



**PROJECT FOR INTEGRATED SOLID WASTE MANAGEMENT MASTER PLAN IN  
GUJRANWALA**

**LANDFILL WASTE BULK DENSITY SURVEY,  
GUJRANWALA**

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## 1. INTRODUCTION:

Gujranwala is an industrial city in Gujranwala District, Punjab Province of Pakistan. It is the fourth most populous metropolitan areas in Pakistan, and is one of the fastest growing cities in the world. Gujranwala is 226 meters (744 ft) above sea level. It shares borders with Ghakhar Mandi, Alipur Chatha, Kamonke and several small towns and villages. About 80 kilometers (50 miles) south is the provincial capital, Lahore, Sialkot and Gujrat lies to its north. The city has many commercial and industrial centers.

Anthropogenic activities in society generate large quantities of wastes posing a problem for their disposal. Improper disposal leads to spreading of diseases and unhygienic condition besides spoiling the aesthetics. Municipal solid waste management has emerged as one of the greatest challenges facing environmental protection agencies in Gujranwala.

Many factors including uncontrolled population, institutional weaknesses, urbanization, lack of resources lack of civic sense towards solid waste disposal have contributed to inadequate Solid Waste Management (hereinafter referred to as “SWM”) in Punjab. Gujranwala City was identified as the highest priority among the cities (Faisalabad, Gujranwala, Lahore, Multan, Rawalpindi, Sargodha and Sialkot) surveyed by the Japan International Cooperation Agency (hereinafter referred to as “JICA”) in 2009 regarding SWM.

With this background, “Integrated Solid Waste Management Master Plan in Gujranwala” is being prepared by the coordination of JICA and Government of the Punjab (hereinafter referred to as “GOPb). Several surveys and studies have been conducted under the umbrella of this project and Landfill waste bulk density Survey is one of them.

Waste Bulk Density plays a critical role in planning and designing of the final disposal plan. Data generated from bulk density studies is used for the planning and designing of the landfill and it gives us idea about the lifespan of landfill or disposal site for future years. The JICA Project Team (hereinafter referred to as “JPT”) has decided to conduct landfill waste bulk density survey for one time at Chianwali dumping site and Gondlanwala dumping site.

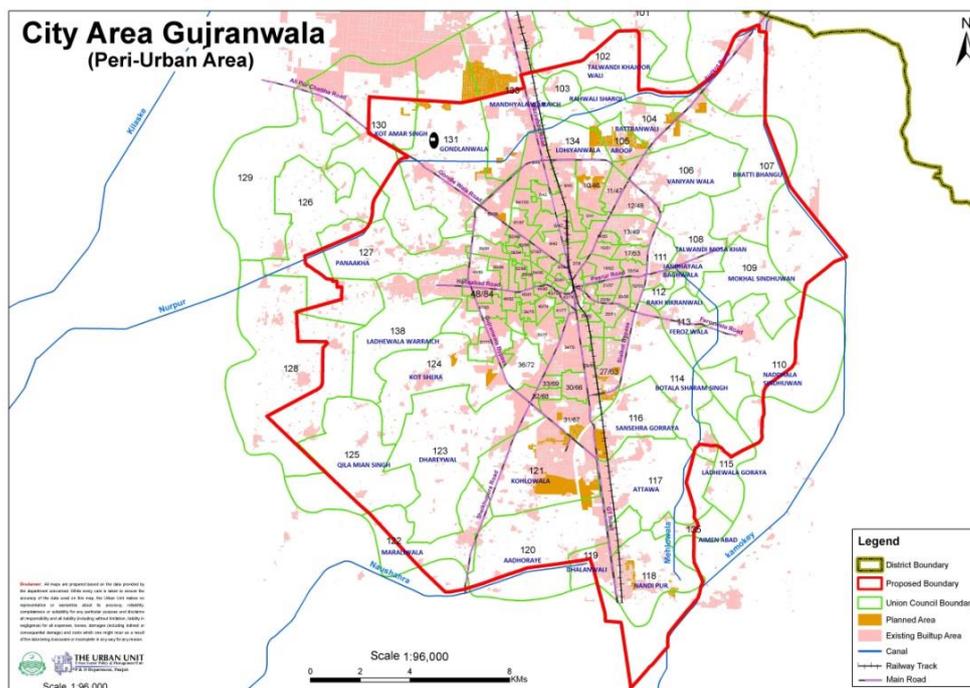


Figure 1: Map of Gujranwala

## **2. OUTLINE AND PURPOSE OF SURVEY**

### **2.2 Outline of Survey**

The “Waste bulk density survey” carried out only once for JICA Project.

### **2.3 Purpose of Survey**

The purpose of the survey is to find out the bulk density which will be used further for the Bakhraywali landfill planning. Specific objective of the survey is:

- Estimating the bulk density of the solid waste at the dumping sites, Chianwali & Gondlanwala

The results of the survey will be very beneficial parameter for planning, scheduling and designing of Municipal solid waste management infrastructure (herein referred as MSWM). Waste bulk density is an important measure used to define the capacity of waste storage and collection facilities required. Based on waste density and the capacity of trucks, the amount of waste collected can be measured in tons (weight). The high density measured reflects the less effectiveness of compaction vehicles for waste transportation. The parameter is affected by many factors such as seasonal variation and the way that waste is put into containers.

## **3. SURVEY METHOD**

### **3.1 Survey Team**

Survey was conducted by Arkham Wahid, Research Assistant deputed by the team leader for this survey.

### **3.2 Survey Period**

The field survey was carried out on February 10, 2015.

### **3.3 Survey Location**

Sampling locations were Chianwali and Gondlanwala disposal sites. Three boreholes each were excavated at Chianwali and Gondlanwala disposal sites for sampling of filled waste volume and weight. Six samples were taken in total. Figure 2 and Figure 3 show location of Chianwali and Gondlanwala disposal sites.



Figure 2: Chianwali Disposal Site

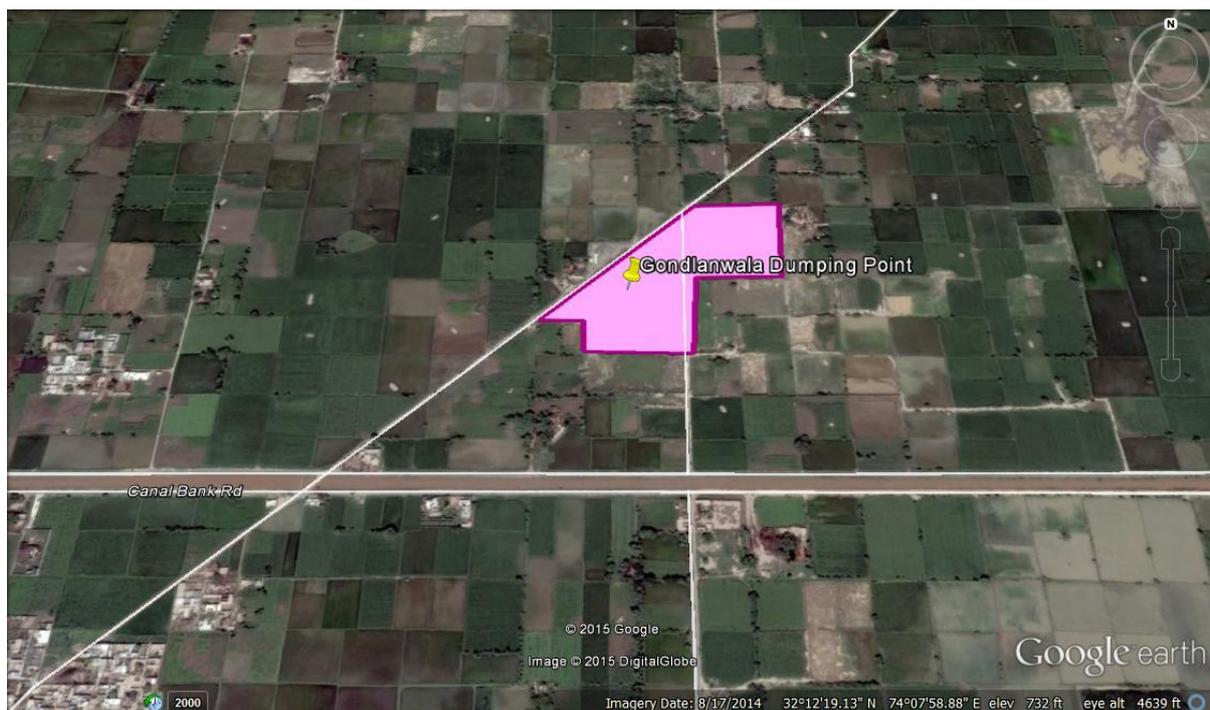


Figure 3: Gondalawala Disposal Site

### 3.4 Survey Method

The sample of the filled waste is taken by an excavator. The size of the pit is 1.0-2.0 meter (approximately) rectangular and 1.0-2.0 meter deep approximately. After excavation of the pit, the actual size of borehole is measured and calculated the volume of the borehole specimen. The excavated sample is loaded to the tractor trolleys for hauling to the weighbridge in Gondlanwala for measuring the net weight of the excavated sample waste. The Bulk Density is computed by division of

the weight by the volume of each sample and then the average bulk density for both sites will be calculated.

## 4. DATA PROCESSING AND RESULT OF SURVEY

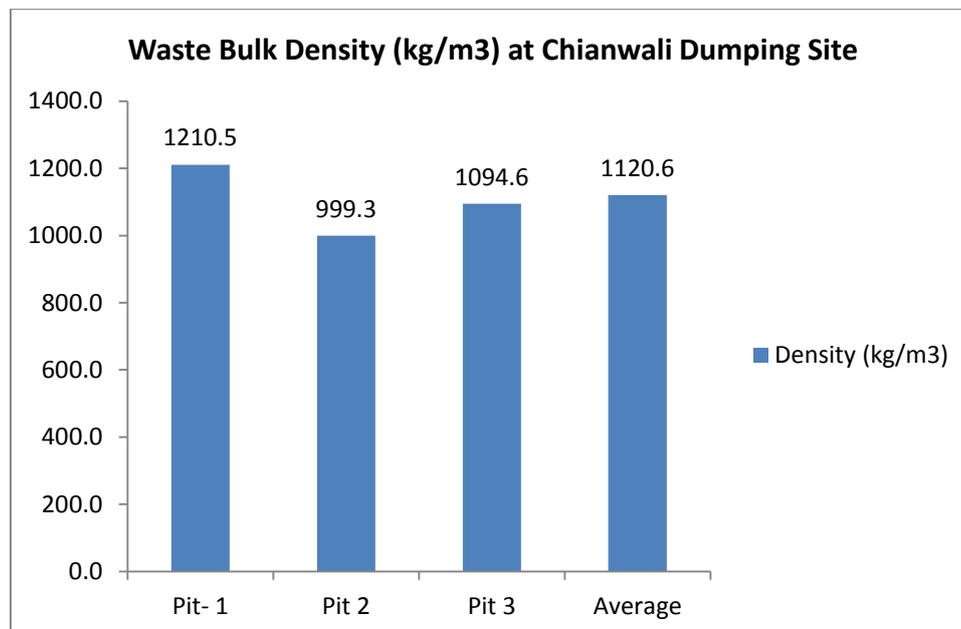
### 4.2 Chianwali Dumping Site:

Three pits were excavated at the Chianwali dumping site through excavator. Excavated waste is loaded on a tractor trolley and weighed at the Gondlanwala weigh bridge. The dimensions of the excavated pit and weight of waste from each pit is shown in Table No 1. The volume of Pit 1 is 4.03 m<sup>3</sup>, volume of Pit 2 is 2.20 m<sup>3</sup> and of Pit 3 is 3.69 m<sup>3</sup>.

**Table 1: Bulk Density at Chianwali Dumping Site**

Landfill Waste Bulk Density				
Particulars	Chianwali			
	Pit- 1	Pit 2	Pit 3	Average
Length (m)	2	1.85	1.9	1.92
Width (m)	1.88	1.13	1.85	1.62
Depth (m)	1.08	1.05	1.05	1.06
Volume (m <sup>3</sup> )	4.03	2.20	3.69	3.31
Waste Amount (kg)	4880	2200	4040	3706.67
Density (kg/m <sup>3</sup> )	1210.5	999.3	1094.6	1120.6

Figure 4 show that density of Pit 1 is 1210.5 kg/m<sup>3</sup>, Pit 2 is 999.3 kg/m<sup>3</sup> and Pit 3 is 1094 kg/m<sup>3</sup>, Average of which is 1120 kg/m<sup>3</sup>. Density of Pit 1 is higher as compared to other 2 pits.



**Figure 4: Bulk density at Chianwali**

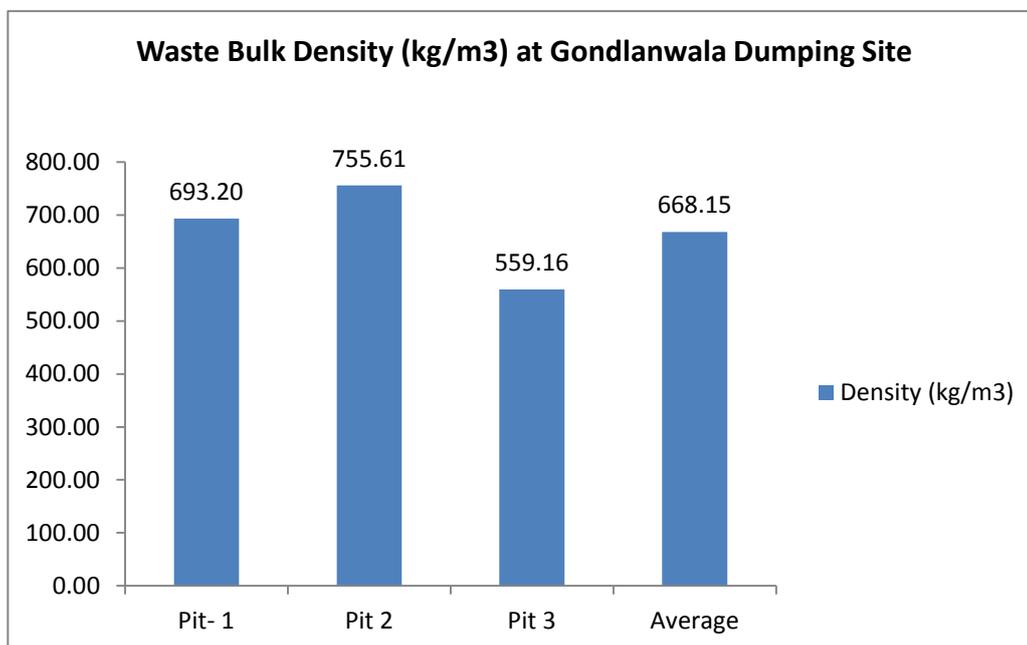
### 4.3 Gondlanwala Dumping Site:

Bulk density of solid waste samples collected at Gondlanwala disposal site seems lesser as that of Chianwali disposal site. Dimensions of pits excavated are shown in Table 2 below.

**Table 2: Bulk Density at Gondlanwala Dumping Site**

Landfill Waste Bulk Density				
Particulars	Gondlanwala			
	Pit- 1	Pit 2	Pit 3	Average
Length (m)	2.15	2.02	2.25	2.14
Width (m)	2.13	2.1	2.025	2.09
Depth (m)	0.975	1.15	1.08	1.07
Volume (m <sup>3</sup> )	4.47	4.87	4.94	4.76
Waste Amount (kg)	3100	3680	2760	3180
Density (kg/m <sup>3</sup> )	693.20	755.61	559.16	668.15

Figure 5 show that the value of bulk density is ranging from 559 – 755 kg/L with an average value of 668.15 Kg/L, lesser than that of Chianwali .Pit 2 has high density as compared to other 2 pits.



**Figure 5: Bulk density at Gondlanwala**

## 5. EVALUATION OF SURVEY RESULTS

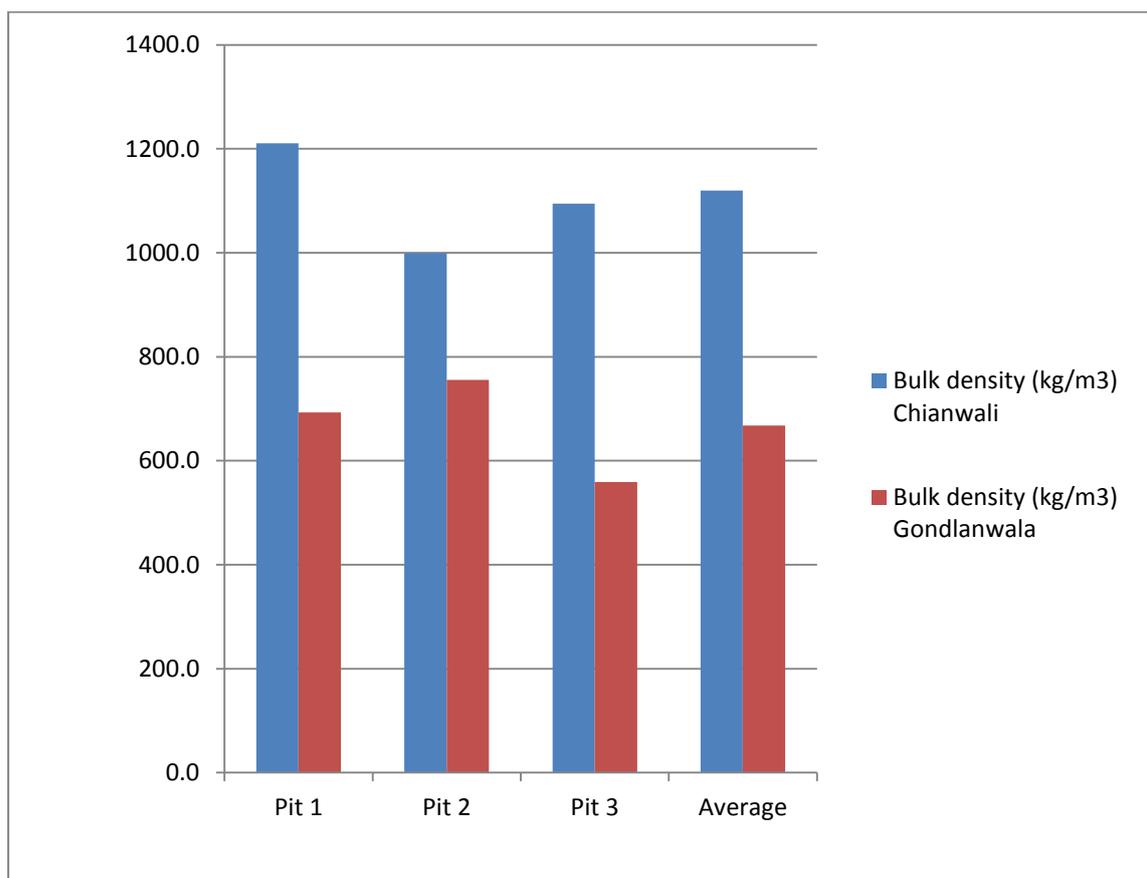
The survey data is evaluated for both Chianwali and Gondlanwala Site.

Table 3 shows the comparison of Bulk density of both sites. Bulk density at Chianwali is higher than bulk density at Gondlanwala.

**Table 3: Comparison of bulk density at Chianwali and Gondlanwala**

Sr. No.	Sample	Bulk density (kg/m <sup>3</sup> )		Volume (m <sup>3</sup> )		Waste Amount (kg)	
		Chianwali	Gondlanwala	Chianwali	Gondlanwala	Chianwali	Gondlanwala
1	Pit 1	1210.5	693.2	4.03	4.47	4880	3100
2	Pit 2	999.3	755.61	2.2	4.87	2200	3680
3	Pit 3	1094.6	559.16	3.69	4.94	4040	2760
	Average	1120.6	668.15	3.31	4.76	3706.2	3180

Figure 6 shows that bulk density of Chianwali is greater than that of Gondlanwala disposal site. Similarly the weight of waste samples excavated at Chianwali is more than Gondlanwala samples excavated.



**Figure 6: Comparison of bulk density at Chianwali and Gondlanwala**

By this bulk density we can find out the life span of the Gondlanwala dumping site. Density indicates that waste is disposed without compaction, therefore reducing the disposal site life.

Table 4 shows that Gondlanwala dumping site will be closed after 445 days.

**Table 4: Life span of Gondlanwala Disposal Site**

<b>Ideal Dumping Capacity of Gondlanwala</b>					
Density(kg/m <sup>3</sup> )	Area(m <sup>2</sup> )	Depth(m)	Waste Generation(tons/day)	Dumping Capacity(tons)	Ideal life time(days)
668	47,000	8.5	800	26,6866	333
<b>Expected life time of Gondlanwala according to daily Operations</b>					
Density(kg/m <sup>3</sup> )	Area(m <sup>2</sup> )	Depth(m)	Daily waste Collection(tons/day)	Dumping Capacity(tons)	Expected Life(days)
668	47,000	8.5	600	26,6866	444

## 6. CONCLUSION AND RECOMMENDATIONS

The results of this survey revealed that Chianwali waste is comparatively compressed as compared to Gondlanwala waste. Chianwali was operational in 2008 and was closed in 2014. Whereas Gondlanwala was operational in 2014.

Average Bulk Density at Chianwali (1120.6 kg/m<sup>3</sup>) > Average Bulk density at Gondlanwala (668.15 kg/m<sup>3</sup>).

Possible reason can be Biological degradation of organic matter in Chianwali as compared to Gondlanwala disposal site.

For planning, scheduling and designing of the Bakhraywali landfill site it is recommended that collection vehicles with compactors should be used for the collection of solid waste hence increasing the life span of the site.

1000 kg/m<sup>3</sup> density should be used for planning of Bakhraywali landfill site keeping in consideration the bulk density of Chianwali (1120.6 kg/m<sup>3</sup>) and Gondlanwala disposal site (668.15 kg/m<sup>3</sup>).