	LHR090	Back side Ferdous Markeet, J Block Gulberg II/ K-Block G-III	2.546296296
91	LHR091	Nala 27 Manzab Pace Town, Q block Gulberg II New	1.796296296
92	LHR092	Over Head Tank, B-Block/T-block gulberg II New	3.884259259
93	LHR093	Nisar Art Press gulberg II	4.208333333

94	LHR094	Near Sui Gas Main Office (Ploice Post Gulberg market	3.240740741
95	LHR095	Ghalab Markeet, Guru Manget A-II	3.259259259
96	LHR096	saint Merry Colony Gulberg-III	3.523148148
97	LHR097	Opposite Lahore cantt Raalway Station, Qurban Line Gulberg-II	3.560185185
98	LHR098	The Pind Furdous Markeet C-1	3.666666667
99	LHR099	Syed Mubsam Ali Rizvi	3.587962963
100	LHR100	New Railway Line (Walton Acadmy), New Makka colony	2.75
101	LHR101	M Block, Henry K Gulberg-III	3.402777778
102	LHR102	G Block Wasa Complant Center	3.787037037
103	LHR103	Opposite Shalimar Towar hotel, Zafar Ali road/Jail road	3.208333333
104	LHR104	Park Back site X PM parvaz Elahi, Fcc block, Gulberg sub Dev	5.125
105	LHR105	Jamiya Masjid Abu bakar Siddique, Khan colony Gulberg III	4.175925926
106	LHR106	social Security hospital, main Feroz pur road, nawaz Shareef colony Feroz pur.	2.699074074
107	LHR107	Green Belt P block, Ghulab Devi Hospital, Gopal Nagar	3.277777778
108	LHR108	Main Bazar Bilal Nagar, Henry Katchi Abadi Gulberg III	3.458333333
109	LHR109	Govt. Islamia College for Boys, Iqbal Park	2.708333333
110	LHR110	Athar Abbas ParkTajpura Pind	2.921296296
111	LHR111	A Block Tajpura	4.489814815
112	LHR112	Main Park Tajpura, Data Park	3.050925926
113	LHR113	D Block Main Park	2.731481481
114	LHR114	Al Madina Colony. A Block Tajpura	3.277777778
115	LHR115	Al Faisal Town, Burgi No. 9	2.625
116	LHR116	Soling Road, Tajpura	2.541666667
117	LHR117	Graveyard Ghaziabad Bus stop No.2	2.898148148
118	LHR118	SDO Office, DO North Tajpura	3.032407407
119	LHR119	DLR Office, Chubacha Phatik	0
120	LHR120	Gulshan Colony Walton	2.912037037
121	LHR121	LDA Quarter Walton	2.425925926
122	LHR122	Ghosia colony	2.886111111
123	LHR123	Gulshan colony Mustafa Abad	2.694444444
124	LHR124	Infentory colony	2.782407407
125	LHR125	Canal Bridge	2.75462963
126	LHR126	Mian Meer Darbar	2.671296296
127	LHR127	Tariq colony, Walton	3.416666667
128	LHR128	Dry Port, Mughalpura	2.736111111
129	LHR129	Canal Bank, Ahata Makhan Sing	2.966666667

130	LHR130	Chubacha Phatik, DLR Office, Mustafaabad Sub Division	0
131	LHR131	Punj Peer Lal pull, Canal Bank, Fateh Garh Sub Div.	2.448148148
132	LHR132	Jahangir Road, Main Chowk Mughal pura Canal Bank, Sub Div. Mughal pura	2.164814815
133	LHR133	Fayaz Park, Canal Bank, Mughal pura Sub. Division	2.274074074
134	LHR134	Maskeenpura, Golden Gate School, Canal Bank, Fateh Garh Division	2.422222222
135	LHR135	Fateh Garh Pull, City District Girls High School, Fateh Garh Div.	2.281481481
136	LHR136	Kotli Ghasi, Govt Boys Primary Scool, Fateh Garh Div.	2.67037037
137	LHR137	Qalandarpura, Fateh garh sub division	2.916666667
138	LHR138	Gawala Colony Herbanspura, Ring road, Faeteh garh sub division	2.622222222
139	LHR139	Iftikhar Park, Harbanspura Park, Fateh garh div.	2.309259259
140	LHR140	Ishfaq Chowk/ Shaoq Chowk, Van Stand Al-Kareem Chowk, Tajpura Sub Div.	2.159259259
141	LHR141	Tajbagh Scheme, Gulshan-e-Rehman, Tajpura Division	3.171296296
142	LHR142	Jore Pull, Tajpura sub Div.	2.648148148
143	LHR143	C Block Al-faisal town Baharshah, Tajpura Sub. Div.	2.453703704
144	LHR144	Canal Bank, Muslim abad, Fateh Garh	2.5
145	LHR145	Peer Naseer, Mughal pura Sub. Div.	2.464814815
146	LHR146	Slamatpura Takkia, Fateh garh Sub Div.	2.967592593
147	LHR147	Gulshan Park, Fateh garh Sub Div.	3.273148148
148	LHR148	Nadia Ghee Mill, Fateh garh Sub Div.	2.851851852
149	LHR149	Dars Bary Mian/ Mujahidabad,	2.50462963
150	LHR150	Salamat Pura 5, Fateh garh Sub Div.	4.412037037
151	LHR151	Shah Din Park, Fateh garh Sub Div.	2.736111111
152	LHR152	Kotli Pir Abdul Rehman, Mughalpura Sub. Div.	2.50462963
153	LHR153	dispensary Road Fateh Garh, Fateh garh Sub Div.	3.277777778
154	LHR154	Faisal Park/ Children Park	2.75
155	LHR155	Sahuwari Sani View Park, Mughalpura	3.25
156	LHR156	Qadir Buksh Park,	3.462962963
157	LHR157	Maskeenpura	3.708333333
158	LHR158	Karim Nagar Salamat pura no. 3	4
159	LHR159	New Shalimar Scheme Salamat Pura	2.791666667
160	LHR160	Sahuwari Takkia Old	2.907407407

161	LHR161	Goshaya Angori	2.800925926
162	LHR162	Shah Kamal Road	2.384259259
163	LHR163	Milap Street	2.884259259
164	LHR164	Sansi Quarder	3.513888889
165	LHR165	Anguri Bagh Scheme No. 2	2.791666667
166	LHR166	Baja Line	3.287037037
167	LHR167	Pakistan Mint New	4.453703704
168	LHR168	Lal School, Dars Baray Mian	4.550925926
169	LHR169	Masjid Taj din	2.680555556
170	LHR170	Parashoot Colony	2.157407407
171	LHR171	Baghechi Sethah Wali New	3.324074074
172	LHR172	Azeem Ground	2.694444444
173	LHR173	B.T.H Drain	2.5
174	LHR174	Achant Garh	2.87037037
175	LHR175	Baba Beri Peer	3.625
176	LHR176	Jamilabad	1.855555556
177	LHR177	Saher Road	4.638888889
178	LHR178	Shah Gohar Abad	3.092592593
179	LHR179	Memood Booti Well Centre II	3.708333333
180	LHR180	Mehmood Booti Well centere III	3.171296296
181	LHR181	Dobi Ghat	3.393518519
182	LHR182	Rohri Per Darbar	4.00462963
183	LHR183	Madhulal Hussain	3.587962963
184	LHR184	Suraya Jabeen Park	3.37962963
185	LHR185	Tiba Qilla Khazana	3.972222222
186	LHR186	Ahma Town	3.921296296
187	LHR187	Gulshan-e-Shalimar	3.356481481
188	LHR188	Memempura	4.138888889
189	LHR189	Baba Ghandi Shah	3.587962963
190	LHR190	Saad Ghee Mill	3.449074074
191	LHR191	Deputy Yaqoob Colony	3.712962963
192	LHR192	Alia Town	3.888888889
193	LHR193	Near Mehmood booti disposal	3.138888889
194	LHR194	Garden Town	2.848148148
195	LHR195	Garden Town	4.148148148
196	LHR196	B Block New Faisal town	2.266666667
197	LHR197	Garden Town	2.824074074
198	LHR198	Garden Town	2.796296296
199	LHR199	M block Model town extension	3.194444444
200	LHR200	Garden Town	3.148148148
201	LHR201	D block Faisal Town	2.377777778
202	LHR202	L Block model town Extension	2.244444444
203	LHR203	Tariq block	2.372222222
204	LHR204	N Block Model Town Extension	2.27962963
205	LHR205	P-Block Model Town Ext.	2.981481481

206	LHR206	C Block Faisal Town	2.274074074
207	LHR207	N Block, Samnabad	2.455555556
208	LHR208	Dholanwal Near Dispensary, Samnabad	2.57037037
209	LHR209	Zubiada Park, Samnabad	2.085185185
210	LHR210	Jhugian Shahabdin, Samnabad	2.25
211	LHR211	choudhary Colony/Khizra Mosque, Dhoongi Ground	2.366666667
212	LHR212	Peer budhan shah, Samnabad	2.385185185
213	LHR213	Bakar Mandi, Samnabad	2.105555556
214	LHR214	Nawan Kot More Samanabad	2.285185185
215	LHR215	Paki Thathi, Samnabad	2.257407407
216	LHR216	Katcha Umer Park/Jinah colony, Samnabad	2.67037037
217	LHR217	Ghulam Nabi colony, Samnabad	2.466666667
218	LHR218	Mushtaq Town, Samnabad	2.07962963
219	LHR219	C Block Sabzazar, Samnabad	2.074074074
220	LHR220	Chah junian Wala/Paki Thathi, Samnabad	2.194444444
221	LHR221	Itehad colony, Samnabad	2.251851852
222	LHR222	Pak block, Iqbal Town Sub Division	2.190740741
223	LHR223	Jahanzeb Block, Iqbal Town Sub Division	2.3
224	LHR224	college block, Iqbal Town Sub Division	2.312962963
225	LHR225	Karim Block-1, Iqbal Town Sub Division	2.396296296
226	LHR226	Asif Block, Iqbal Town Sub Division	2.357407407
227	LHR227	F & V Market 2, Iqbal Town Sub Division	2.164814815
228	LHR228	New Chinab Block 2, Overhead Tank Park, Iqbal Town Sub Division	2.294444444
229	LHR229	Nishtar Block 2, Graveyard, Iqbal Town Sub Division	1.874074074
230	LHR230	Cliton Colony, Backside Girls Pilot School, Iqbal Town Sub Division	2.459259259
231	LHR231	Ravi Block New, Main Multan Road, Kharak TW, Iqbal Town Sub Division	2.446296296
232	LHR232	Mehran Block New, Main Multan Road, F & V Market, Iqbal Town Sub Division	2.246296296
233	LHR233	Huma Block, Rahim Store Iqbal Town Sub Division	2.355555556
234	LHR234	Raza Block, Children Park, Iqbal Town Sub Division	2.216666667
235	LHR235	Kamran Block, Malik Sultan Children Park	2.209259259
236	LHR236	Nelam Block, Small Park, Iqbal Town Sub Division	2.77962963
237	LHR237	Nargis Block, Children Park Small Market, Iqbal Town Sub Division	2.72037037
238	LHR238	Hunza Block, Children Park, Iqbal Town Sub Division	2.507407407

239	LHR239	Kareem Block 2, Steet Jamia Masjid Allah Wali, Graveyard, Iqbal Town Sub Division	2.216666667
240	LHR240	Islampura, Complaint Center WASA, Ravi Road Sub Division	2.505555556
241	LHR241	Awa Phari Queen Road	2.425925926
242	LHR242	Shadman Market	2.921296296
243	LHR243	Rehmania Park Shadman	2.689814815
244	LHR244	Hamoon Shah Park	2.643518519
245	LHR245	Mason Road	2.675925926
246	LHR246	Ahata Mool Chand-1	2.069444444
247	LHR247	Kot Abdullah Shah	2.287037037
248	LHR248	Mian Aslam Iqbal Park	2.62037037
249	LHR249	Lyton Road	2.231481481
250	LHR250	Apwa College	2.550925926
251	LHR251	Aibak Park	3.106481481
252	LHR252	Waris Road	2.990740741
253	LHR253	Patiala House Children Complex	2.768518519
254	LHR254	Faehh Road	2.875
255	LHR255	Roza abu Ishaq	2.75
256	LHR256	Saadi Park	3.550925926
257	LHR257	Shah Jamal	3.546296296
258	LHR258	Bagh gul Begum	2.166666667
259	LHR259	Ahata Mool Chand-2	1.990740741
260	LHR260	Doungi Ground Fazlia Colony	2.425925926
261	LHR261	Shadman Ganda Nala	2.305555556
262	LHR262	Shadman Mental Hospital Tanki	2.328703704
263	LHR263	Aisha Park Shadman	2.24537037
264	LHR264	H-3 Block	2.490740741
265	LHR265	G-4 Block Centre Park Reservior	2.240740741
266	LHR266	E-I Block Opposite LGS School/C-II Block	2.685185185
267	LHR267	J Block Park	0.850925926
268	LHR268	L Block Near Police Choki	0.786111111
269	LHR269	Beer Pind	2.453703704
270	LHR270	Shah De Khoi, Near Johar Banquet	2.425925926
271	LHR271	G-I Block Opposite LGS School	0.774074074
272	LHR272	E Block Park	2.490740741
273	LHR273	D-II Block Park	2.199074074
274	LHR274	Campus View Near Moon Heights	2.175925926
275	LHR275	Oppsite Jamiya Masjid Muhammamdi, Muhammadi Park, Johar town Sub Division	2.634259259
276	LHR276	Hanif Park Tunda Phatak	3.787037037
277	LHR277	Hanif Park Street no.6	3.986111111
278	LHR278	siddique Pura	3.337962963
279	LHR279	Shad Bagh No.3	2.735185185
280	LHR280	Hyssain Park	4.523148148

281	LHR281	Qadafi colony	3.939814815
282	LHR282	Khokhar road-3	3.819444444
283	LHR283	Ali Pura Lift Station	2.583333333
284	LHR284	Reheempura Park	2.12037037
285	LHR285	Khokhar road-1	4.37037037
286	LHR286	Khokhar road-2	3.953703704
287	LHR287	Kohlu Ghar	2.938888889
288	LHR288	Chah Motian Wala	4.097222222
289	LHR289	Khakhar Road no.4, Band Road (Ring Road	3.935185185
290	LHR290	Mozang Ada	2.564814815
291	LHR291	Cattle Park	2.310185185
292	LHR292	Royal Park	2.203703704
293	LHR293	Qilla Gujar Singh/Nisar Scheme	3.759259259
294	LHR294	Landa Bazar	3.574074074
295	LHR295	Usmania Colony	2.634259259
296	LHR296	Lady Mclegan	3.523148148
297	LHR297	Railway Road	2.310185185
298	LHR298	Guru Agreen Nagar/Circular Road shah Alam	1.014814815
299	LHR299	Pathi Ground/Rashi Bhawan	1.194444444
300	LHR300	Nisbat Road Mohalla Gawalan	1.518518519
301	LHR301	Nasir Bagh	5.740740741
302	LHR302	Katcha Nisbat Road	2.277777778
303	LHR303	Patiala Ground	1.008333333
304	LHR304	Napier Road	2.588888889
305	LHR305	Fareed Kot House	2.422222222
306	LHR306	Ada Crown Bus	2.235185185
307	LHR307	Haji Camp	2.251851852
308	LHR308	Dhobi Mandi	2.5
309	LHR309	Abdul Kareem road/Mela Ram Park	2.227777778
310	LHR310	Takkia Khusrian Wala	4.37037037
311	LHR311	G.T Road	4.342592593
312	LHR312	Floor Mill Near WAPDA Power Palant	4.986111111
313	LHR313	majeed Park	7.24537037
314	LHR314	Saeed Park	3.25462963
315	LHR315	Shahdra Twon	3.828703704
316	LHR316	Qaiser Town	10.63888889
317	LHR317	Qazi Park	4.930555556
318	LHR318	Begum Da Bagh	6.12037037
319	LHR319	Rave Cricket Ground	3.509259259
320	LHR320	Latif chowk Wandala road	4.152777778
321	LHR321	Yousaf Park	5.712962963
322	LHR322	Shaokat Colony	3.339814815
323	LHR323	Gulshan-E-Hayat Colony	3.069444444
324	LHR324	Kamran Park	3.115740741

325	LHR325	Begum Kot New	5.356481481
326	LHR326	Aziz colony	6.273148148
327	LHR327	Farkhabad Nala	2.634259259
328	LHR328	Match Factory	4.097222222
329	LHR329	Farakhabad Disposal	4.226851852
330	LHR330	Faisal Park/children Park	2.810185185
331	LHR331	Jia Musa	5.111111111
332	LHR332	D Block Gujarpura	2.431481481
333	LHR333	Ablock Gujarpura	2.288888889
334	LHR334	Kot khawaja Saeed Khan Je house	2.285185185
335	LHR335	Jamil Park china Scheme	2.211111111
336	LHR336	Sultan Pura New	2.203703704
337	LHR337	Ahata Thanidaran chah meran	2.192592593
338	LHR338	Usman Park Singpura	2.303703704
339	LHR339	Chemra Mandi School	2.288888889
340	LHR340	Kot khawaja Saeed Khan Je house	2.303703704
341	LHR341	Tezab Ahata New	2.408333333
342	LHR342	Shah Badar Dewan	2.240740741
343	LHR343	Jinah Park	2.388888889
344	LHR344	Begumpora Mehmodabad	2.57037037
345	LHR345	Own Wali Building	2.548148148
346	LHR346	Jamshed Park/Singhpura	2.512962963
347	LHR347	Bhogiwal New	2.138888889
348	LHR348	Swami Nagar (Submersible)	0
349	LHR349	Sultani Park	2.127777778
350	LHR350	Shuja Colony Sawami Nagar	2.053703704
351	LHR351	Gujar Pura B Block china Scheme	2.783333333
352	LHR373	Yasrab Colony	2.722222222
353	LHR374	Akramabad Park	2.50462963
354	LHR375	Hamad colony	2.87962963
355	LHR376	Lady Sofia Park	2.819444444
356	LHR377	Nabi Baksh Park	2.166666667
357	LHR378	Peeran Wala	2.886111111
358	LHR379	Lady Sofia Park Old	2.290740741
359	LHR380	Chah Meran Old	2.319444444
360	LHR381	Well Centre 1	3.152777778
361	LHR382	Well Centre 2	4.597222222
362	LHR383	Well Centre 4	2.842592593
363	LHR384	Tajpura Ground	3.171296296
364	LHR385	Ilahi Park	2.638888889
365	LHR386	Chah Meran New	2.694444444
366	LHR387	Naoshahi road Bhagatpura/Ahmad Park	2.527777778
367	LHR388	Shah Stadium	2.837962963
368	LHR389	Shamshed Park	2.657407407
369	LHR390	Khuda Buksh Park	2.606481481

370	LHR391	Children Park	3.180555556
371	LHR392	Wasan Pura Scheme	#VALUE!
372	LHR393	Nazimabad Shad Bagh	3.166666667
373	LHR394	Old Ravi Well Centre III	2.409259259
374	LHR395	Old Ravi Well Centre IV	2.811111111
375	LHR396	Sheran Wala	2.016666667
376	LHR397	Shah Alam Gate	2.074074074
377	LHR398	Akbari Gate (Old)	1.812962963
378	LHR399	Bhati Gate	2.825925926
379	LHR400	Iqbal Park Fort	2.051851852
380	LHR401	Shesh Mohal Road Bhati Gate	2.668518519
381	LHR402	Mori Gate New	3.444444444
382	LHR403	F&V Market Sabzi Mandi	3.048148148
383	LHR404	Main Bazar Qila Mohammadi	1.266666667
384	LHR405	Chumala	1.72037037
385	LHR406	Masti Gate	1.268518519
386	LHR407	Lorry Ada Badami Bagh	1.255555556
387	LHR408	Shah Alam Market	2.013888889
388	LHR409	New Tehsil Garden	3.648148148
389	LHR410	Yaki Gate New	1.685185185
390	LHR411	Timber Market	2.99537037
391	LHR412	Akbari Gate	2.115740741
392	LHR413	Nawaz Sharef Park	2.564814815
393	LHR414	Lohari Gate New	2.856481481
394	LHR415	Texali Gate	3.027777778
395	LHR416	Kashmiri Gate	2.337962963
396	LHR417	Al Madad Park	3.402777778
397	LHR418	Windsor Park/Altakeen Road	3.00462963
398	LHR419	A Block Muslim Town	2.675925926
399	LHR420	Nadeem Park	4.222222222
400	LHR421	Rasool Park	2.75
401	LHR422	New LOS Chaudhary colony	2.597222222
402	LHR423	Qubra Mosque	3.25462963
403	LHR424	A Block Rehman Pura	2.680555556
404	LHR425	C Block Muslim Town	2.949074074
405	LHR426	Mehbob Park	3.541666667
406	LHR427	Wahdat Colony	4.425925926
407	LHR428	Shah Kamal/Ganda Nala	3.064814815
408	LHR429	Punj Peer Road	3.060185185
409	LHR430	Karnalpura/Alhamd colony	2.402777778
410	LHR431	Bukhari Market	3.180555556
411	LHR432	New Ayubia Market	2.476851852
412	LHR433	Ichra Moe New	2.675925926
413	LHR434	New Takkia Lehri Shah	2.555555556
414	LHR435	Kramabad Rehmanpura	4.175925926

415	LHR436	Gawala Colony-1	2.062962963
416	LHR437	2 D I	2.751851852
417	LHR438	2-C-II	2.475925926
418	LHR439	1-B-II (Old)	3.242592593
419	LHR440	3-D-I	2.437037037
420	LHR441	4-C-2	2.442592593
421	LHR442	5-D-I	2.583333333
422	LHR443	3-D-II	2.166666667
423	LHR444	13-B-I	2.492592593
424	LHR445	11-B-2	2.290740741
425	LHR446	Bhata No. 1&2	2.261111111
426	LHR447	Keer Kalan Pind	2.65
427	LHR448	Bagrian Pind	2.035185185
428	LHR449	4-D-II	2.133333333
429	LHR450	I-D-II	2.22037037
430	LHR451	5-C-II	2.262962963
431	LHR452	1 C-I	2.431481481
432	LHR453	Gawala Colony 3	2.175925926
433	LHR454	1 B-II New	2.875925926
434	LHR455	5-D-II New	2.494444444
435	LHR456	Aoqaf Colony	2.592592593
436	LHR457	Hakim Town	2.018518519
437	LHR458	3-C-I Green Town	2.794444444
438	LHR459	2 B-I Township	2.222222222
439	LHR460	6-B-I	2.253703704
440	LHR461	16-B-I/Pathanewala	2.32037037
441	LHR462	5 D-2 Old	2.333333333
442	LHR463	Q Block Near Police Station	1.888888889
443	LHR464	R Block	1.972222222
444	LHR465	S Block Model Town	2.144444444
445	LHR466	Pindi stop	2.133333333
446	LHR467	Albadar Hospital	2.396296296
447	LHR468	R Block New	2.464814815
448	LHR469	Nasrat Road	2.255555556
449	LHR470	Bhati Colony Model Town	2.268518519
450	LHR471	Nadeem Park/Rahat Park	2.059259259
451	LHR472	Pindi Rajputan	2.216666667
452	LHR473	Akbar Sheed Road	2.290740741
453	LHR474	Ittefaq Hospital Cricket Ground	2.059259259
454	LHR475	Block 4 Sector A-II Township	2.35
455	LHR476	Baba Fareed Colony Near Jail	2
456	LHR477	Bank Stop/Mian Fazal Haq Colony	2.464814815
457	LHR478	Nishter colony Near Police Station	2.388888889
458	LHR479	Nishter Colony Near Tanky	2.011111111
459	LHR480	Block 6 Sector A-II Township	2.142592593

460	LHR481	Qanchi Stop	2.485185185
461	LHR482	Itefaq Colony	2.153703704
462	LHR483	Sitara Colony	1.892592593
463	LHR484	Katcha Jail road/Irigation Colony	2.244444444
464	LHR485	Awami Colony	2.377777778
465	LHR486	Ghulam Hussain Bhati Colony UC 129	2.351851852
466	LHR487	Baba Fareed Colony Near PECO	2.424074074
467	LHR488	Chungi Amarsadhu Near Shell Pump	2.068518519
468	LHR489	Block 2 Sector A-II Township	2.401851852
469	DHA-01	K-Block Phase VI Avenue-1 Tank-1	1.576851852
470	DHA-02	A-Block Phase VI Avenue-4 Lahore, Pakistan	1.638888889
471	DHA-03	St-17, Sector Y, Phase-3 Lahore.	1.580555556
472	DHA-04	St-16, Sector Z Phase-3 Lahore, Pakistan	1.291666667
473	Cantt-01	Allama Iqbal Road Lahore.	1.457407407
474	Cantt-02	Sarwar Road, Lahore.	1.664814815
475	Cantt-03	C.M.H Hospital, Lahore.	1.67962963
476	Cantt-04	Zarar Shaheed Road	1.675925926
477	Cantt-05	Askari Flat -01 Tufail Road Sadder	1.671296296

4.3.3 Cancer Risk

Last but not the least in order to calculate the cancer risks associated with each water sample certain calculations were done. Table below is a representation of all results deduced from those calculations.

Table 4.6 Cancer risk Values for Arsenic

CANCER RISK VALUES			
S. No	Sample Code	Location of tube well	Cancer Risk Values
1	LHR001	Tegro Park	0.00199292
2	LHR002	Muhammad Nagar	0.00133708
3	LHR003	Habibullah Road Baghyshah	0.00239375
4	LHR004	Children Park	0.0016925
5	LHR005	Habibullah Road Baghyshah	0.00172917
6	LHR006	Scotch Corner/Upper Mall	0.0010625
7	LHR007	Mian Meer Pind	0.0026
8	LHR008	anand road Upper Mall	0.00221833
9	LHR009	Garhi Shahu Police Station	0.00160208

10	LHR010	Main Bazar Ghazi Mohalla Garhi Shahu	0.001525
11	LHR011	Larex Colony	0.00151875
12	LHR012	Zaman Park	0.00167625
13	LHR013	Basti syden Shah	0.0017
14	LHR014	Bagh Munshi Ladha	0.00144167
15	LHR015	Yaseen Road	0.0011875
16	LHR016	Umar Park Bilal Ganj	0.00103333
17	LHR017	Mohni Road	0.0011875
18	LHR018	Karim Pak Ground Old	0.00160417
19	LHR019	Qasor Pura/Ameen colony	0.001525
20	LHR020	New Umer Park	0.00106042
21	LHR021	Gulshan-e-Riaz	0.0009875
22	LHR022	Ibraheem Road	0.00110833
23	LHR023	Sardar Chapal	0.00102917
24	LHR024	Munshi Hospital	0.0010375
25	LHR025	Main Outfull Road	0.00128542
26	LHR026	Karim Park Block 3	0.00133333
27	LHR027	National Ravi 2	0.00150833
28	LHR028	Bajri Adda	0.00123958
29	LHR029	Main Outfull Road New	0.00095833
30	LHR030	Ameen Park	0.0013125
31	LHR031	Rehmat Flour Road	0.00145417
32	LHR032	Allah Wali Mosque	0.00091875
33	LHR033	Shafiqueabad	0.00120625
34	LHR034	Takoni Ground Islam pura	0.00375417
35	LHR035	Firdos Park	0.00136667
36	LHR036	Chohan Park	0.00073958
37	LHR037	DCO Office	0.00104167
38	LHR038	Akram Park Band Road	0.00192083
39	LHR039	Nehru Park/Afgharn Park	0.00098
40	LHR040	Rafayabad Park	0.00095625
41	LHR041	MC High School Sanda	0.00128125
42	LHR042	Liqatabad	0.00188542
43	LHR043	Commisioner Office	0.00097083
44	LHR044	Ali Park New	0.00099583
45	LHR045	G Block Gulshan Ravi	0.00131875
46	LHR046	60-Road Shera Kot Babu Sabu	0.0007
47	LHR047	Moon Market Gulshan Ravi	0.00076875
48	LHR048	Jaffiria colony	0.00109167
49	LHR049	Rustam Park	0.00113125
50	LHR050	Umer Park Sodiwal Quarder	0.00094167
51	LHR051	Naunarian	0.0011125
52	LHR052	Nawa Kot WASA Colony	0.001015
53	LHR053	Dhop Sari Malik Munir Road	0.00095625
54	LHR054	E Block Gulshan Ravi	0.00126458

55	LHR055	Zubair Park Gulshan Ravi	0.000665
56	LHR056	Firdos Colony	0.000925
57	LHR057	Usman Park F Block Gulshana Ravi	0.00085417
58	LHR058	Sikandria colony	0.00110417
59	LHR059	Babu Sabu School	0.0008625
60	LHR060	Near WASA Complaint Center	0.00078
61	LHR061	Riwaz Garden Markeet	0.00111875
62	LHR062	Takkia Mehmood Shah,Sanda Road Rahat Street	0.00103792
63	LHR063	Bilal Park, Raj Garh	0.00129583
64	LHR064	Riifle Range, New Chlazji	0.00111667
65	LHR065	Ghulam Hussain colony Across Bund road, Main Street Bazar, Imam Din road	0.001725
66	LHR066	Patwar Khana,Grave yard Sanda Road	0.00164375
67	LHR067	Jahangir Town	0.00159792
68	LHR068	A Block gulshan-e-ravi	0.0011875
69	LHR069	Bund Road UC84	0.00125167
70	LHR070	Zubair Road Rajgarh	0.0020125
71	LHR071	Muslim Park Rajgarh	0.00164792
72	LHR072	B Block Gulshan e Ravi, Qazafi Park	0.00085208
73	LHR073	Park P Block, Sabza zar Opp Malik Yasir House	0.0014875
74	LHR074	D Block Main Park Off Fezan-e-Rasool Road	0.00107083
75	LHR075	A Block Park on main road	0.00152083
76	LHR076	shah Fared Takani Park, Shah Fareed Markeet	0.00131875
77	LHR077	Masroor Ahmad	0.00177083
78	LHR078	Takoni Ground Off Grave Yard	0.00135625
79	LHR079	Near Park, H block	0.001475
80	LHR080	Takin Chowk Main Bazar Khardk	0.00143958
81	LHR081	Liaqat Chowk, Asad Plaza Markeet	0.00127292
82	LHR082	Kasar Block Jinnah Block/Awan town	0.00151875
83	LHR083	Main Park One Head Tank,K Block	0.00122917
84	LHR084	Main Park N Block near Qalza Masjid	0.00255625
85	LHR085	E-1 Block Fcc Katchi abadi Gulbug III	0.00149375
86	LHR086	H Block Gulbarg III	0.00119375
87	LHR087	Makka Colony Street 22, Gulbarg III	0.00148125
88	LHR088	B-1 Block Gulberg III	0.00187708
89	LHR089	Railway line,Jinna Park Gulburg II	0.00204583
90	LHR090	Back side Ferdous Markeet, J Block Gulberg II/ K-Block G-III	0.00114583
91	LHR091	Nala 27 Manzab Pace Town, Q block Gulberg II New	0.00080833
92	LHR092	Over Head Tank, B-Block/T-block gulberg II New	0.00174792
93	LHR093	Nisar Art Press gulberg II	0.00189375

94	LHR094	Near Sui Gas Main Office (Ploice Post Gulberg market)	0.00145833
95	LHR095	Ghalab Markeet, Guru Manget A-II	0.00146667
96	LHR096	saint Merry Colony Gulberg-III	0.00158542
97	LHR097	Opposite Lahore cantt Raalway Station, Qurban Line Gulberg-II	0.00160208
98	LHR098	The Pind Furdous Markeet C-1	0.00165
99	LHR099	Syed Mubsam Ali Rizvi	0.00161458
100	LHR100	New Railway Line (Walton Acadmy), New Makka colony	0.0012375
101	LHR101	M Block, Henry K Gulberg-III	0.00153125
102	LHR102	G Block Wasa Complant Center	0.00170417
103	LHR103	Opposite Shalimar Towar hotel, Zafar Ali road/Jail road	0.00144375
104	LHR104	Park Back site X PM parvaz Elahi, Fcc block, Gulberg sub Dev	0.00230625
105	LHR105	Jamiya Masjid Abu bakar Siddique, Khan colony Gulberg III	0.00187917
106	LHR106	social Security hospital, main Feroz pur road, nawaz Shareef colony Feroz pur.	0.00121458
107	LHR107	Green Belt P block, Ghulab Devi Hospital, Gopal Nagar	0.001475
108	LHR108	Main Bazar Bilal Nagar, Henry Katchi Abadi Gulberg III	0.00155625
109	LHR109	Govt. Islamia College for Boys, Iqbal Park	0.00121875
110	LHR110	Athar Abbas ParkTajpura Pind	0.00131458
111	LHR111	A Block Tajpura	0.00202042
112	LHR112	Main Park Tajpura, Data Park	0.00137292
113	LHR113	D Block Main Park	0.00122917
114	LHR114	Al Madina Colony. A Block Tajpura	0.001475
115	LHR115	Al Faisal Town, Burgi No. 9	0.00118125
116	LHR116	Soling Road, Tajpura	0.00114375
117	LHR117	Graveyard Ghaziabad Bus stop No.2	0.00130417
118	LHR118	SDO Office, DO North Tajpura	0.00136458
119	LHR119	DLR Office, Chubacha Phatik	0
120	LHR120	Gulshan Colony Walton	0.00131042
121	LHR121	LDA Quarter Walton	0.00109167
122	LHR122	Ghosia colony	0.00129875
123	LHR123	Gulshan colony Mustafa Abad	0.0012125
124	LHR124	Infentory colony	0.00125208
125	LHR125	Canal Bridge	0.00123958
126	LHR126	Mian Meer Darbar	0.00120208
127	LHR127	Tariq colony, Walton	0.0015375
128	LHR128	Dry Port, Mughalpura	0.00123125
129	LHR129	Canal Bank, Ahata Makhan Sing	0.001335

130	LHR130	Chubacha Phatik, DLR Office, Mustafaabad Sub Division	0
131	LHR131	Punj Peer Lal pull, Canal Bank, Fateh Garh Sub Div.	0.00110167
132	LHR132	Jahangir Road, Main Chowk Mughal pura Canal Bank, Sub Div. Mughal pura	0.00097417
133	LHR133	Fayaz Park, Canal Bank, Mughal pura Sub. Division	0.00102333
134	LHR134	Maskeempura, Golden Gate School, Canal Bank, Fateh Garh Division	0.00109
135	LHR135	Fateh Garh Pull, City District Girls High School, Fateh Garh Div.	0.00102667
136	LHR136	Kotli Ghasi, Govt Boys Primary Scool, Fateh Garh Div.	0.00120167
137	LHR137	Qalandarpura, Fateh garh sub division	0.0013125
138	LHR138	Gawala Colony Herbanapura, Ring road, Faeteh garh sub division	0.00118
139	LHR139	Iftikhar Park, Harbanapura Park, Fateh garh div.	0.00103917
140	LHR140	Ishfaq Chowk/ Shaoq Chowk, Van Stand Al-Kareem Chowk, Tajpura Sub Div.	0.00097167
141	LHR141	Tajbagh Scheme, Gulshan-e-Rehman, Tajpura Division	0.00142708
142	LHR142	Jore Pull, Tajpura sub Div.	0.00119167
143	LHR143	C Block Al-faisal town Baharshah, Tajpura Sub. Div.	0.00110417
144	LHR144	Canal Bank, Muslim abad, Fateh Garh	0.001125
145	LHR145	Peer Naseer, Mughal pura Sub. Div.	0.00110917
146	LHR146	Slamatpura Takkia, Fateh garh Sub Div.	0.00133542
147	LHR147	Gulshan Park, Fateh garh Sub Div.	0.00147292
148	LHR148	Nadia Ghee Mill, Fateh garh Sub Div.	0.00128333
149	LHR149	Dars Bary Mian/ Mujahidabad,	0.00112708
150	LHR150	Salamat Pura 5, Fateh garh Sub Div.	0.00198542
151	LHR151	Shah Din Park, Fateh garh Sub Div.	0.00123125
152	LHR152	Kotli Pir Abdul Rehman, Mughalpura Sub. Div.	0.00112708
153	LHR153	dispensary Road Fateh Garh, Fateh garh Sub Div.	0.001475
154	LHR154	Faisal Park/ Children Park	0.0012375
155	LHR155	Sahuwari Sani View Park, Mughalpura	0.0014625
156	LHR156	Qadir Buksh Park,	0.00155833
157	LHR157	Maskeempura	0.00166875
158	LHR158	Karim Nagar Salamat pura no. 3	0.0018
159	LHR159	New Shalimar Scheme Salamat Pura	0.00125625
160	LHR160	Sahuwari Takkia Old	0.00130833

161	LHR161	Goshaya Angori	0.00126042
162	LHR162	Shah Kamal Road	0.00107292
163	LHR163	Milap Street	0.00129792
164	LHR164	Sansi Quarder	0.00158125
165	LHR165	Anguri Bagh Scheme No. 2	0.00125625
166	LHR166	Baja Line	0.00147917
167	LHR167	Pakistan Mint New	0.00200417
168	LHR168	Lal School, Dars Baray Mian	0.00204792
169	LHR169	Masjid Taj din	0.00120625
170	LHR170	Parashoot Colony	0.00097083
171	LHR171	Baghechi Sethah Wali New	0.00149583
172	LHR172	Azeem Ground	0.0012125
173	LHR173	B.T.H Drain	0.001125
174	LHR174	Achant Garh	0.00129167
175	LHR175	Baba Beri Peer	0.00163125
176	LHR176	Jamilabad	0.000835
177	LHR177	Saher Road	0.0020875
178	LHR178	Shah Gohar Abad	0.00139167
179	LHR179	Memood Booti Well Centre II	0.00166875
180	LHR180	Mehmood Booti Well centere III	0.00142708
181	LHR181	Dobi Ghat	0.00152708
182	LHR182	Rohri Per Darbar	0.00180208
183	LHR183	Madhulal Hussain	0.00161458
184	LHR184	Suraya Jabeen Park	0.00152083
185	LHR185	Tiba Qilla Khazana	0.0017875
186	LHR186	Ahma Town	0.00176458
187	LHR187	Gulshan-e-Shalimar	0.00151042
188	LHR188	Memempura	0.0018625
189	LHR189	Baba Ghandi Shah	0.00161458
190	LHR190	Saad Ghee Mill	0.00155208
191	LHR191	Deputy Yaqoob Colony	0.00167083
192	LHR192	Alia Town	0.00175
193	LHR193	Near Mehmood booti disposal	0.0014125
194	LHR194	Garden Town	0.00128167
195	LHR195	Garden Town	0.00186667
196	LHR196	B Block New Faisal town	0.00102
197	LHR197	Garden Town	0.00127083
198	LHR198	Garden Town	0.00125833
199	LHR199	M block Model town extension	0.0014375
200	LHR200	Garden Town	0.00141667
201	LHR201	D block Faisal Town	0.00107
202	LHR202	L Block model town Extension	0.00101
203	LHR203	Tariq block	0.0010675
204	LHR204	N Block Model Town Extension	0.00102583
205	LHR205	P-Block Model Town Ext.	0.00134167

206	LHR206	C Block Faisal Town	0.00102333
207	LHR207	N Block, Samnabad	0.001105
208	LHR208	Dholanwal Near Dispensary, Samnabad	0.00115667
209	LHR209	Zubiada Park, Samnabad	0.00093833
210	LHR210	Jhugian Shahabdin, Samnabad	0.0010125
211	LHR211	choudhary Colony/Khizra Mosque, Dhoongi Ground	0.001065
212	LHR212	Peer budhan shah, Samnabad	0.00107333
213	LHR213	Bakar Mandi, Samnabad	0.0009475
214	LHR214	Nawan Kot More Samanabad	0.00102833
215	LHR215	Paki Thathi, Samnabad	0.00101583
216	LHR216	Katcha Umer Park/Jinah colony, Samnabad	0.00120167
217	LHR217	Ghulam Nabi colony, Samnabad	0.00111
218	LHR218	Mushtaq Town, Samnabad	0.00093583
219	LHR219	C Block Sabzazar, Samnabad	0.00093333
220	LHR220	Chah junian Wala/Paki Thathi, Samnabad	0.0009875
221	LHR221	Itehad colony, Samnabad	0.00101333
222	LHR222	Pak block, Iqbal Town Sub Division	0.00098583
223	LHR223	Jahanzeb Block, Iqbal Town Sub Division	0.001035
224	LHR224	college block, Iqbal Town Sub Division	0.00104083
225	LHR225	Karim Block-1, Iqbal Town Sub Division	0.00107833
226	LHR226	Asif Block, Iqbal Town Sub Division	0.00106083
227	LHR227	F & V Market 2, Iqbal Town Sub Division	0.00097417
228	LHR228	New Chinab Block 2, Overhead Tank Park, Iqbal Town Sub Division	0.0010325
229	LHR229	Nishtar Block 2, Graveyard, Iqbal Town Sub Division	0.00084333
230	LHR230	Cliton Colony, Backside Girls Pilot School, Iqbal Town Sub Division	0.00110667
231	LHR231	Ravi Block New, Main Multan Road, Kharak TW, Iqbal Town Sub Division	0.00110083
232	LHR232	Mehran Block New, Main Multan Road, F & V Market, Iqbal Town Sub Division	0.00101083
233	LHR233	Huma Block, Rahim Store Iqbal Town Sub Division	0.00106
234	LHR234	Raza Block, Children Park, Iqbal Town Sub Division	0.0009975
235	LHR235	Kamran Block, Malik Sultan Children Park	0.00099417
236	LHR236	Nelam Block, Small Park, Iqbal Town Sub Division	0.00125083
237	LHR237	Nargis Block, Children Park Small Market, Iqbal Town Sub Division	0.00122417
238	LHR238	Hunza Block, Children Park, Iqbal Town Sub Division	0.00112833

239	LHR239	Kareem Block 2, Steet Jamia Masjid Allah Wali, Graveyard, Iqbal Town Sub Division	0.0009975
240	LHR240	Islampura, Complaint Center WASA, Ravi Road Sub Division	0.0011275
241	LHR241	Awa Phari Queen Road	0.00109167
242	LHR242	Shadman Market	0.00131458
243	LHR243	Rehmania Park Shadman	0.00121042
244	LHR244	Hamoon Shah Park	0.00118958
245	LHR245	Mason Road	0.00120417
246	LHR246	Ahata Mool Chand-1	0.00093125
247	LHR247	Kot Abdullah Shah	0.00102917
248	LHR248	Mian Aslam Iqbal Park	0.00117917
249	LHR249	Lyton Road	0.00100417
250	LHR250	Apwa College	0.00114792
251	LHR251	Aibak Park	0.00139792
252	LHR252	Waris Road	0.00134583
253	LHR253	Patiala House Children Complex	0.00124583
254	LHR254	Faeeh Road	0.00129375
255	LHR255	Roza abu Ishaq	0.0012375
256	LHR256	Saadi Park	0.00159792
257	LHR257	Shah Jamal	0.00159583
258	LHR258	Bagh gul Begum	0.000975
259	LHR259	Ahata Mool Chand-2	0.00089583
260	LHR260	Doungi Ground Fazlia Colony	0.00109167
261	LHR261	Shadman Ganda Nala	0.0010375
262	LHR262	Shadman Mental Hospital Tanki	0.00104792
263	LHR263	Aisha Park Shadman	0.00101042
264	LHR264	H-3 Block	0.00112083
265	LHR265	G-4 Block Centre Park Reservior	0.00100833
266	LHR266	E-I Block Opposite LGS School/C-II Block	0.00120833
267	LHR267	J Block Park	0.00038292
268	LHR268	L Block Near Police Choki	0.00035375
269	LHR269	Beer Pind	0.00110417
270	LHR270	Shah De Khoi, Near Johar Banquet	0.00109167
271	LHR271	G-I Block Opposite LGS School	0.00034833
272	LHR272	E Block Park	0.00112083
273	LHR273	D-II Block Park	0.00098958
274	LHR274	Campus View Near Moon Heights	0.00097917
275	LHR275	Oppsite Jamiya Masjid Muhammadi, Muhammadi Park, Johar town Sub Division	0.00118542
276	LHR276	Hanif Park Tunda Phatak	0.00170417
277	LHR277	Hanif Park Street no.6	0.00179375
278	LHR278	siddique Pura	0.00150208
279	LHR279	Shad Bagh No.3	0.00123083
280	LHR280	Hyssain Park	0.00203542

281	LHR281	Qadafi colony	0.00177292
282	LHR282	Khokhar road-3	0.00171875
283	LHR283	Ali Pura Lift Station	0.0011625
284	LHR284	Reheempura Park	0.00095417
285	LHR285	Khokhar road-1	0.00196667
286	LHR286	Khokhar road-2	0.00177917
287	LHR287	Kohlu Ghar	0.0013225
288	LHR288	Chah Motian Wala	0.00184375
289	LHR289	Khakhar Road no.4, Band Road (Ring Road	0.00177083
290	LHR290	Mozang Ada	0.00115417
291	LHR291	Cattle Park	0.00103958
292	LHR292	Royal Park	0.00099167
293	LHR293	Qilla Gujar Singh/Nisar Scheme	0.00169167
294	LHR294	Landa Bazar	0.00160833
295	LHR295	Usmania Colony	0.00118542
296	LHR296	Lady Mclegan	0.00158542
297	LHR297	Railway Road	0.00103958
298	LHR298	Guru Agreen Nagar/Circular Road shah Alam	0.00045667
299	LHR299	Pathi Ground/Rashi Bhawan	0.0005375
300	LHR300	Nisbat Road Mohalla Gawalan	0.00068333
301	LHR301	Nasir Bagh	0.00258333
302	LHR302	Katcha Nisbat Road	0.001025
303	LHR303	Patiala Ground	0.00045375
304	LHR304	Napier Road	0.001165
305	LHR305	Fareed Kot House	0.00109
306	LHR306	Ada Crown Bus	0.00100583
307	LHR307	Haji Camp	0.00101333
308	LHR308	Dhobi Mandi	0.001125
309	LHR309	Abdul Kareem road/Mela Ram Park	0.0010025
310	LHR310	Takkia Khusrin Wala	0.00196667
311	LHR311	G.T Road	0.00195417
312	LHR312	Floor Mill Near WAPDA Power Palant	0.00224375
313	LHR313	majeed Park	0.00326042
314	LHR314	Saeed Park	0.00146458
315	LHR315	Shahdra Twon	0.00172292
316	LHR316	Qaiser Town	0.0047875
317	LHR317	Qazi Park	0.00221875
318	LHR318	Begum Da Bagh	0.00275417
319	LHR319	Rave Cricket Ground	0.00157917
320	LHR320	Latif chowk Wandala road	0.00186875
321	LHR321	Yousaf Park	0.00257083
322	LHR322	Shaokat Colony	0.00150292
323	LHR323	Gulshan-E-Hayat Colony	0.00138125
324	LHR324	Kamran Park	0.00140208
325	LHR325	Begum Kot New	0.00241042

326	LHR326	Aziz colony	0.00282292
327	LHR327	Farkhabad Nala	0.00118542
328	LHR328	Match Factory	0.00184375
329	LHR329	Farakhabad Disposal	0.00190208
330	LHR330	Faisal Park/children Park	0.00126458
331	LHR331	Jia Musa	0.0023
332	LHR332	D Block Gujarpura	0.00109417
333	LHR333	Ablock Gujarpura	0.00103
334	LHR334	Kot khawaja Saeed Khan Je house	0.00102833
335	LHR335	Jamil Park china Scheme	0.000995
336	LHR336	Sultan Pura New	0.00099167
337	LHR337	Ahata Thanidaran chah meran	0.00098667
338	LHR338	Usman Park Singpura	0.00103667
339	LHR339	Chemra Mandi School	0.00103
340	LHR340	Kot khawaja Saeed Khan Je house	0.00103667
341	LHR341	Tezab Ahata New	0.00108375
342	LHR342	Shah Badar Dewan	0.00100833
343	LHR343	Jinah Park	0.001075
344	LHR344	Begumpora Mehmodabad	0.00115667
345	LHR345	Own Wali Building	0.00114667
346	LHR346	Jamshed Park/Singhpura	0.00113083
347	LHR347	Bhogiwal New	0.0009625
348	LHR348	Swami Nagar (Submersible)	0
349	LHR349	Sultani Park	0.0009575
350	LHR350	Shuja Colony Sawami Nagar	0.00092417
351	LHR351	Gujar Pura B Block china Scheme	0.0012525
352	LHR373	Yasrab Colony	0.001225
353	LHR374	Akramabad Park	0.00112708
354	LHR375	Hamad colony	0.00129583
355	LHR376	Lady Sofia Park	0.00126875
356	LHR377	Nabi Baksh Park	0.000975
357	LHR378	Peeran Wala	0.00129875
358	LHR379	Lady Sofia Park Old	0.00103083
359	LHR380	Chah Meran Old	0.00104375
360	LHR381	Well Centre 1	0.00141875
361	LHR382	Well Centre 2	0.00206875
362	LHR383	Well Centre 4	0.00127917
363	LHR384	Tajpura Ground	0.00142708
364	LHR385	Ilahi Park	0.0011875
365	LHR386	Chah Meran New	0.0012125
366	LHR387	Naoshahi road Bhagatpura/Ahmad Park	0.0011375
367	LHR388	Shah Stadium	0.00127708
368	LHR389	Shamshed Park	0.00119583
369	LHR390	Khuda Buksh Park	0.00117292
370	LHR391	Children Park	0.00143125

371	LHR392	Wasan Pura Scheme	#VALUE!
372	LHR393	Nazimabad Shad Bagh	0.001425
373	LHR394	Old Ravi Well Centre III	0.00108417
374	LHR395	Old Ravi Well Centre IV	0.001265
375	LHR396	Sheran Wala	0.0009075
376	LHR397	Shah Alam Gate	0.00093333
377	LHR398	Akbari Gate (Old)	0.00081583
378	LHR399	Bhati Gate	0.00127167
379	LHR400	Iqbal Park Fort	0.00092333
380	LHR401	Shesh Mohal Road Bhati Gate	0.00120083
381	LHR402	Mori Gate New	0.00155
382	LHR403	F&V Market Sabzi Mandi	0.00137167
383	LHR404	Main Bazar Qila Mohammadi	0.00057
384	LHR405	Chumala	0.00077417
385	LHR406	Masti Gate	0.00057083
386	LHR407	Lorry Ada Badami Bagh	0.000565
387	LHR408	Shah Alam Market	0.00090625
388	LHR409	New Tehsil Garden	0.00164167
389	LHR410	Yaki Gate New	0.00075833
390	LHR411	Timber Market	0.00134792
391	LHR412	Akbari Gate	0.00095208
392	LHR413	Nawaz Sharef Park	0.00115417
393	LHR414	Lohari Gate New	0.00128542
394	LHR415	Texali Gate	0.0013625
395	LHR416	Kashmiri Gate	0.00105208
396	LHR417	Al Madad Park	0.00153125
397	LHR418	Windsor Park/Altakeen Road	0.00135208
398	LHR419	A Block Muslim Town	0.00120417
399	LHR420	Nadeem Park	0.0019
400	LHR421	Rasool Park	0.0012375
401	LHR422	New LOS Chaudhary colony	0.00116875
402	LHR423	Qubra Mosque	0.00146458
403	LHR424	A Block Rehman Pura	0.00120625
404	LHR425	C Block Muslim Town	0.00132708
405	LHR426	Mehbob Park	0.00159375
406	LHR427	Wahdat Colony	0.00199167
407	LHR428	Shah Kamal/Ganda Nala	0.00137917
408	LHR429	Punj Peer Road	0.00137708
409	LHR430	Karnalpura/Alhamd colony	0.00108125
410	LHR431	Bukhari Market	0.00143125
411	LHR432	New Ayubia Market	0.00111458
412	LHR433	Ichra Moe New	0.00120417
413	LHR434	New Takkia Lehri Shah	0.00115
414	LHR435	Kramabad Rehmanpura	0.00187917
415	LHR436	Gawala Colony-1	0.00092833

416	LHR437	2 D I	0.00123833
417	LHR438	2-C-II	0.00111417
418	LHR439	1-B-II (Old)	0.00145917
419	LHR440	3-D-I	0.00109667
420	LHR441	4-C-2	0.00109917
421	LHR442	5-D-I	0.0011625
422	LHR443	3-D-II	0.000975
423	LHR444	13-B-I	0.00112167
424	LHR445	11-B-2	0.00103083
425	LHR446	Bhata No. 1&2	0.0010175
426	LHR447	Keer Kalan Pind	0.0011925
427	LHR448	Bagrian Pind	0.00091583
428	LHR449	4-D-II	0.00096
429	LHR450	I-D-II	0.00099917
430	LHR451	5-C-II	0.00101833
431	LHR452	1 C-I	0.00109417
432	LHR453	Gawala Colony 3	0.00097917
433	LHR454	1 B-II New	0.00129417
434	LHR455	5-D-II New	0.0011225
435	LHR456	Aoqaf Colony	0.00116667
436	LHR457	Hakim Town	0.00090833
437	LHR458	3-C-I Green Town	0.0012575
438	LHR459	2 B-I Township	0.001
439	LHR460	6-B-I	0.00101417
440	LHR461	16-B-I/Pathanewala	0.00104417
441	LHR462	5 D-2 Old	0.00105
442	LHR463	Q Block Near Police Station	0.00085
443	LHR464	R Block	0.0008875
444	LHR465	S Block Model Town	0.000965
445	LHR466	Pindi stop	0.00096
446	LHR467	Albadar Hospital	0.00107833
447	LHR468	R Block New	0.00110917
448	LHR469	Nasrat Road	0.001015
449	LHR470	Bhati Colony Model Town	0.00102083
450	LHR471	Nadeem Park/Rahat Park	0.00092667
451	LHR472	Pindi Rajputan	0.0009975
452	LHR473	Akbar Sheed Road	0.00103083
453	LHR474	Ittefaq Hospital Cricket Ground	0.00092667
454	LHR475	Block 4 Sector A-II Township	0.0010575
455	LHR476	Baba Fareed Colony Near Jail	0.0009
456	LHR477	Bank Stop/Mian Fazal Haq Colony	0.00110917
457	LHR478	Nishter colony Near Police Station	0.001075
458	LHR479	Nishter Colony Near Tanky	0.000905
459	LHR480	Block 6 Sector A-II Township	0.00096417
460	LHR481	Qanchi Stop	0.00111833

461	LHR482	Itefaq Colony	0.00096917
462	LHR483	Sitara Colony	0.00085167
463	LHR484	Katcha Jail road/Irigation Colony	0.00101
464	LHR485	Awami Colony	0.00107
465	LHR486	Ghulam Hussain Bhati Colony UC 129	0.00105833
466	LHR487	Baba Fareed Colony Near PECO	0.00109083
467	LHR488	Chungi Amarsadhu Near Shell Pump	0.00093083
468	LHR489	Block 2 Sector A-II Township	0.00108083
469	DHA-01	K-Block Phase VI Avenue-1 Tank-1	0.00070958
470	DHA-02	A-Block Phase VI Avenue-4 Lahore, Pakistan	0.0007375
471	DHA-03	St-17, Sector Y, Phase-3 Lahore.	0.00071125
472	DHA-04	St-16, Sector Z Phase-3 Lahore, Pakistan	0.00058125
473	Cantt-01	Allama Iqbal Road Lahore.	0.00065583
474	Cantt-02	Sarwar Road, Lahore.	0.00074917
475	Cantt-03	C.M.H Hospital, Lahore.	0.00075583
476	Cantt-04	Zarar Shaheed Road	0.00075417
477	Cantt-05	Askari Flat -01 Tufail Road Sadder	0.00075208

4.4 Graphical Representations

Following are the graphical representations of some of the results deduced from this study.

- **Arsenic Concentrations**

The following graph represents the concentrations of arsenic of all the collected water samples which is further compared with WHO and NEQs standards.

Arsenic Concentrations (ppb)

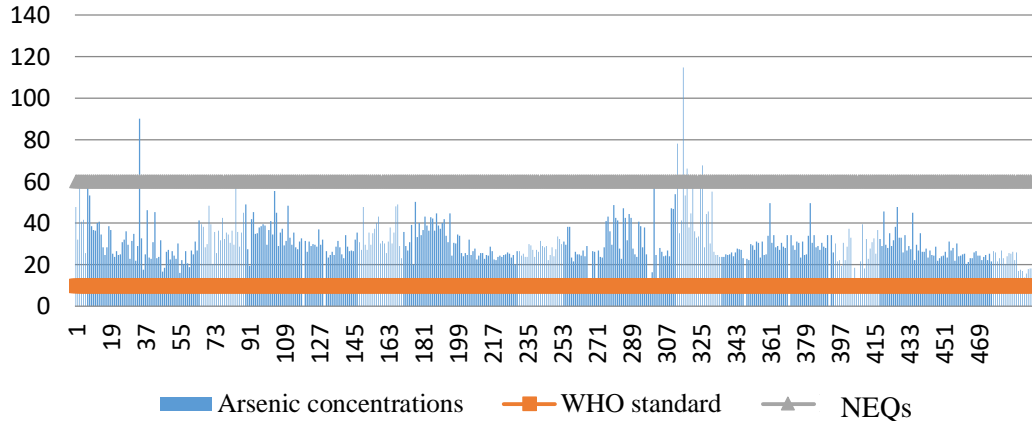


Figure 4.1 Concentration of As in collected samples

- **Hazard Quotient**

Following graphical representation depicts the amount of hazard that is associated with each collected water sample under a term called Hazard Quotient. Amongst the collected samples, the samples with a HQ of above 1 was considered unsuitable for drinking.

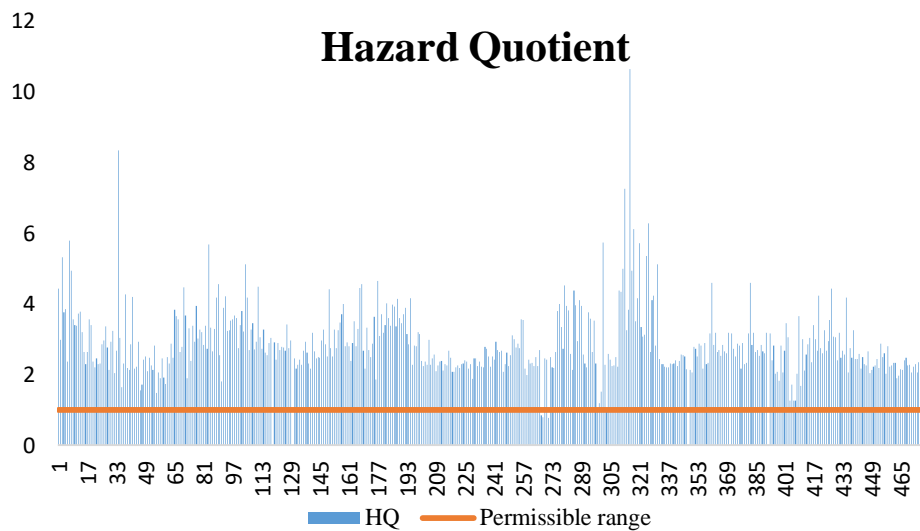


Figure 4.2 Hazard Quotient Values for collected Samples

- **Cancer Risk**

The following graphical representation depicts the potential cancer risk for each collected sample of water, which in turn explains as to what extent people who are consuming this water on daily basis have a risk of experiencing different sorts of cancers if not yet then may be in the long run.

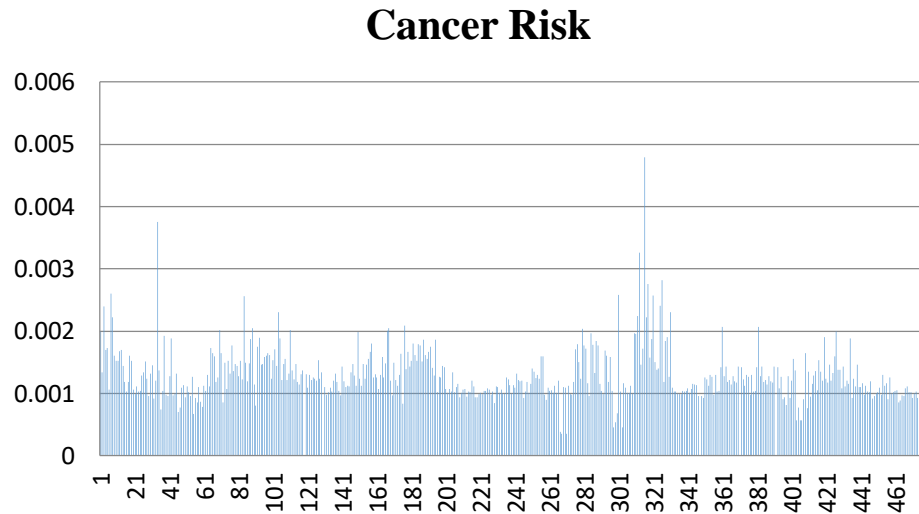


Figure 4.3 Cancer Risks associated with collected water samples

4.5 GIS Mapping

As explained earlier once all the information and results were collected and maps were prepared on the basis of pre-selected risk criterion i.e., one on the basis of WHO standards and the other one on the basis of NEQs standards.

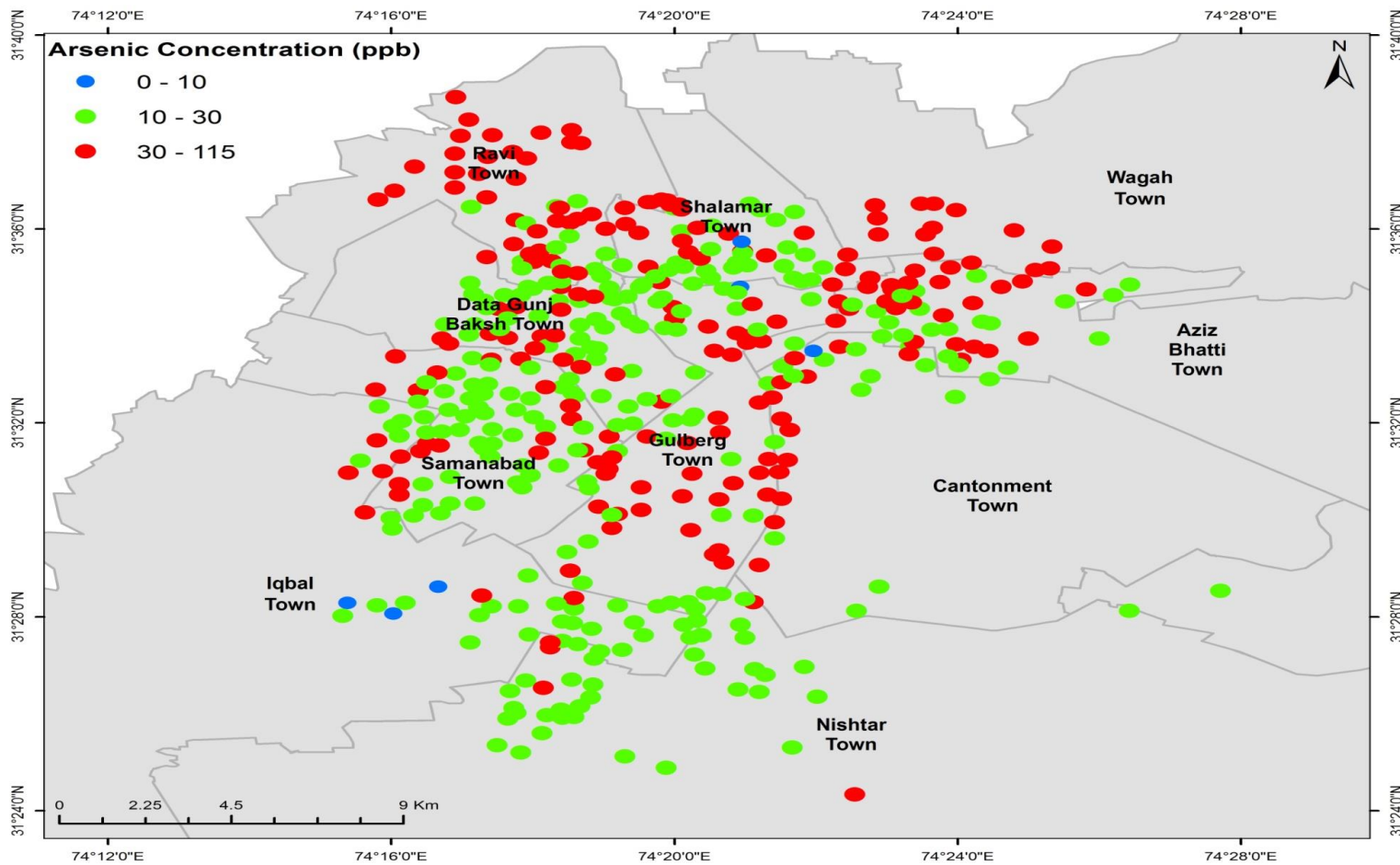


Figure 4.4 Map of Lahore depicting the risk of As contamination in underground water in different areas of the city according to WHO

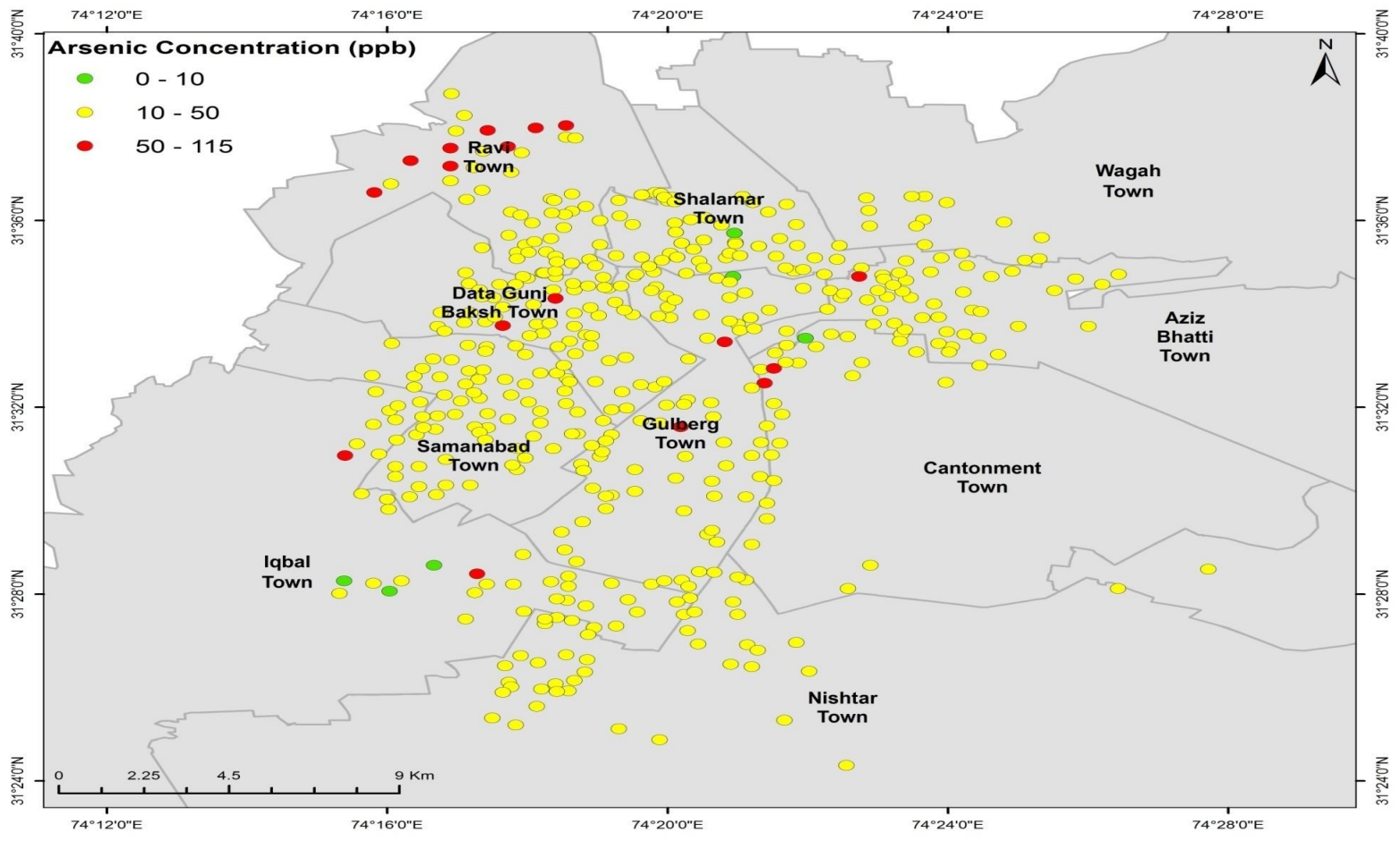


Figure 4.5 Map of Lahore depicting the risk of As contamination in underground water in different areas of the city according to NEQs

Figure 4.4 and figure 4.5 clearly identifies all the areas that are at higher risk of As pollution of ground water reservoirs. These areas are more likely to be under the effect of numerous diseases that are caused due to arsenic pollution and the population living in these areas are more likely to suffer from all those diseases

CHAPTER FIVE

DISCUSSION

This research was conducted to analyze the arsenic levels in the underground water reservoirs of Lahore. In order to achieve the identified goals a total of 477 samples from tube wells were collected from different locations of Lahore. For the purpose of sampling, suitable protocols were followed. Later, these samples were tested through the Atomic Absorption Spectrometer to identify the concentration As in each sample.

These concentrations were compared against NEQs and WHO standards.

A relation was developed between the concentration of As and depth of the tubewell using Pearson correlation. The result of the test revealed that depth of tubewell and concentration As is negatively related.

Once all the required statistics for the study were obtained the study moved to the next objective i.e. Human Health Risk Assessment (HHRA). To fulfill this objective standard referenced steps were followed. First the exposure dose for every sample was found out. Next was to find the hazard quotient for each sample and last was to identify the cancer risk associated with each and every sample.

The result of AAS clearly shows that 467 samples were exceeding the permissible limit of As set by World Health Organization making it 98% of the total sample size. The areas where arsenic was found to be in high concentration are mainly from five old towns of Lahore, namely, Data Gunj Baksh Town, Ravi Town, Samanabad Town, Shalamar Town and Aziz Bhatti town. The reasons for these high concentrations of As in these backward areas are the carelessness of the residents that dump their organic, inorganic and radioactive waste in the open areas without having awareness that how the waste can seep through the ground there by contaminating the ground water resources. Moreover, these areas of Lahore have many small industries mostly textile, which have their industrial runoff that also through various routes find its way to the underground water there by contaminating it even further.

This 98% of As contaminated water cannot just be collateral damage of human activities, there by rising a question of additional sources that have been polluting the under ground water reservoir of the city. According to the recent study its been observed that certain areas have more concentration of arsenic in deep waters of the tubewell. The reason behind this is that arsenic is a metalloid that is quite abundant in nature. The natural source of As pollutes sub surface water through Arsenic Cycling. Arsenic cycling in anaerobic environment lead to oxidation of organic matter. This generally happen in alluvial soil. The oxidation of this organic matter releases the solid arsenic (As III) into water as liquid arsenic (As V). Thereby, leading to arsenic pollution of ground water aquifer (Oremland et al., 2003). The soil type of entire Lahore city is alluviam, which means that these anaerobic conditions are quite common in all the five towns of Lahore that show higher concentration of As. The soil basically favors the conditions that increases the microbial reaction which in turns increases the replacement of elemental As to As-V (aqueous), there by polluting the entire reservoir.

Although previous studies have repeatedly showed that man made pollution is the most dangerous kind of pollution there has ever been. A study revealed various anthropogenic sources of arsenic including use of pesticides that contain As in any form, process of mining and smelting also releases various forms of As into the aquifers (USEPA, 2001). In case of the present city, however, the most important man made contributor of arsenic in the ground water pollution is the increased industrialization in the city. The Ravi town and the Shadman Town of Lahore have a number of industries within vicinity (LCCI, 2007). Arsenic identified by a WHO study, As is used as an alloying agent in many industries namely glass, pigment, textile and metal. Therefore the most important contributor of As pollution in these areas is rapid induatrialization.

In the present study, As content of Sample range from 2 ppb to 114 ppb. Ninety eight percent (98%) of the samples exceed the international standard of As set by WHO (10ppb), while 5% samples exceed permissible limits set by NEQs (50 ppb). Once these concentrations were found out, the research moved further that was to develop a correlation between this concentration and the depth of the tube well.

This was accomplished by running Pearson Correlation test. The test results showed that the depth of the tubewells was inversely related to the concentration of As in them. The study

concluded that there is a negative relationship between the two variable. A similar study conducted in Muzaffargarh, Pakistan showed the same trend. In that study a total of 49 samples were obtained from tube wells of different depths. These samples were obtained from both rural and urban areas. The samples that showed unexpectedly high concentration of As were from urban areas. These wells had a depth of more than 30 meters and all these samples were exceeding the As value of 50 ppb, thereby making them unsuitable for drinking purpose (Nickson et al., 2005).

Another study was done in Nepal yielded the same results. In this study the sample that had depth of 50 - 70 meters were exceeding the As permissible limit set by WHO internationally. These samples with such high concentration of As made 50% of the total sample size. The study associated this extreme arsenic contamination of water with the conventional form of agriculture that was being done in the area using commercial based pesticides and fertilizers with high nitrogen content. This study once again proved that depth of the tube well is in an indirect relationship with As (Kayastha, 2015).

As depicted in the results earlier the concentration of As is surpassing the permissible limit set by WHO in 98% of the sample and a little i.e. 5% of the samples are even exceeding the lenient limits set by the NEQs. This increase in ground water contamination through As is detrimental for human health. The present study also carried out Human Health Risk Assessment (HHRA). This technique helped in establishing a link between the As contamination and disease. The model that was used for this purpose was developed by USEPA. It was used to identify all possible risks posed to the locals of Lahore city from Arsenic.

The HHRA model was divided in certain steps, namely exposure dose, hazard quotient and cancer risk. In the present study the dose response relationship showed alarming values. Table 4.4 show all the values for ED which were found by estimating the health quotient (HQ). The value of ED fall within a range of 0.000501389 to 0.001328611, whereas the reference dose for arsenic is 0.0003, thereby suggesting that the exposure to As contaminated water is way too much than it should be. Intake of any substance that exceeds the permissible level could result in various health risks that can be acute or chronic depending upon its concentration, consumption rate, type and toxicity in the drinking water. Therefore, the exceeding values of exposure dose are not a good sign for the city and the locals. The results of a study conducted

in West Bengal are in agreement with the results of the current research. The study showed that increase values for ED for this kind of dose response relationship of Arsenic leads to As poisoning which ultimately leads to multiple health impacts including skin lesions, hypertension, neurological disorder, cardiovascular problems and different kinds of cancers (Yoshida et al., 2004). In case of the current research these high values of ED can be attributed to contamination from urban and industrial sewage and waste water.

Table 4.5 shows that HQ values of As in collected water samples. The HQ values for As in the underground water samples range between 1.671296296 to 4.428703704. The rule that is followed by this model is that if HQ value is greater than 1 ($HQ < 1$) then intake of such water that pose serious health risk. This study showed that just 8 localities of Lahore had a HQ value of greater than 1 rest were all ≥ 1 . A similar study was done in Rampur Diara (RD) Haldichapra (HC) of the Maner Block of the Patna District, Bihar (India). In this study, the HQ values for RD and HC were in between 12.1 to 41.6 and 58.3 to 192.5, respectively, both were crossing the permissible risk index 1. This study suggested that such high values of HQ for As are held responsible for a number of diseases that are prevalent in the localities including pigmentation, arsenicosis, diarrhea, body itching and gastric problems (Singh et al., 2012). Hence, the population of Lahore obtaining water from these WASA are under threat related to various health risks like skin disorder, neurological disorders and even some kind of cancer. Severe exposure can cause diabetes, pulmonary disease and cardio vascular ailment. This particular metalloid is also held responsible for disorders of cognitive development, intelligence and in extreme cases even memory loss (WHO fact sheet, 2017).

Therefore, the current research acts as an alarm for the authorities to do something on the increasing pollution before the situation worsen and the people suffer from all these diseases. The recorded cancer risk values for this research ranged between 0.00075208 to 0.00199292. Cancer risk values greater than 1 in a million is mostly considered as a cancer risk. However, these values get altered according to the local environment and national policies (Anwar et al., 2015). The results revealed that for now the risk of As is nothing to worry about but if the trend continues it might impact locals and spread various kinds of cancers in the population.

Lastly, the spatial distribution of arsenic was shown on a map using ArcGIS. The maps depict the areas with low, moderate and high concentration of As. This categorization was made according to the WHO and NEQs standards.

CONCLUSION

This research has provided detailed As data on the Lahore aquifers. It has shown that if we apply WHO limit of 10 ppb, 98% of our samples exceed this limit but if we apply NEQs limit of 50 ppb then only 5% samples exceed the limit. However, WHO limit is gradually being accepted world wide. EPA Punjab has also agreed to accept WHO standards on Arsenic. It is therefore concluded that in near future Lahore aquifer will be regarded as, As contaminated unfit for human consumption. In that case, providing drinking and potable water will be a big challenge for authorities.

RECOMMENDATIONS

- Regular and proper water quality monitoring set up should be arranged. Arsenic removing units should be added to Filtration plants.
- Substitute high-arsenic sources, such as ground water, with low-arsenic, microbiologically safe sources such as rain water and treated surface water.
Low-arsenic water can be used for drinking, cooking and irrigation purposes, whereas high-arsenic water can be used for other purposes such as bathing and washing clothes.
- Proper monitoring system must be installed for tube wells so that the arsenic penetration into aquifers can be checked over time.
- Awareness to the residents through seminars and meetings

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