BE CIVIL ENGINEERING
PROJECT REPORT

WATER CONSUMPTION AND CONSERVATION MEASURES IN PROFESSIONAL CAR WASH INDUSTRY FOR THE DESIGN OF CAR WASH IN RISALPUR CANTT

Project submitted in partial fulfilment of the requirements for the degree of BE Civil Engineering

PROJECT ADVISOR
Lec Ahmad Hanan

SUBMITTED BY

281192	BSM Muhammad Zoun O Rain (Syndicate Leader)
281194	GC Ismail
281184	GC Abdullah Shameer
281214	GC Ahmed Ali Nasir
281187	GC Afaq Ahmed Qureshi

MILITARY COLLEGE OF ENGINEERING (MCE)

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This is to certify that the

BE Civil Engineering Project entitled

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GC Ismail	**CMS-281194**
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GC Ahmed Ali Nadir	**CMS-281214**
GC Afaq Ahmed Qureshi	**CMS-281187**

Has been accepted towards the partial fulfilment of the requirement for

BE Civil Engineering Degree

Lec Ahmad Hanan

Syndicate Advisor

Department of Water Resources,

Military College of Engineering, Risalpur

National University of Sciences and Technology (NUST), Islamabad

This research work is dedicated to

Our beloved Parents and Teachers, who have been a source of inspiration for us.

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Members of our syndicate owe a debt of gratitude to their loving parents, who guided us through every tribulation of life and sacrificed all of their comforts for our bright future. This is also a homage to our instructors, who inspired us to face challenges with inventiveness and fearlessness, and who helped us become the people we are today, Alhamdulillah.

Finally, we want to express our gratitude to our family and friends for their prayers, which enabled us to complete this assignment.

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List of Abbreviations

OSHA	The Occupational Safety and Health Administration
DI	De-Ionization Process
RO	Reverse Osmosis Process
P/R	Product/Reject ratio
PLCs	Programmable Logic Controller
AFPGMI	Armed Forces Post Graduate Medical Institute
gpm	Gallons per minute
gpv	Gallons per vehicle
gpd	Gallons per day
psi	Pounds per square inch

Abstract

The use of water in professional vehicle washes is a particularly striking illustration of the application of water in a professional process. This research was carried out so that an inquiry could be carried out on the amount of water that is used by vehicle washes as well as the quality of the effluent that is produced by them.

The second section presents the findings about the quality of both the wastewater and the solid garbage that was collected.

The goal of this research is to integrate information from studies done at specific sites in Lahore, Peshawar, and Islamabad in order to see if climatic variances in different regions have a substantial influence on water consumption or water loss owing to variations in evaporation and carryout. This report will then provide comparison and commentary on that information. In addition, the data obtained was utilised in the design of the car wash located in Risalpur Cantt.

When regulators are confronted with the necessity to apply water conservation or drought limitations, the data supplied can be used to estimate the contribution to water consumption reductions that professional car washes can effectively undertake. This is achievable since the data shows how much water can be saved at professional vehicle washes by using less water.

CHAPTER 1

1 INTRODUCTION

1.1 Background

Water usage in professional car washes is a very apparent example of water usage in a professional procedure. As a result, the public and government scrutinize it, particularly during times of drought or water scarcity.

Water consumption includes not only the vehicle wash procedure but also landscape and, in certain professional full-service car washes, domestic water usage. Conservation and reclaim can thus be practiced in all three of these aspects of a professional vehicle wash operation. Operators are driven to install conservation measures at their locations for water and sewer cost, environmental duty, and/or regulation. Each type of professional car wash has unique characteristics that influence potential conservation measures, as well as universal measures that can be adopted regardless of the type of professional car wash.

This report was compiled to carry out an investigation into the water consumption of vehicle washes and the quantity of the wastewater reclaimed by them. The first part of this article takes a look at how much water is wasted owing to evaporation and carryout. The findings on the quantity of the wastewater reclaimed are presented in the second part and the third part is the design of a car wash based on this data.

The prior studies discovered that the most readily accessible data on water use came largely from the specifications provided by manufacturers, with very little or no data coming from field surveys. This study was based on data collected in the field. This report's purpose is to combine information that was received from the work that was undertaken at particular locations in Lahore, Peshawar and Islamabad to provide comparison and commentary on that information in order to investigate whether climatic variations in various regions have a substantial effect on water consumption or water loss owing to variations in evaporation and carryout.

When faced with the need to implement water conservation or drought restrictions, regulators can use the data presented to determine the contribution to water use cutbacks that can be successfully implemented by professional car washes. This is especially helpful in situations where water conservation or drought restrictions are required. Calculations for sewage rates based on a proportion of the amount of fresh water utilised might benefit from its usage in this context as well. The findings of the study may be utilized to calculate the relative amount of water that can be saved by putting in place and maintaining a water reclamation system using the information that has been supplied.

1.2 Problem Statement

Over the previous ten years, the number of cars on the road has climbed considerably. Pakistan had 2.3 million licensed private automobiles and vans in 1998. This number had nearly tenfold increased to 19.7 million in 2007. Due to the accumulation of dirt and debris on vehicles, as the number of on-road cars grows, so does the requirement to maintain and clean them. It has an impact on the vehicle's appearance as well as its performance. Individuals are concerned not only with maintaining the appearance and shine of their automobiles, but also with implementing measures to increase the efficiency of dirt-affected vehicles.

The research gathered information that pertained to these three fundamental questions: the quantity of water that was used per vehicle, the amount of water that was lost due to evaporation and carryout, and the possible water-saving methods that included reclamation and lastly highlights of how a car wash can be designed.

1.3 Project Objective

The primary objective of this research is:

- Calculate the average amount of water used per car cleaned.
- To figure out how much fresh water is used and how much wastewater is released by professional in-bay automatic car washes, self-serve car washes, and conveyor car washes.
- To employ reclamation systems in order to save water.
- To research and design for a car wash service centre in Risalpur Cantt that is efficient in terms of delivering the needed number of spaces, pressure, requirement and flow.

1.4 Scope

This study brings together data from previous studies and industry publications to help advance the conservation around water and its reclamation;

- Defining several crucial words in professional car wash conservation and reclamation.
- Describing the prospects for water saving and utilization in professional vehicle washes.
- Dividing the essential components of different water reclamation systems into distinct processes.
- Explaining professional car washes ability to respond to drought.
- Examining the pros and cons of retrofitting existing commercial vehicle washes with reclaim.
- Looking at examples of industry/utility collaboration in the field to enhance water conservation.

CHAPTER 2

2 LITERATURE REVIEW

2.1 Car Wash Service Center

A building facility that is constructed exclusively to be for automobile wash and where a number of options are available at the customer's service is known as a car wash or an auto wash service centre. Other names for this type of facility are car wash and auto wash service centre. It is a facility that is used to clean the exterior of motor cars, as well as the interior of the vehicles in some instances. There are three different types of car washes: self-service, full-service, and fully automated. (Lee, 2021)

2.2 Classification of Car Washes and Types of Water Processes

There are no industry-wide water flow requirements. The professional car wash sector receives equipment from a large number of different manufacturers, which results in a certain amount of variation in the amount of water used. The most common kinds of car washes fall into one of these three major categories: conveyor, in-bay automated, and self-service. (Söderlundh, Svensson, & Mårtensson, 2010)

- Conveyor automatic car wash
- Self-service car wash
- In-bay automatic car wash

2.2.1 Conveyor Automatic Car Wash

According to an individual's requirements, conveyor automated vehicle washes come in two varieties:

- Full-service
- Exterior only

While the customer waits outside the vehicle for the wash to be completed, the professional full-service wash will clean both the inside and outside of the vehicle. The professional exterior-only wash requires the driver to remain in the vehicle while it is being cleaned from the outside. During any of these car washing processes, the vehicle is moved down a conveyor belt.

In addition to the categorization that is based on the quality of service, there are also two primary technologies that are utilized during the wash cycle. These technologies include friction and frictionless. In order to provide a touch less wash, the frictionless conveyor utilizes high-pressure nozzles whereas the friction conveyor makes use of brushes, various types of material, or curtains formed of strips of fabric. (Lalluwadia, Bhatia, & Rana, 2017)

Figure 2.1 Conveyor Automatic Car Wash

2.2.1.1 Full-Service Car Wash

The other vehicle washes can't compare to how thorough this one is. In addition to the interior of the vehicle being vacuumed, the exterior of the vehicle will be cleaned, as will the inside of the windows. This will be completed in a timely manner while the client relaxes in the spacious waiting area.

2.2.1.2 Exterior Car Wash

This kind of car wash often makes use of a car wash tunnel, which washes, polishes, and dries the outside of your vehicle all at the same time. It makes use of the same fundamental equipment as is utilized in a full service car wash, but it does not clean the inside windows or vacuum the interior. It takes on average fewer than five minutes to complete this process, which is both a quick and convenient method of shielding the automobile from the weather. The consumer does not have to exit their car during this kind of wash.

2.2.2 Self-Service Car Wash

There are car washes that allow customers to wash their own vehicles, sometimes known as do-it-yourself car washes, and there are also labours which are present specifically for the purpose of washing a customer's vehicle. Using the wands and brushes provided at these car washes, one is able to clean their vehicle using materials of a superior grade. (Meuter & Bitner, 1998)

Figure 2.2 Self – Serve Car Wash

2.2.3 In-Bay Automatic Car Wash

This is a reference to touch less vehicle washes, which are typically located in conjunction with convenience stores and petrol stations. At a touch less in-bay automatic car wash, the customer drives their vehicle into a bay and follows the instructions that are displayed on lighted signs. The equipment then cleans your vehicle by going around it and spraying it with high-pressure water streams and detergents that have been carefully balanced. The time required for this ever-more-popular service to wash cars is around 5 minutes. (Janik & Kupiec, 2007)

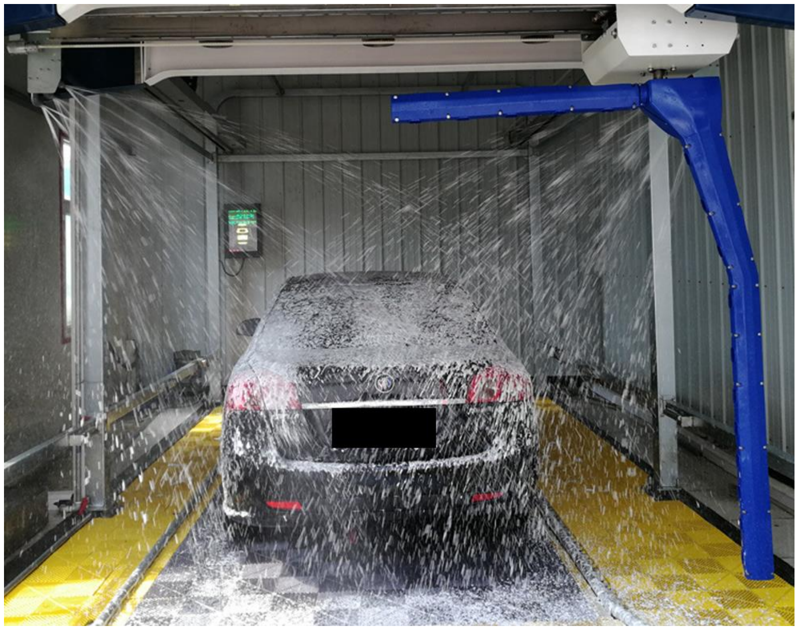


Figure 2.3 In - Bay Automatic Car Wash

2.3 Building Codes and Car Wash Service Centres

The following standards must be met by all vehicle washes, including those that are operated manually, those that are automated and those that offer complete service:

- The wash rack and any other enclosed work space must be constructed and arranged in such a way that their entrances, exits, and openings do not face any property located in a residential zone, must have adequate screening, and must have noise buffering from the residential zone in order to comply with the regulations (s).
- Each development site may have no more than one driveway leading to any given roadway, unless the Director authorizes an exception from this requirement.

- Servicing of motor vehicles, including but not limited to cleaning, polishing, and the dispensing of fuel and oil, shall not be allowed unless the facility also satisfies all of the requirements for a vehicle repair garage. Exceptions to this rule include car washes and car washes that are open to the public.
- At full-service car washes, the water used for washing and rinsing vehicles must be completely recovered and reused. It is permissible to use more water that has not been recycled if doing so is essential to make up for evaporation losses or other incidental or unavoidable water losses.
- The water that is used for washing activities must be contained on the premises and may not spill over any public sidewalks.
- It is required that public bathrooms be supplied, as well as that automated car washes be allowed as accessory uses to automotive service stations, and that they be positioned no closer than fifty feet from a residential zone, unless the Director approves a different distance. (Stabler, 1987)

2.4 Car Wash Service Centre Regulations

The Occupational Safety and Health Administration (OSHA) has established requirements to guarantee that workers at car wash facilities can do their jobs in an environment that is secure and well-maintained. Auditing the workplace in the appropriate manner is necessary for ensuring worker safety. Pay attention to the following areas:

- **Conditions that make the floor slippery:** An accumulation of soap, wax, and other chemicals on the floor might put workers at risk of slipping and falling.
- **Impaired lines of sight:** The wrong positioning of the equipment can make it difficult for employees to see, which can lead to accidents with automobiles or other pieces of equipment. This can also lead to injuries to employees.
- **Electrical dangers:** It should go without saying that water and exposed wires or electrical fixtures that have been illegally placed by an electrician do not mix, and that this creates a very dangerous situation for the people working for you.
- **Personal protection equipment:** Employers are obligated to provide their employees with protective gear such as gloves, masks, or goggles if their employees are exposed to conditions that might irritate their skin, eyes, nose, or other parts of their body.
- **Hazardous communication and training:** Employers have a responsibility to teach and inform their workers about the substances that they use.
- **First Aid:** Appropriate first aid procedures should always be on hand and brought up to date.
- **Ensure Adequate Ventilation:** One should ensure that their vehicle wash facility has adequate ventilation in order to eliminate engine exhaust from the air. In the event that this cannot be accomplished, employers are obligated to supply their staff members with respirators.
- **Lockout/Tag out:** Employers are required to repair, replace, and maintain equipment in order to keep a safe working environment for their employees. (PÎSLARU, LEON, & VÎLCU)

2.5 Standards for Car Wash Service Centres

- **Ramp Break Over Angle:** Measure ability of the car to break over the steep ramp either climbing or descending without scrapping (Min 10%).
- **Angle of Departure:** Min 10° to reduce incident of tailpipe and rear bumping dragging.
- **Angle of Approaches:** Min 15°.
- **Ramp Slopes:** Max 15%.
- **Ramp Width:** One way straight ramp-min 12 feet.
- **Ramp Turn Super Elevation:** ½ inch/foot of ramp width at sharpest turning.
- **Fee Collection:** Fixed or variable charged pay. (Asha et al., 2016)

2.6 Criteria for Quality Car Wash Service Centre

There is a certain benchmark for car wash service centres so as to insure general building quality. These may include:

- Clear visibility
- Integration into the context of town planning
- Good natural lighting and ventilation
- Low maintenance
- Personal safety
- Simple layouts
- Ease of entry and exit (Zaneti, Etchepare, & Rubio, 2013)

2.7 Steps in a Professional Car Wash Process

a. **Pre-soak**:

A spray gun with an automated nozzle or a hand-held spray gun is used for the pre-soak step. Not to be found in every single vehicle wash.

b. **Wash:**

The material may be washed with a high-pressure spray or a towel soaked in solution of detergent.

c. **Rocker panel / undercarriage**:

Fabric or high-pressure sprays were sprayed to the vehicle's sides and bottom, respectively. These can be controlled by separate arms or carriages that spray upward from under or behind the vehicle in a conveyor system.

d. **First Rinse:**

The first rinsing is done with water under high pressure.

e. **Wax and Sealers**:

Wax, sealers, and polishes are all examples of surface finishes that may be sprayed on a vehicle.

f. **Final Rinse:**

The vehicle is next subjected to a final rinse, which consists of a low-pressure spraying of fresh or membrane-filtered/deionized water.

g. **Air Blowers:**

These devices blast air over the car to eliminate water and help it dry faster. (El-Ashtoukhy, Amin, & Fouad, 2015)

2.8 Water Resource Utilization

Audits were performed at each of the research locations to determine the amount of water utilized during each cycle as well as the total gallons of water used per car for each of the different types of washes. A large majority of previous research relied on consumption estimates based on manufacturer specifications. Based on field research, this study makes a comparison of the amount of water used across different types of car washes and regions. (Zou & Cong, 2021)

2.9 Carryout and Evaporation of the Liquid

Data was gathered to calculate the quantity of water that was lost due to evaporation and carryout. Carryout refers to the water that remains on the vehicle after it has been cleaned at the car wash as well as the water that is expelled from the bay by the wind.

Location, local climate, wind orientation, bay size, water pressure, and the size and orientation of the nozzle are all factors that impact evaporation and carryout losses. Evaporation and carryout both contribute to the loss of water, which in turn lowers the amount of wastewater that is discharged from the plant. This is significant in areas where the cost of sewage service is determined by a figure that reflects the proportion of freshwater that is recycled back into the system for treatment.

In this study, real return flows were measured against freshwater intakes over a complete week for each studied location. The researchers compared the two sets of data to calculate evaporation and carryout losses. (Zhakhovskii & Anisimov, 1997)

2.10 Preservation and Reclamation of Land

The water audits that were carried out at each location uncovered a variety of possible water conservation methods. Adjustments made to the nozzle size, water pressure, and the detection and correction of leaks have allowed operators of car washes to minimize the amount of water used per vehicle cleaned. Audits were conducted at each location, and the results indicated prospective conservation measures as well as providing economic statistics for operators contemplating the installation of such measures.

The potential for water saving offered by water reclaim was studied by comparing the levels of water consumption at locations that only used freshwater to those at locations that had water reclaim systems that were both operational and installed. (Weng et al., 2015)

2.11 Deionization and Reverse Osmosis

As a result of the presence of dissolved contaminants in the water supply, several car washes now provide spot-free rinsing options for their customers. De-ionization and reverse osmosis are two processes that may be used to remove minerals and other ions that have been dissolved.

De-ionization (DI) is a process that includes passing water through beds of cations and anions that bind the dissolved ions and produce filtered water as a by-product. Pressure is used to force water that is full of solutes through a semi-permeable membrane in the reverse osmosis process (RO). Pure water is created on the side of the membrane that is responsible for giving the spot-free rinse. Brine or "reject" water is dumped on the other side of the membrane. The RO unit's reject water can be recycled in a closed loop system by returning to the wash reclamation system, or it can be used for landscaping or other non-potable applications within the professional car wash.

In-bay and self-service vehicle washes are more likely to have spot-free rinses than full-service conveyor car washes, since full-service washes use towel drying, which reduces the need for spot-free water. (Qin et al., 2019)

CHAPTER 3

3 RESEARCH METHODOLOGY

3.1 General

An audit was undertaken at each car wash station, and one week's worth of freshwater and effluent flows were gathered in the same manner. Extra measurements were taken where necessary. In conveyor carwashes, washing machine loads were analysed and accounted for in water use per vehicle, evaporation, and carryout. This reduced water waste. Following sections detail data collection and analysis procedures.

3.2 Meters

Water metering is the practice of measuring water use. Water meters measure the volume of water flow. Understanding how your water meters work can help you detect leaks, save water, and lower your water bill.

3.2.1 Municipal Meter

The water meter measuring the water consumption is normally situated in a small chamber on the pavement outside your property. On the monthly bill, the water usage is indicated.

3.2.2 Master Meter

Master metering involves measuring the water or usage of multiple tenants with the same meter.

3.2.3 Manhole Meter

Flow metering manholes, also known as packaged metering manholes are used to measure open channel flow and the type of flow that you are attempting to measure will influence the primary device that is installed in your manhole.

3.2.4 Positive Displacement Meter

A positive displacement meter is a type of flow meter that requires fluid to mechanically displace components in the meter in order for flow measurement. Positive displacement flow meters measure the volumetric flow rate of a moving fluid or gas by dividing the media into fixed, metered volumes.

3.2.5 Paddle Wheel Motor

Paddlewheel flowmeters measure the velocity of liquids in pipes, such as chemicals, water and liquids. High accuracy is attainable if carefully installed. These flowmeters are measuring flow at the edge of the flow profile and thus are affected by viscosity changes.

3.3 Audits of the Water

The purpose behind the selection of the sites was to get an accurate measurement of both the inflow and the outflow. It was determined which of the plumbings at the car wash shared the water supply meter with the rest of the facility, and all operations at the car wash were halted, if at all feasible, while the meter was being read. In the event that the water supply could not be turned off, water usage was also measured as part of the audit.

All ancillary operations, such as towel washing and housekeeping, were audited. Some car washes employed a dedicated meter on the freshwater supply line. This was done when the car wash piping was easily accessible and distinguishable from other plumbing. Because the car wash's major supply pipe was typically run through a wall or under a floor, installing specialized meters at all places was often impractical.

3.4 Measurement of Flow Rates per Cycle

Flow rate and cycle length were timed. To do this for conveyers, each component's wash water must be determined. In-bay automatic vehicle wash needed monitoring nozzle flow rates during different cycles, checking each cycle's water pressure, shutting off all water uses in a car wash, driving multiple cars through it and measuring overall flow through the master meter or a dedicated meter for each vehicle were also used to analyse each vehicle's water consumption. The audit determined cycle flow rates and durations for reclamation vehicle washes.

In self-service operations, water consumption flow rates per cycle can be defined, but the length is controlled by customer selections to switch from a soap cycle to a rinse cycle. The examination included monitoring cycle flow rates. The total flow measured by the meter was compared to the time consumers paid to create a gallons-per-minute flow rate. This determined the average flow rate over time (gpm).

Stop watches measured how long people used the equipment in two locations. Using this data, the average number of Self Service car usage was calculated. The average time needed for each self-service wash was then multiplied by the gpm flow rate to establish how much water was needed. During an audit of one location, it was discovered that some customers drove through the car wash without using the equipment. Instead of traffic counts, researchers used this strategy.

3.5 Measurement of Reject Water

Reject water from reverse osmosis car washes is quantified and added back to the wash water. Reverse osmosis includes forcing water through a membrane such that only pure water is left on the filtered side and the remainder salty water is transferred to the sewage system. The phrase "product" refers to filtered water, whereas "reject" or "brine" refers to saltier water. The P/R Ratio and its impact on water usage were studied.

3.6 Evaporation of Water and Carry Out

The quantity of evaporation and carryout was estimated by comparing the freshwater entering the vehicle wash with the amount released into the sanitary sewage system. The assessment considered a facility's known water demands. On certain sites, family water use and car wash water consumption shared the same meter, but car wash sewage was recorded separately from toilet sewage.

Ongoing sewage flow measurement may be difficult and expensive. Suspended contaminants complicate vehicle washing. A permanent flume may be possible, but the benefit seldom justifies modifying an existing plumbing system. Temporary water meters were necessary at car washes to detect evaporation and runoff. These measurements needed room for the meter installation.

3.7 Waste Water Metering

Few car washes with low flow rates use positive displacement meters, while some have paddle wheel meters. Both were used to measure wastewater. The last manhole featured meters to measure sewage flow. To reduce flow turbulence, metre components were put into a straight pipe. At the end of each assembly, a 45-degree fitting was placed so the meter would receive the full pipe flow. During metering, this design facilitated traffic flow.

3.8 Audit of Meter Readings

At each location, meter readings were monitored for a week. Each car wash's owner provided vehicle counts. In-bay and conveyor car washes employed PLCs to track vehicle wash numbers (PLCs). During the weekly metering period, the number of automobiles cleaned, water consumption, and effluent released at each station were monitored. These counts and the amount of freshwater consumed during the metering period and by each vehicle were compared to audit results.

3.9 Obstacles

Self-service car washes were a unique hurdle. Because the controllers only measure the number of minutes utilized and not the number of vehicles cleaned. To count the cars and construct a link between the time spent washing cars and the amount of water utilised for each vehicle, an additional approach was required.

In Islamabad, we counted traffic; in Lahore, we looked about. Customers utilising a self-service vehicle wash in Lahore were seen driving through the bays without paying a wash, according to a study. A visual survey and timer produced the most accurate results for estimating the time and water needed to wash an automobile. On a Saturday, two technicians sat away from the bays at two busy sites and recorded start and end timings for each wash for 5.25 hours. Before and after the survey, water meter readings were taken. The number of vehicles washed in Lahore and Peshawar was obtained by dividing the average time needed to perform a single wash by the total number of minutes the car wash was open during the monitoring period.

3.10 Analysis of Variance

Variation in a number of water-related parameters was investigated. Water consumption, evaporation and carryout rates by kind of professional vehicle wash as well as freshwater use by reclaim and non-reclaim car washes were studied in different regions. These variables were assessed in the study.

3.11 Sites

The numerous researched sites were classed by location, kind, and number. They are:

- A location in Lahore will be denoted by the letter L
- A location in Peshawar with P
- A location in Islamabad with I.

The second identifier is the site type, which can be represented as following:

- C for Conveyor Automatic Car Wash
- I for In-Bay Car Wash
- S for Self-serve Car Wash

After that, random numbers were assigned to the individual sites in each location and kind, and the final designation follows the format LC1 to LC4, PI1 to PI4, IS1 to IS3, etc. for the 32 studied SITES. This section summarizes each location's research.

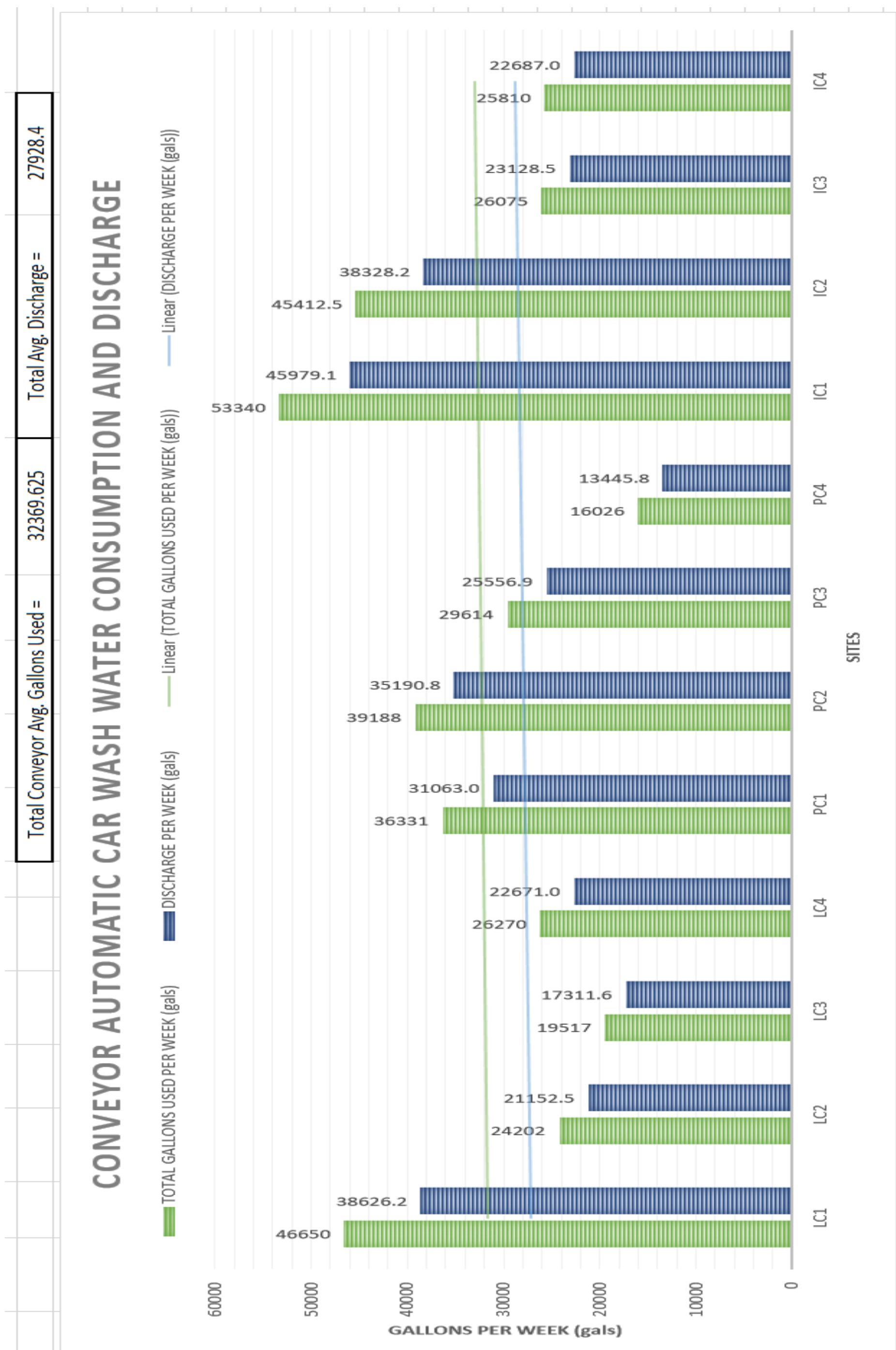
3.11.1 Conveyor Automatic Car Wash Data and Graph

LAHORE - CONVEYOR AUTOMATIC CAR WASH								
	FRESH WATER CONSUMPTION (gpv)							
SITE	SMALL CAR	LARGE CAR	NO. OF CARS PER WEEK	TOTAL GALLONS USED PER WEEK (gals)	Avg. Gallons Used	DISCHARGE PER WEEK (gals)	Avg. Gallons Used	LOSSES (%)
LC1	21.3	40.9	1500	46650	29159.75	38626.2	24940.3	17.2
LC2	24.5	37.4	782	24202	29159.75	21152.5	24940.3	12.6
LC3	25	33	673	19517	29159.75	17311.6	24940.3	11.3
LC4	30	41	740	26270	29159.75	22671.0	24940.3	13.7

PESHAWAR - CONVEYOR AUTOMATIC CAR WASH								
	FRESH WATER CONSUMPTION (gpv)							
SITE	SMALL CAR	LARGE CAR	NO. OF CARS PER WEEK	TOTAL GALLONS USED PER WEEK (gals)	Avg. Gallons Used	DISCHARGE PER WEEK (gals)	Avg. Discharge	LOSSES (%)
PC1	26	34.3	1205	36331	30289.75	31063.0	26314.1	14.5
PC2	26	31	1375	39188	30289.75	35190.8	26314.1	10.2
PC3	21	31	1139	29614	30289.75	25556.9	26314.1	13.7
PC4	21.6	33	587	16026	30289.75	13445.8	26314.1	16.1

ISLAMABAD - CONVEYOR AUTOMATIC CAR WASH								
	FRESH WATER CONSUMPTION (gpv)							
SITE	SMALL CAR	LARGE CAR	NO. OF CARS PER WEEK	TOTAL GALLONS USED PER WEEK (gals)	Avg. Gallons Used	DISCHARGE PER WEEK (gals)	Avg. Discharge	LOSSES (%)
IC1	22.4	28.4	2100	53340	37659.375	45979.1	32530.7	13.8
IC2	31	44	1211	45412.5	37659.375	38328.2	32530.7	15.6
IC3	34	51	590	26075	37659.375	23128.5	32530.7	11.3
IC4	36	53	580	25810	37659.375	22687.0	32530.7	12.1

Table 3.1 Conveyor Automatic Car Wash Data Collected on Site



Graph 3.1 Conveyor Automatic Car Wash Water Consumption and Discharge

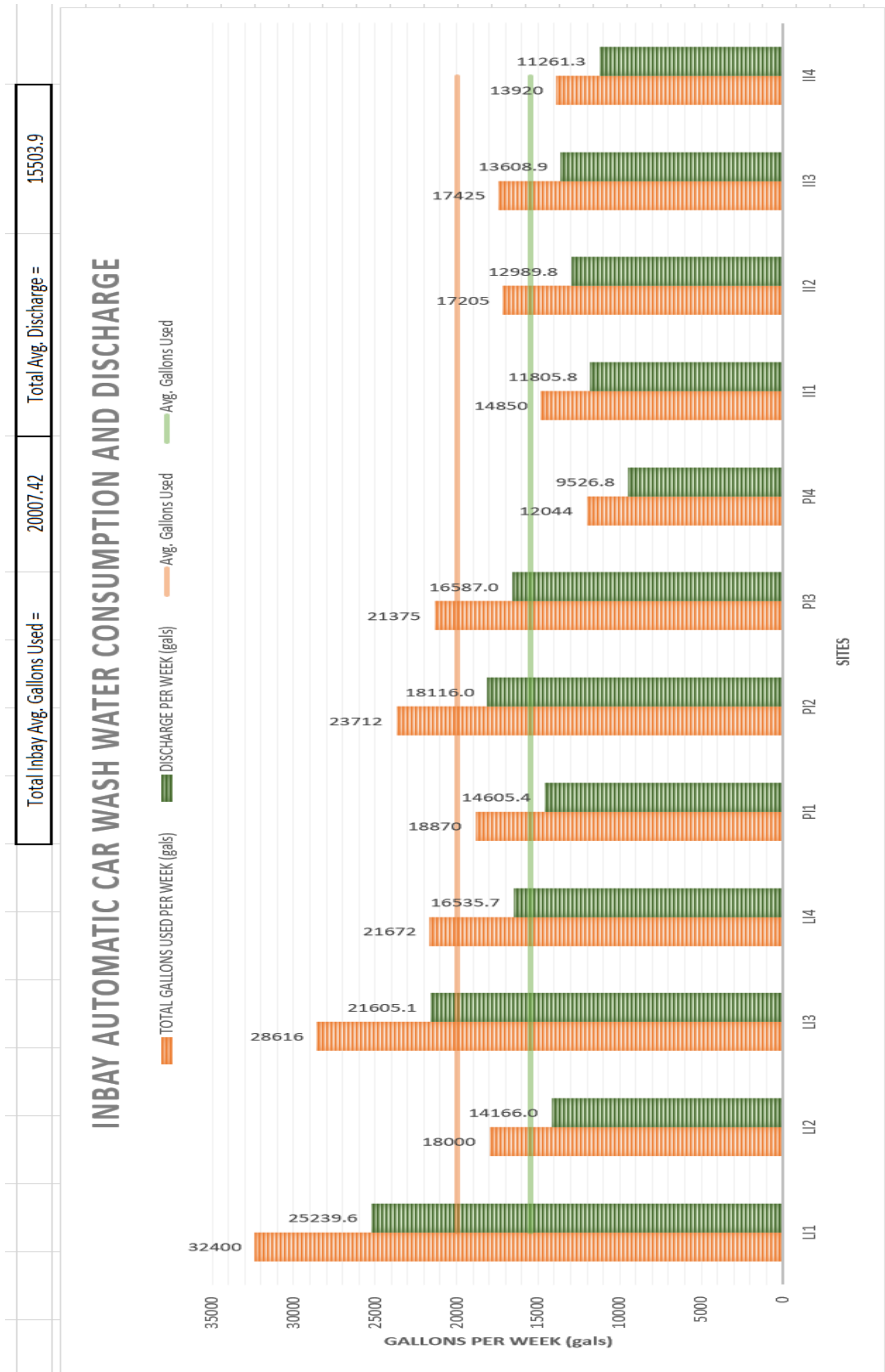
3.11.2 In – Bay Automatic Car Wash Data and Graph

LAHORE - INBAY AUTOMATIC CAR WASH								
SITE	FRESH WATER CONSUMPTION (gpv)		NO. OF CARS PER WEEK	TOTAL GALLONS USED PER WEEK (gals)	Avg. Gallons Used	DISCHARGE PER WEEK (gals)	Avg. Gallons Used	LOSSES (%)
	SMALL CAR	LARGE CAR						
LI1	30	51	800	32400	20007.42	25239.6	15503.9	22.1
LI2	31	44	480	18000	20007.42	14166.0	15503.9	21.3
LI3	33.6	44.8	730	28616	20007.42	21605.1	15503.9	24.5
LI4	33	44.4	560	21672	20007.42	16535.7	15503.9	23.7

PESHAWAR - INBAY AUTOMATIC CAR WASH								
SITE	FRESH WATER CONSUMPTION (gpv)		NO. OF CARS PER WEEK	TOTAL GALLONS USED PER WEEK (gals)	Avg. Gallons Used	DISCHARGE PER WEEK (gals)	Avg. Gallons Used	LOSSES (%)
	SMALL CAR	LARGE CAR						
PI1	30	44	510	18870	20007.42	14605.4	15503.9	22.6
PI2	31	47	608	23712	20007.42	18116.0	15503.9	23.6
PI3	29	46	570	21375	20007.42	16587.0	15503.9	22.4
PI4	33	44.7	310	12044	20007.42	9526.8	15503.9	20.9

ISLAMABAD - INBAY AUTOMATIC CAR WASH								
SITE	FRESH WATER CONSUMPTION (gpv)		NO. OF CARS PER WEEK	TOTAL GALLONS USED PER WEEK (gals)	Avg. Gallons Used	DISCHARGE PER WEEK (gals)	Avg. Gallons Used	LOSSES (%)
	SMALL CAR	LARGE CAR						
II1	41	58	300	14850	20007.42	11805.8	15503.9	20.5
II2	36	57	370	17205	20007.42	12989.8	15503.9	24.5
II3	34	51	410	17425	20007.42	13608.9	15503.9	21.9
II4	34	53	320	13920	20007.42	11261.3	15503.9	19.1

Table 3.2 In-Bay Automatic Car Wash Data Collected on Site



Graph 3.2 In-Bay Automatic Car Wash Water Consumption and Discharge

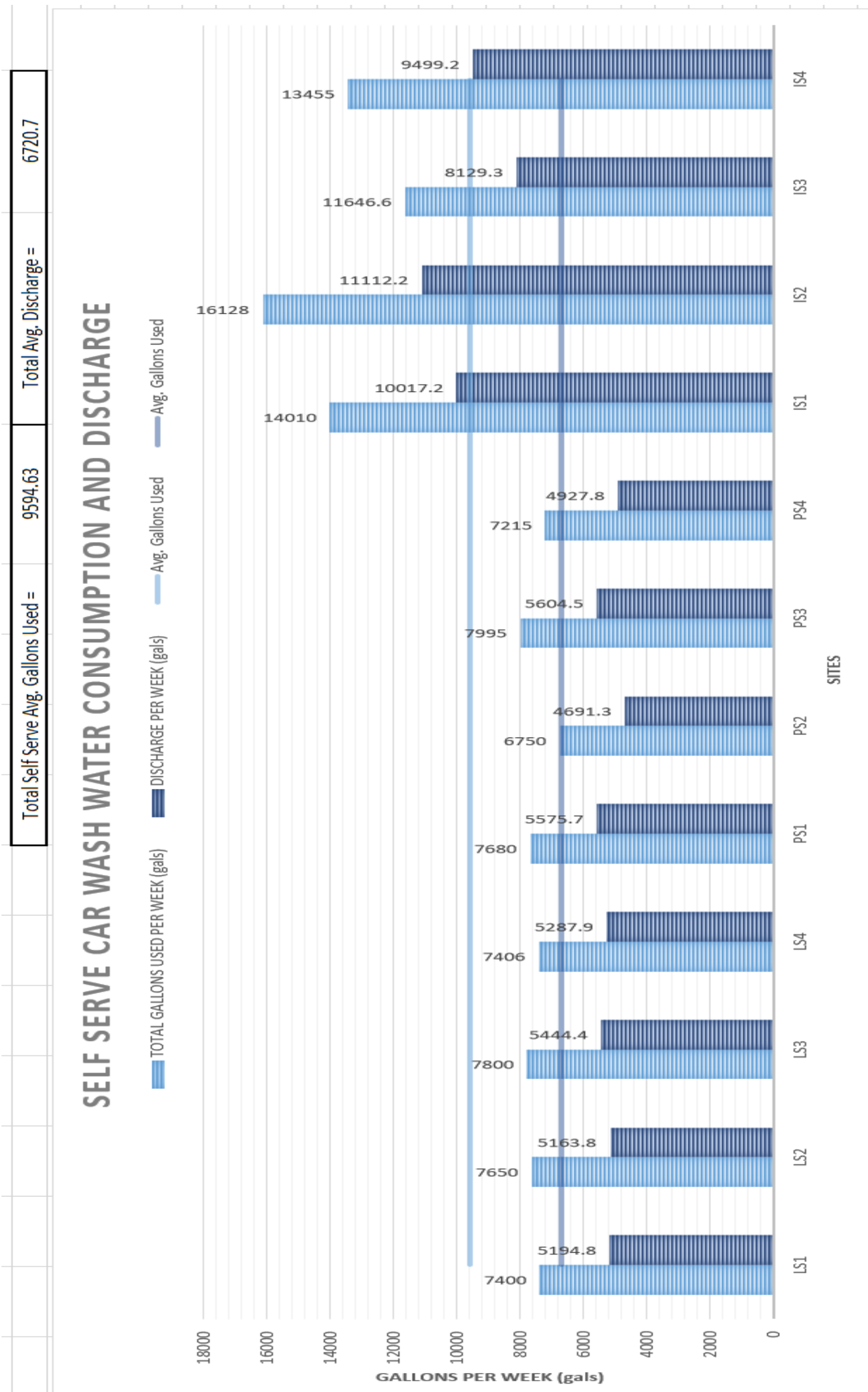
3.11.3 Self – Serve Car Wash Data and Graph

LAHORE - SELF SERVE CAR WASH								
	FRESH WATER CONSUMPTION (gpv)							
SITE	SMALL CAR	LARGE CAR	NO. OF CARS PER WEEK	TOTAL GALLONS USED PER WEEK (gals)	Avg. Gallons Used	DISCHARGE PER WEEK (gals)	Avg. Gallons Used	LOSSES (%)
LS1	16	24	370	7400	9594.63	5194.8	6720.7	29.8
LS2	18	24.5	360	7650	9594.63	5163.8	6720.7	32.5
LS3	15.5	23.5	400	7800	9594.63	5444.4	6720.7	30.2
LS4	16	23.5	375	7406	9594.63	5287.9	6720.7	28.6

PESHAWAR - SELF SERVE CAR WASH								
	FRESH WATER CONSUMPTION (gpv)							
SITE	SMALL CAR	LARGE CAR	NO. OF CARS PER WEEK	TOTAL GALLONS USED PER WEEK (gals)	Avg. Gallons Used	DISCHARGE PER WEEK (gals)	Avg. Gallons Used	LOSSES (%)
PS1	17	23	384	7680	9594.63	5575.7	6720.7	27.4
PS2	16.5	21	360	6750	9594.63	4691.3	6720.7	30.5
PS3	15	24	410	7995	9594.63	5604.5	6720.7	29.9
PS4	16	23	370	7215	9594.63	4927.8	6720.7	31.7

ISLAMABAD - SELF SERVE CAR WASH								
	FRESH WATER CONSUMPTION (gpv)							
SITE	SMALL CAR	LARGE CAR	NO. OF CARS PER WEEK	TOTAL GALLONS USED PER WEEK (gals)	Avg. Gallons Used	DISCHARGE PER WEEK (gals)	Avg. Gallons Used	LOSSES (%)
IS1	13	17	934	14010	9594.63	10017.2	6720.7	28.5
IS2	14	18	1008	16128	9594.63	11112.2	6720.7	31.1
IS3	14.4	21	658	11646.6	9594.63	8129.3	6720.7	30.2
IS4	16	23	690	13455	9594.63	9499.2	6720.7	29.4

Table 3.3 Self-Serve Car Wash Data Collected on Site



Graph 3. 3 Self-Serve Car Wash Water Consumption and Discharge

CHAPTER 4

4 REVIEW OF PRELIMINARY COLLECTED DATA

The type of car wash influences the quantity of water used per vehicle and wasted through evaporation and carryout, according to a research conducted in three cities. For professional vehicle washes, the following table displays typical freshwater consumption, evaporation, and carryout rates. Water use, evaporation, and carryout losses are compared by vehicle wash type to introduce the facts and discussion. The distinctions between each region were then investigated. The following is a summary of the water savings achieved using reclaim systems for car washes, as well as the possibility for more water conservation and financial advantages

4.1 Consumption of Water

In-bay automatic car washes consumed 32369.625 gallons per week for an average of 1040 vehicles. On average 31.12 gallons of fresh water per vehicle (gpv) in each location was calculated. Islamabad's conveyor automatic carwashes used the least water per wash. This was partly because almost all vehicle washes in Islamabad had reclamation machinery. We'll discuss how much water is saved at vehicle washes using reclamation systems and how much is utilized overall.

AVERAGE CONSUMPTION AND LOSS OF FRESH WATER BY CAR WASH TYPE						
	Water Consumption (gpv)			**Carryout & Evaporation (%)**		
Car Wash Type	**P**	**L**	**I**	**P**	**L**	**I**
Self - Serve	19.44	16.16	15.09	29.88	30.28	29.8
In - Bay	38.09	38.98	45.5	22.38	22.9	21.5
Conveyor	31.64	31.64	37.48	13.63	13.7	13.2
P = Peshawar; L = Lahore; I = Islamabad						

Table 4.1 Fresh Water Loss and Averages by Car Wash Type

Average water consumption for all car washes for the three cities are as follows:

- Lahore = 28.93 gpv
- Peshawar = 29.72 gpv
- Islamabad = 32.69 gpv

It is evident that Islamabad uses substantially more water than the other. The higher water consumption variability in Islamabad hampered statistical separation of the three locations. Islamabad has the most water usage data.

Evaporation and Carryout for all car washes for the three cities are as follows:

- Lahore = 22.3%
- Peshawar = 21.96%
- Islamabad = 21.5%

According to this study, climatic changes don't seem to affect water consumption or loss. Standard deviations show the large amount of variety in the sample. Increasing sample numbers may enhance statistical confidence in mean values for different car washes and locations. The observed variance may still be large due to differences in manufacturer, maintenance plan, and operator preferences.

4.2 Variance of Car Wash Equipment Utilized

In this study, the most important factor determining water utilisation was the type of vehicle wash equipment employed. The following criteria were used to assess water consumption:

- Self-serves = 16.9 gpv
- In Bays = 40.9 gpv
- Conveyors = 33.6 gpv

Only around 1% of the discrepancies were due to chance. Consumers may shop without leaving their automobiles with most In-Bay automatic washers. The consumer selects his or her wash and pays for it. Manufacturers specify equipment speeds and pressure levels. Equipment design limits water consumption rate changes. The owner or operator can vary water pressure and nozzle size, however water consumption variations are the most limited.

4.3 Conservation via Pressure Control and Nozzle Sizes

Conveyor car washes allow owners and operators additional control over pressure and nozzle sizes. Adjustable conveyor speed. Even little modifications might impact water use. Changing spray nozzle pressure or size influences water usage. "Mitters" require less water over time. 36-cloth conveyor carwashes use the least water. Several nozzles supposed to moisten the brushes weren't turned on, thus the vehicle's water drenched the textile equipment or mitter. On 9 of the 12 conveyors, employees used spray wands and/or brushes. This has an impact on the water used in conveyor vehicle washes.

Self-service grossed 16.9 gpv. Self-serve vehicle washes in Islamabad presumably used automatic traffic counts, resulting in a lower average gpv. Automatic traffic counters count vehicles regardless of cleanliness. Larger vehicle counts resulted in lower gpv totals since self-service PLCs tally the minutes spent washing a car. Observations of automobiles going through Lahore wash bays without paying control to visual assessments to calculate average wash time. Over 5.25 hours, 97 cars were cleaned for 8 minutes each. To calculate the number of autos washed in Lahore and Peshawar, multiply the total minutes spent washing by the average time spent cleaning. Total PLC time and metered fresh water use were compared to determine average gallon per vehicle. Freshwater use per wash is metered consumption divided by time.

4.4 Conservation via Towel Drying Type Carryout

Based on manufacturer estimates, previous research revealed conveyor car washed consume less water. Changes in water usage at researched sites may explain reduced water consumption rates. The Boxplot of Water Consumption by Type of Car Wash (gpv) reveals that, while being lower than projected, the water conveyor predictions are accurate. Evaporation and transport losses were similar among vehicle washes. All locations had similar evaporation losses:

- Conveyor = 13.51%,
- In-bays = 22.26%
- Self-serves = 29.99%.

The Conveyor car washes recorded 9% and 16.5% behind In-bays and Self-serves, perhaps due to towel drying. Towel-drying conveyor vehicle washes may collect more water for the sanitary sewer. The sanitary sewer gets towel washer wash water after wastewater tanks. Leaving enough distance between the last water usage and the tunnel's end helps decrease wind-blown mist. End can help reduce the amount of water blown away by the wind and condensed into mist.

4.5 Conservation via Blower Type Evaporation

Conveyors did not show the same value fluctuation as In-bays and Self Serves. According to the average and median data, professional vehicle washers lose 20% to evaporation and carryout. Using blowers after washing affects evaporation and carryout. Evaporation and carryout are affected by equipment type, power, direction, and aperture number.

This study didn't examine dryers. Some conveyors included a tunnel beyond the blow dryer to collect windblown water and return it to the car wash tanks. Some conveyors have a tunnel after the dryer, despite appearances. Because clients employ In-Bays' drying equipment, sample variability rises.

4.6 Conservation via Reclamation System

Eleven locations used reclamation. Sample variability was substantial since reclaim was used in various cycles at each car wash. The table below shows the average amount of freshwater used each wash, as well as the total number of gallons utilised in the maximum wash (including recovered water), and the percentages of reclaimed water used by various wash settings. Reclamation sites consumed 17.84 gpv or 50.28% of total volume. The audit found reclaim water and freshwater flow rates and durations in reclaim car washes. Sites with and without reclamation systems have similar evaporation and carryout.

CONTRIBUTION OF RECLAIM SYSTEMS TO WATER USE EFFICIENCY AT ELEVEN SITES IN LAHORE, PESHAWAR AND ISLAMABAD						
SITE	**No. of Cars per week**	**No. of Gallons per week (gpv)**	**Avg. Fresh Water (gpv)**	**Total with Reclaim (gpv)**	**Min. Reclaim Range**	**Max Reclaim Range**
LC2	782	24202	30.9	33.9	9%	10%
LC3	673	19517	29.0	46.7	53%	69%
LC4	740	26270	35.5	50.4	38%	46%
LI4	560	21672	38.7	57.5	44%	53%
PC2	1375	39188	28.5	42.0	33%	62%
PC3	1139	29614	26.0	42.8	55%	74%
PI1	510	18870	37.0	64.9	69%	82%
PI2	608	23712	39.0	65.9	67%	71%
PI3	570	21375	37.5	59.1	54%	61%
PI4	310	12044	38.9	49.7	12%	44%
PI4	300	14850	49.5	74.3	37%	63%
Total Respective Avg.	**687.9**	**22846.7**	**35.50**	**53.38**	**42.82%**	**57.73%**

Table 4.2 Reclaim Systems Contribution to Water Use Efficiency

4.7 Cost Benefit Analysis

The Water savings and cost/benefits were analysed for sites without a reclamation system. Lahore's reclamation system was investigated. The equipment and installation were estimated to cost Rs 1,500,000/- and Rs 1,600,000/-, respectively. The system had a 10-year life expectancy, therefore capital expenses were computed at 8% interest. The layout and application of recovered water were considered in each location's cost-benefit study. Analysis of the facility's water consumption data determined water use and expenditures. Self-serve setups lacked cost-effective reclamation. Low water use per vehicle and high construction expenditures reduced ROI. Due to decreased utilisation, in-bay locations have lower water costs than conveyor sites. Reduced water use from reclamation car washes may warrant financial incentives. Economic value of a reclamation system relies on water cost and utilisation.

4.8 Conservative Measures

The research also evaluated numerous conservation measures.

- Self-serve facilities utilise less water, thus nozzles should be smaller. Small savings would result.
- High-pressure periods increased in-bay automatics' water use, suggesting pressure management might reduce water use. Spray arms on in-bay automatics continued past compacts.
- Changing technology to measure automobile length might save money.
- In-bay systems may save money by adjusting phase timing and arm depressurization/draining. The same nozzles clean, finish, and rinse.

- PI1 and PI2 carwashes had numerous manifolds that reused soapy or finish-containing water as a result reduced waste.
- Lower pressure settings on the study's high pressure conveyors and turning down some tunnel arches or nozzles saved money.
- Positive shut-off valves in the arches save money between washes. Even if the pressure fell, water would stay in the arches.

4.9 Analysis for Losses

The researchers used field data to determine the amount of water used, lost to evaporation, and carried in the professional vehicle wash sector. Previous research described car wash water utilisation using manufacturer data and anecdotes. Field data indicated substantial variability, but they also proved that manufacturer estimations and earlier research were within field range.

Audit processes that focused on individual car water use were more reliable than those that focused on time or wash components. Some In-Bay and Conveyor equipment has spray nozzles on fast-moving arms, making data collection problematic.

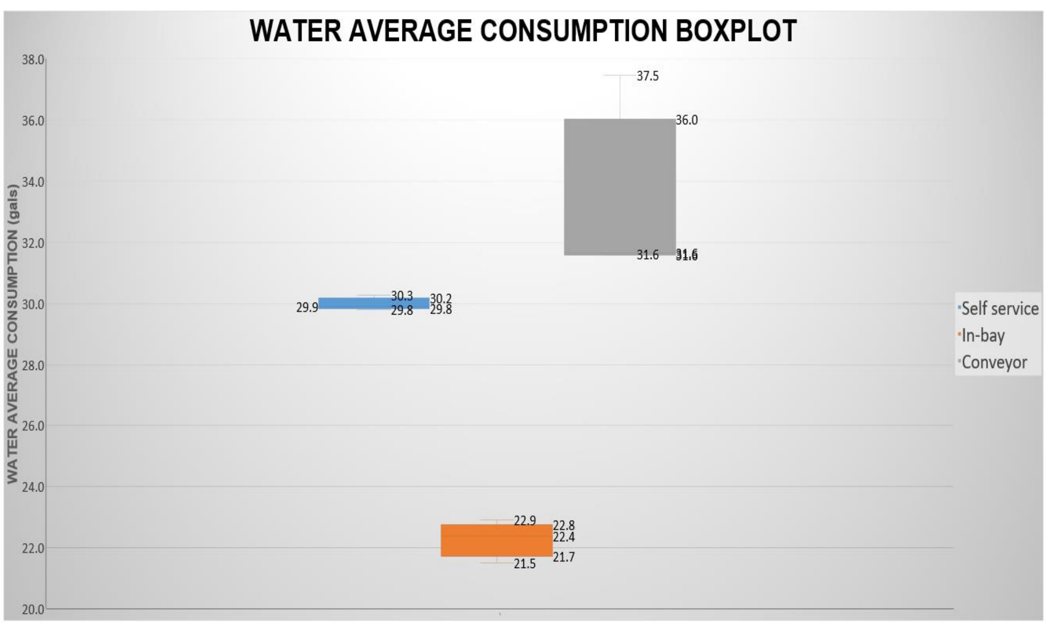
Climate implies no regional water usage disparities. This illustrates that carryout losses make up more of overall carryout and evaporation losses. The combined impacts of evaporation and carryout were constant across geographic borders and changes; the sample mean was 21.92%. Larger sample numbers may give statistical distinction in water usage by location, but the large diversity within the sample shows that individual variances in car wash equipment design, operation, and maintenance are likely to be more relevant than climate.

4.10 Water Consumption by Type of Car Wash (gpv)

Boxplots of water use data illustrate the data's midpoint. The size of the box displays data variability by estimating the true mean. Fences represent furthest data points from the credible estimates. Therefore it's unrealistic to forecast conveyor car wash values below 31.6 gpv or beyond 37.5 gpv or In-bay values below 21.5 gpv or over 22.9 gpv or Self-Serve values below 29.8 gpv or over 30.3 gpv

Water Consumption			
City	Self service	In-bay	Conveyor
Peshawar	19.44	38.09	31.64
Lahore	16.16	38.98	31.64
Islamabad	15.09	45.5	37.48

WATER CONSUMPTION AVERAGE(gals)			
	Self service	In-bay	Conveyor
MAXIMUM	30.3	22.9	37.5
MINIMUM	29.8	21.5	31.6
QUARTILE 1	29.8	21.9	31.6
QUARTILE 3	30.1	22.6	34.6
MEDIAN	29.9	22.4	31.6

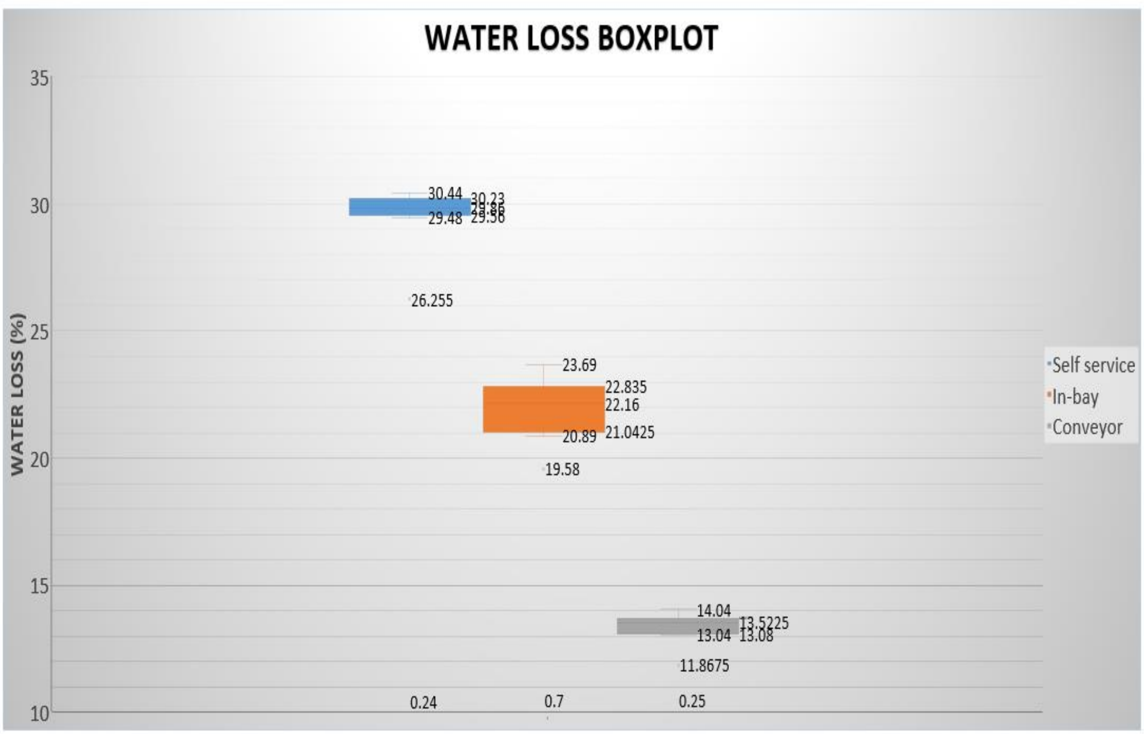


Graph 4.1 Boxplot of Water Consumption (gpv)

This Boxplot illustrates average evaporation and carryout. All three categories have comparable median price. Fences represent furthest data points from the credible estimates. Therefore it's unrealistic to forecast conveyor car wash values below 13.2 gpv or beyond 13.7 gpv or In-bay values below 38.1 gpv or over 45.5 gpv or Self-Serve values below 15.1 gpv or over 19.4 gpv. Lower circles on all three washing processes and the conveyor are likely not outliers.

Water Loss / Evaporation			
City	Self service	In-bay	Conveyor
Peshawar	29.88	22.38	13.63
Lahore	30.28	22.9	13.7
Islamabad	29.8	21.5	13.2

Water Loss / Evaporation			
	Self service	In-bay	Conveyor
MAXIMUM	19.4	45.5	13.7
MINIMUM	15.1	38.1	13.2
QUARTILE 1	15.6	38.5	13.4
QUARTILE 3	17.8	42.2	13.7
MEDIAN	16.2	39.0	13.6



Graph 4.2 Boxplot of Water Losses (gpv)

CHAPTER 5

5 DESIGN OF CAR WASH FOR RISALPUR CANTT

5.1 Site Selection

5.1.1 Characteristics of Good Site for Car Wash Service Station

The site must be on one side of the Cantt and should be easily accessible to every vehicle entering the facility or leaving it. The site must be in the vicinity of the commercial hub of the Cantt and the consumer coming to the car wash service centre can afford the facility easily.

5.1.2 Proposed Sites

We selected the following sites for our project:

- Military Petrol Station (Near MT ground), Risalpur Cantt
- Family Park (Opposite of CSD), Risalpur Cantt

The reason for selecting these specific sites was ease of data collection and shorter travelling distance and their nearness to the commercial sites.

5.1.3 Final Site Selection

We selected "Family Park (Opposite of CSD), Risalpur Cantt" as our final site. This selection is based upon the facts that Risalpur Cantt has a very limited free space for the construction of a facility like a car wash near a commercial site.

Moreover less traffic congestion and more commercial activity near Family Park site was much preferable as compared to other site.

5.2 Selected Site Details

5.2.1 Location

The site is located in the commercial centre of Risalpur Cantt near CSD. Almost 90% of vehicles entering Cantt centre use the road leading to Gate - 03. It is an important Cantt centre and now a focus for all major commercial activities of the area. Traffic congestion and parking is not major problem on this road.

Following images were taken from "Google Maps" website:

Figure 5.1 Satellite view of the selected site

5.2.2 Size of the Site

Area of car wash on site = 152’ x 126’

Area of dedicated parking zones:

- Zone -1
  - Length = 63’9” & Width = 15’ 6”

- Zone – 2
    - Length = 100’9” & Width = 15’9”

These areas are mentioned and shown clearly on the site plans attached in the Appendix B.

5.2.3 Access

Access to the area is good with a high quality road network and good public transport. Local transport links are also good with easy access. The main roads coming to this Cantt centre are; Nisar Shaheed Road & Gate – 03 Road.

5.2.4 Ownership

The full extent of ownership of this site is with the Station Headquarters, Risalpur Cantt.

5.2.5 Photographs of the Site

Figure 5.2 On ground site topography – Front view

Figure 5.3 On ground site topography – Side view

5.2.6 Data Collection

Data collection is one of the essentials of the project. For this purpose we visited various and met with different personals of the field. The following data was collected.

5.2.6.1 Population

Total population of Risalpur Cantt = 6750

(Source: Station Head Quarters, Risalpur Cantt)

5.2.6.2 No. of Cars

The following data was collected from Station Head Quarters, Risalpur Cantt.

- Total No. of cars in Risalpur Cantt = 1250
- Total No. of cars in and near the Cantt centre = 750

5.2.6.3 Car Sizes

All general cars in Pakistan have following range of sizes:

- Length = 12’ to 18’
- Width = 4’ to 5’
- Height = 5'

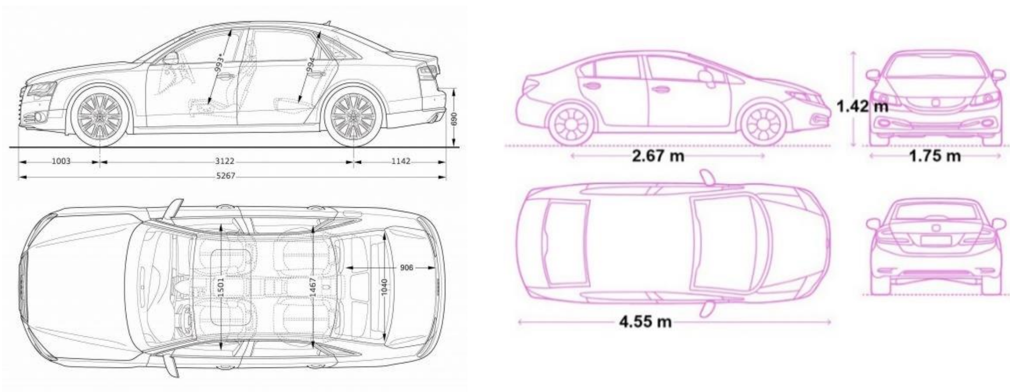


Figure 5.4 Size of Design Car

5.2.6.4 No. of Cars Coming to the Site

We counted the number of cars for a complete hour and the total number of cars per day were calculated. Summary of average calculations are:

- No. of cars entering from Nisar Shaheed Road = 450 cars
- No. of cars entering from Road leading to Gate – 03 = 550 cars
- Total no. of cars coming to site = 1000 cars approx.

5.2.6.5 Peak Time

Weekdays:

- 08:30 AM to 10:00 AM opening shops near Nisar Shaheed Road, offices and university teachers and students.
- 02:00 to 03:30 PM - closing of offices and university.
- 08:00 to 10:00 PM - closing of commercial shops.

Weekends:

- 08:00 AM to 09:00 AM - opening of commercial shops and good deliveries.
- 09:00 AM to 11:00 PM - closing of commercial shops.

Peak Duration:

- Peak Time - 8:00 PM to 9:30 PM
- Peak Time Duration - 1 Hour 30 Minutes

5.2.6.6 Estimation of Quantity

- Total no. of cars proceeding for car wash = 1050 (Assumption as per data)
- Total amount of water/Car = 30 gal
- Total storage = 250*4 = 1000 gallons = 3786 litres
- No. of cars storage can support = 33 cars (Surplus water in pipes as well)
- No. of cars on normal days = 50 (Mon to Thu) > 12 cars/day
- No. of cars on weekends = 200 (Fri to Sun) > 60 cars/day

5.2.6.7 Factors Affecting Rate of Demand

- No. of cars coming to the site
- Weekends
- Climate of Risalpur Cantt (Dry, Dusty & Windy)
- Routine and nature of people
- Quality of service provided to the customer

5.2.6.8 Quality of Water

Water samples were taken and were tested at AFPGMI, Rawalpindi. The results concluded came out satisfactory for use of municipal water in car wash. The report is attached in Appendix A.

5.2.6.9 Population Parameters

Population calculation is a very important consideration in the designing of any building facility which serves the general public. It depends upon the amount of population of the area under consideration. After getting the present number of population, the future population is forecasted using various methods for which the system is being designed. This data was collected from Station Headquarters, Risalpur Cantt.

Total population of the area = 6750

5.2.6.10 Water Requirements

1. **Total Demand** = 3100 gpd

- **Calculation:**

No of cars / day = 90 (max)

Water consumed for washing / vehicle = 30 gal

Total water consumed / day = T1 = 90 x 30 = 2700 gal/day

Avg water demand for miscellaneous purposes = T2 = 400 gpd

Total Demand = T1 + T2 = 2700 + 400 = 3100 gpd

(To be on the critical side we have used the max value per day)

- **Reclaimed water =** 520 gpd

Reclamation capacity of total water = 57.727%

(Calculated as per data collected from 36 sites)

Reclaimed Water = 57.727% x Total Demand

= 57.727% x 3100

= 1790 gpd

2. **Fresh water demand =** Total demand - Reclaimed water

= 3100 - 1790 = 1310 gpd

3. **Losses:**

From the book, Losses and Demands (Rangwala), assuming 14% of the general losses. The total loss is given as;

- Loss = 0.14 x Total Demand = 0.14 x 3100 gpd **=** 434 gpd

4. **Future Projection:**

As it is an army garrison so there should not be any significant increase in the population in the future even still to be on the safer side the assumed increase in the demand is taken as 2.5% per 10 years.

So the projection for 20 years = 5%

Demand after 20 years = (0.05 x Total Demand) + Total Demand

= (0.05 x 3100) + 3100 gpd

= 3255 gpd

5.2.7 Size of Car Space

In Europe and Asia smaller cars are used and even tighter dimensions can accommodate most of the cars in use. The following dimensions were selected which can handle almost 99% public general use cars in Pakistan.

- Length of space = 11’ 6”
- Width of space = 5’ 6”
- Height of space = 10’ 9”

5.2.8 Heights

From our design plan, as inter-column distance is 30 ft so by rule of thumb 30 ft long beam will have 30 inches thickness including slab thickness. 3" floor finishes can be assumed.

- Slab thickness = 10"to 9"
- Clear height from floor finish to bottom of beams = 8'

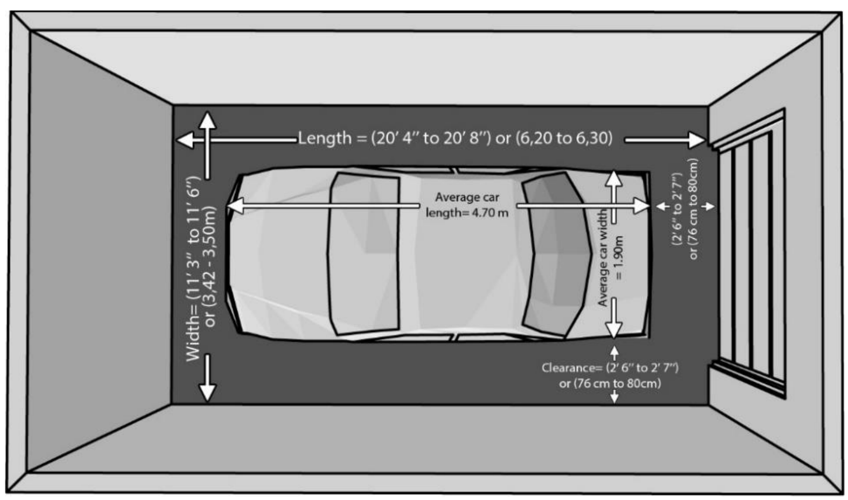


Figure 5. 5 Clear-way space for the designed car wash bay

5.2.9 Driveway Width

We have selected two-way traffic system so two-way driveway width is discussed here. 20 ft to 24 ft wide driveway is recommended in most data books of European and

Asian countries because:

- It provides good level of service
- Our site floor area is huge so 22 ft driveways can be easily accommodated

➢ Driveway width selected = 22 ft

5.2.10 Storage Type

- 4 x Polyethylene Water Storage Tanks
- Each with a 250 gallons capacity
- Dimension of each: 35” x 35” x 68” (Market Survey)

5.2.11 Hydraulic Lift

- Length =5 ft
- Width = 1.5 ft
- Height = 2-5 ft (min – max rise)

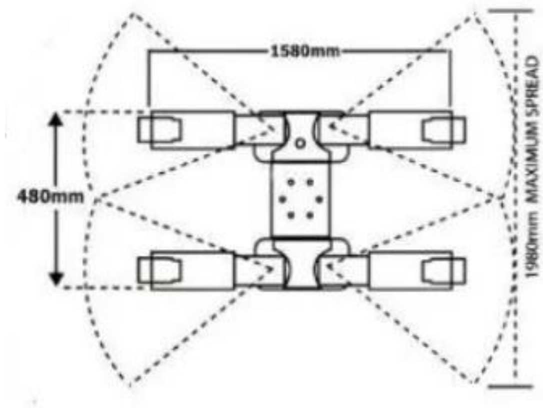


Figure 5.6 Hydraulic Lift with Dimensions

Type	*One Cylinder Hydraulic Lift*
Lifting Capacity	7000 kg
Max Lift Height	5 feet
Min Lift Height	2 feet
Maximum Load	7000 kg

Table 5.1 Hydraulic Lift Specifications

5.2.12 Types of Pipes

Stainless copper pipes (fibre glass insulation)

- ¾ inches for normal car washing pipes
- 4 inches for sewerage pipes (from building to sewer)
- 4 inches for main water pipes from Fresh water tanks
- 6 inches for main sewer storage in and out.

Background Calculations:

Velocity calculations:

$$\boldsymbol{V = k \times C \times R^{0.63} \times S^{0.54}} \textbf{ (Hazen William Equation)}$$

Now,

K = 0.849 (For metric system)

C = 140 for copper

R = 0.00475 ($\frac{Area}{perimeter}$ $for\ \boldsymbol{d = 0.75"\ pipe\ dia}$)

S = 0.07 (design consideration)

$$V = 0.849 \times 140 \times 0.07^{0.54} \times 0.00475^{0.63}$$

$$\boldsymbol{V = 0.972\ m/s}$$

As we know limitations for velocity of water in a pipe network is;

0.6 m/s < Velocity < 3 m/s (Okay!)

Flow-rate Calculations:

$$\boldsymbol{Q = A \times V}$$

Now,

$A = 0.00028\, m^2$

$V = 0.972\, m/s$

$$Q = 0.00028 \times 0.972$$

$$\boldsymbol{Q = 0.000275\, m^3/s} \textbf{ (Theoretical Value)}$$

Design Flow-rate:

Total Demand = 3100 gpd

Calculation:

No of cars / day = 90 (max)

Water consumed for washing / vehicle = 30 gal

Total water consumed / day = T1 = 90 x 30 = 2700 gal/day

Avg water demand for miscellaneous purposes = T2 = 400 gpd

Total Demand = T1 + T2 = 2700 + 400 = 3100 gpd

(To be on the critical side we have used the max value per day)

Avg time per car wash = 8 mins

Now,

Q = Total demand / time

$= 3100/(8 \times 90)$ Since (8 mins per car)

Q = 4.3 gpm

Q = $\mathbf{0.00027\ m^3/s}$ (same as theoretical calculation)

Losses:

- Major Losses

$$hf = \frac{fl}{d}\frac{{v^2}_2}{2g}$$

$$hf = \frac{0.02 \times 10}{0.019} \times \frac{0.972^2}{2 \times 9.81}$$

$$\boldsymbol{hf = 0.507m}$$

- Minor Losses

$$h_l = k\frac{{v^2}_2}{2g}$$

$$h_l = 0.5 \times \frac{0.972^2}{2 \times 9.81}$$

$$\boldsymbol{h_l = 0.024m}$$

5.2.13 Drainage

Flush valves with timers are fitted to the drain ends to flush the system automatically as needed. After that, connect them to a timer and a sump pump in the pit. Slot Drain will then flush itself on a regular basis, reusing and recycling its own water.

They are about 16” deep and about 14' wide. We have a “T” on every bay to keep any floating debris from going to the next bay or into the oil/water separator tanks. There is a 4” pipe that goes under the equipment room floor.

5.2.14 Type of Motor Pump

Bosch Aquatak 125 pressure washer (max adjustable =1750 psi)

Around 1200 to 1900 PSI is suitable for car wash

Capacity = Gpm x pressure (psi) / 1714

= (2.15 x 1750) / 1714 {gpm= total water / 24 x60 = 3100 / 24 x 60}

Req Power = 2.2 HP

Bosch Aquatak 125 pressure washer’s Power = 2.252 HP

Motor’s Power > Req power (selected)

5.2.15 Type of Compressor

Laston Air Compressor

Req power = 2.2 HP

Power (Laston) = 2-10 (Selected on the desire of work)

LASTON

Availability
2 Hp To 10 Hp (Depends on your desire)

Tank Size
180 Pounds To 350 Pounds

Pressure
8 Bars To 10 Bars

Unit
2 Cylinders, 3 Cylinders, Multi Stage / High Low. (Depends on your Desire)

5.2.16 Architectural Plan

The original architectural plan is attached in Appendix B along with rendered diagrams of the designed car wash. Following is an outlook of the designed site

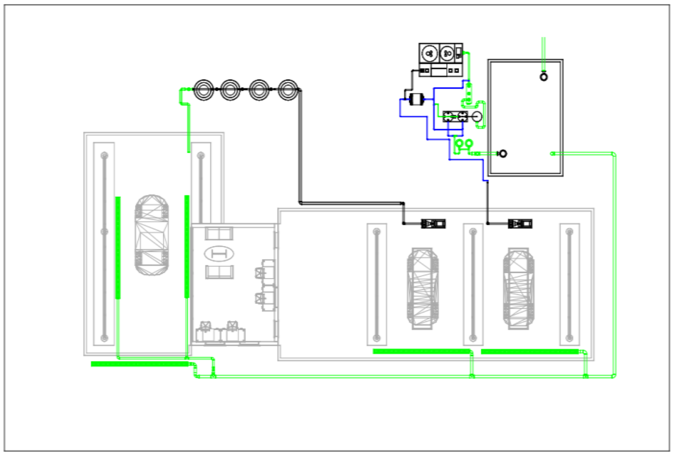


Figure 5.7 Plan of the designed site with its pipe networking

CHAPTER 6

6 CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusions

This study uncovered a number of facts about the professional car wash company, water use and losses due to evaporation, and carryout using field data. For water utilization by vehicle wash equipment, previous research have relied on manufacturer estimates and anecdotal information. This is the first multi-regional research that is entirely based on field data. Field data revealed variance, as predicted, but also proved that the manufacturers' estimations reported in previous research were within the bounds of values obtained in the field.

According to audit processes, water consumption by individual autos was shown to be more reliable than water use over time or water consumption by particular components inside the wash. The design of In-Bay and Conveyor equipment with spray nozzles positioned on rapidly moving arms made data gathering on individual components difficult, if not impossible, in some scenarios.

Changes in water usage due to climate change do not appear to be significant. This implies that carryout losses account for a greater share of overall evaporation and carryout losses. With a mean value of 24.0 17.4 percent for the whole sample, evaporation and carryout were found to be consistent across geographical boundaries and variations. Larger sample sizes may allow for statistical separation of water use by region, but the sample's wide variation implies that individual differences in car wash equipment design, operation, and maintenance are more important than climatic variances.

Encourage the use of reclamation and educate owners/operators about the savings that may be gained through equipment modification and maintenance to encourage water conservation. Local utilities with longer-term water constraints may provide incentive programs to encourage car wash companies to invest in reclamation technology. By recognising water conservation car washes through certification, water planning agencies and utilities may save money all year round in collaboration with competent car wash operators.

Temporary metering of wastewater flows from a professional vehicle wash is challenging due to the usual plumbing layout of the sewer outfall. Non-intrusive metres, such as ultrasonic metres or magnetic metres, are commonly used in the water sector to detect flows including large amounts of entrained materials. A continuous length of pipe to which the metre may be attached is required for these metres. The bulk of wastewater outfall pipe at car washes is buried beneath the bay or parking lot floor, behind asphalt or concrete. Car washes should retain a segment of outfall pipe accessible through a metre box large enough to insert non-invasive temporary monitoring equipment in the future. This would make it easy for a car wash owner/operator to show the water losses due to evaporation and carryout at their facility.

6.2 Recommendations

Following are few measures that must be adopted to reduce water consumption:

- Reduce the operating pressure and flow rate of the nozzles by installing nozzles with a lower flow rate.
- It is necessary to do periodic checks to ensure that the nozzles are aligned correctly.
- Conduct routine checks to identify and repair any water leaks that may have formed over time.
- Stainless steel or strong ceramic nozzles should be used instead of brass or plastic nozzles, which corrode more quickly. Nozzles made of brass and plastic are less durable..
- If you want your landscape to look its best, use recovered water or water that has been sent away by the RO system.
- If you want to construct a beautiful landscape for your home, you should pick plants that are "water friendly."
- The arches in the conveyor should be precisely timed so that they light up when a car drives underneath them, and then they should switch off when the car drives out from underneath them.
- Weep systems should be configured such that they turn on at a temperature of 320 degrees Fahrenheit.
- Before allowing the vehicle to depart the bay, a dwell period should be established. Before the vehicle is permitted to depart the bay, water is allowed

to flow off the vehicle and into the reclamation pit. For the goal of water conservation, make sure that all water-using equipment is kept in working order to either its original specification or an improved one.

- In order to maintain the best possible level of water utilisation efficiency at the car wash, it is vital that each spray nozzle be replaced on a regular basis. This will guarantee that the highest possible level of water utilisation efficiency is maintained.

– – –

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Appendix A

Armed Forces Institute of Pathology
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Entered By: Irum Pervez
Entered At: 09 May 2022 11 50
Print Date: 10 May 2022 09 25

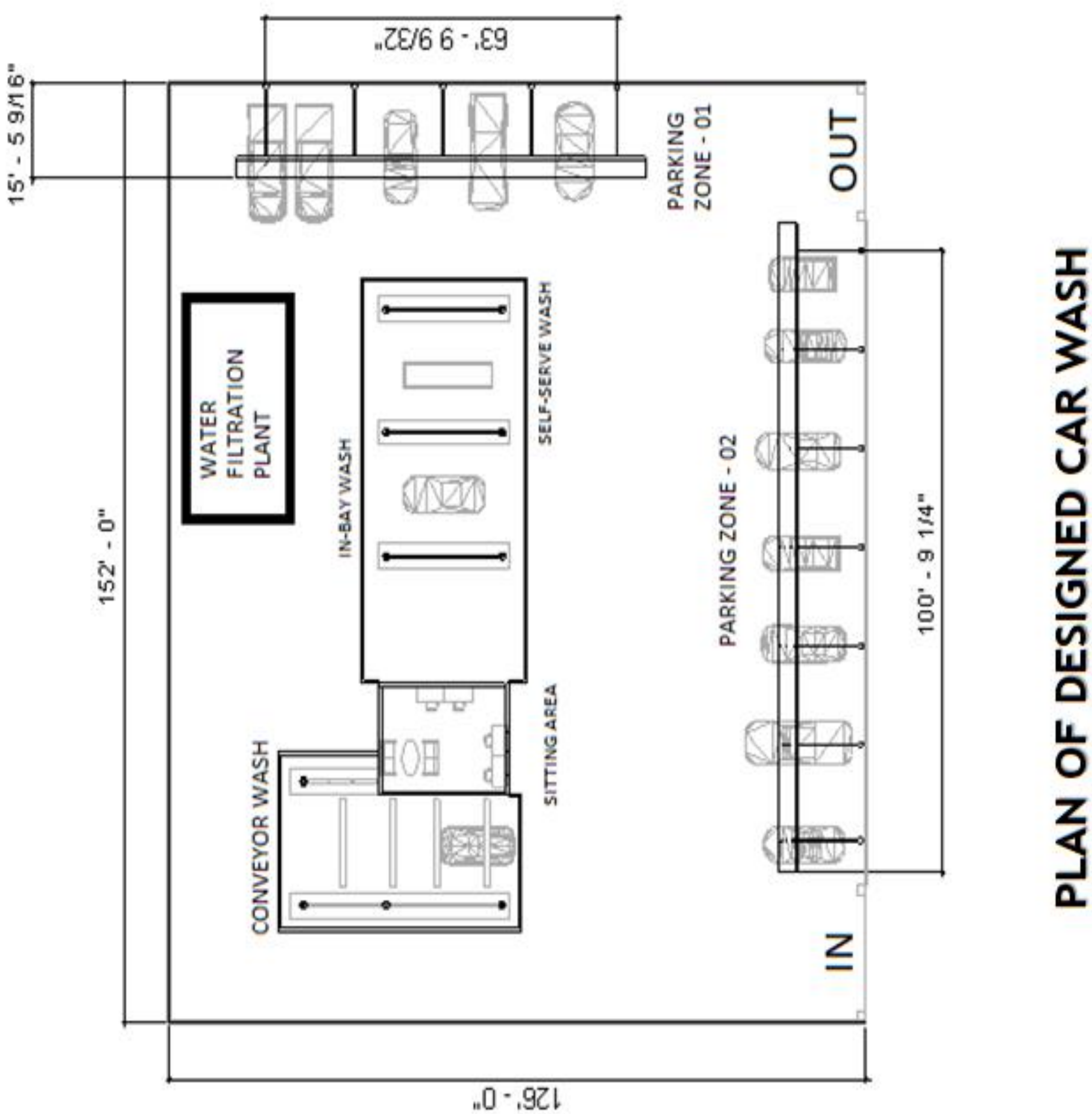
Lab ID: 22291406 Unit: MCE RISALPUR
Patient: 7375930 SEP Filter Plant (M) (30 Y)

Water For Coliform Count

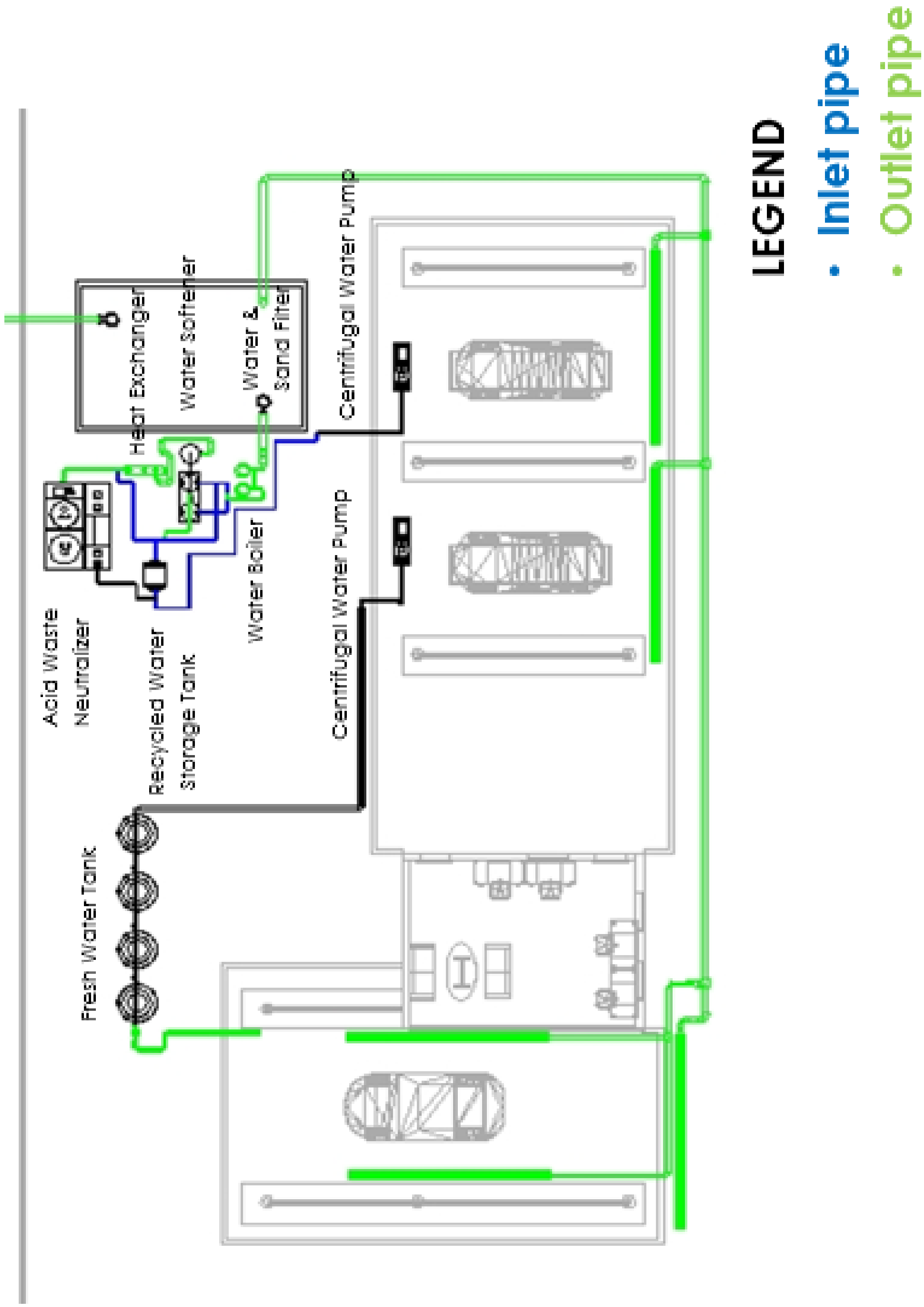
Water No:	25227
Sample taken by	Sep Sajjad Ahmed
Date of sampling	06/05/2022
Type of water	Drinking water
Treatment	Filtration
Thermotolerant Coliform	Nil/100 ml
Pseudomonas Count	Nil/100 ml
Opinion	**Bacteriologically Satisfactory**
Note	1. Proper collection of sample is mandatory for correct results. 2. The party submitting the specimen at lab shall assume full responsibility for the ethical use of the results in the analysis/ test reports and the laboratory shall be held free from any claims which may result from the use of such data. 3. This analytical/test report is based solely on the particular sample (s) supplied by the party and should not be reproduced in part .

Report Authorized By: Dr.Ammarah Mehmood.

Appendix B



63' - 9 9/32"
15' - 5 9/16"
PARKING ZONE - 01
OUT
WATER FILTRATION PLANT
IN-BAY WASH
SELF-SERVE WASH
152' - 0"
PARKING ZONE - 02
100' - 9 1/4"
SITTING AREA
CONVEYOR WASH
IN
126' - 0"
PLAN OF DESIGNED CAR WASH


LEGEND
• Inlet pipe
• Outlet pipe
Acid Waste Neutralizer
Recycled Water Storage Tank
Fresh Water Tank
Heat Exchanger
Water Softener
Water & Sand Filter
Water Boiler
Centrifugal Water Pump
Centrifugal Water Pump

hb

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Abstract

The use of water in professional vehicle washes is a particularly striking illustration of the application of water in a professional process. This research was carried out so that an inquiry could be carried out on the amount of water that is used by vehicle washes as well as the quality of the effluent that is produced by them.

The second section presents the findings about the quality of both the wastewater and the solid garbage that was collected.

The goal of this research is to integrate information from studies done at specific sites in Lahore, Peshawar, and Islamabad in order to see if climatic variances in different regions have a substantial influence on water consumption or water loss owing to variations in evaporation and carryout. This report will then provide comparison and commentary on that information. In addition, the data obtained was utilized in the design of the car wash located in Risalpur Cantt.

When regulators are confronted with the necessity to apply water conservation or drought limitations, the data supplied can be used to estimate the contribution to water consumption reductions that professional car washes can effectively undertake. This is achievable since the data shows how much water can be saved at professional vehicle washes by using less water.