Water Conservation in the Professional Car Wash Industry

A Report for the International Carwash Association

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Published by
International Carwash Association

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Executive Summary

In order to better clarify water consumption and potential conservation measures in response to the water use restrictions imposed by states in the eastern United States in the summer of 1999, the International Carwash Association commissioned a survey of techniques used to conserve and reclaim water in the car wash industry and to define those techniques in a standardized manner.

A “Think Tank” comprised of the car wash industryís experts in water conservation included operators, manufacturers, reclaim system manufacturers, professional car wash product suppliers and conservation experts was convened to examine the optimum means of creating a standard for water efficiency in the professional car wash. The results of this examination are designed to advance the discussion of water conservation and reclaim in the professional car wash industry. For use by car wash operators and regulatory staff to ensure that professional car washes are water efficient year-round, and that emergency drought measures result in measurable reductions in water consumption.

Water Use and Conservation in the Professional Car Wash

This report describes the water use and conservation opportunities for self-service, in-bay automatic, and conveyor car washes. Conservation and drought management plans focus on the amount of potable water that can be saved through various measures. On a gallon-per-vehicle (gpv) basis, professional car washes use a minimal amount of water when conservation equipment, including reclaim systems, is installed. When no reclaim system is installed, water use can range from a low of 15 gpv for self-service car washes, to a high of 85.3 gpv in a frictionless conveyor car wash for a basic wash using equipment and optimal operating parameters for water efficiency. For professional car washes using separation reclamation, the range varies from 30 gpv for in-bay automatics to 70 gpv for frictionless conveyor car washes. When a reclaim system with full filtration is used the range is estimated from 8 gpv for in-bay automatics to 31.8 gpv for frictionless conveyor car washes. Seasonal considerations, the age of the equipment and wash packages designed to clean dirtier cars will all affect actual water use.

Car Wash Water Reclaim

Professional car wash water reclamation has been in use and growing in sophistication for at least three decades. Reclamation has attracted more attention in the past several years from regulators and manufacturers as a means of water conservation and quality control. Most reclaim systems that have been installed meet the needs of the individual professional car wash operator, whether that be to reduce sewer discharge or fresh water consumption, control water and sewer hookup costs, meet regulatory demands or some combination of these factors. The circumstances faced by the professional car wash operator and the desire to conserve water or reduce discharges will dictate the choice of approach and reclaim equipment installed.

The process of reclaiming water can be looked at by dividing the process into its component parts. Where the reclaim water is intended for reuse in the professional car wash will dictate the level of treatment the water receives. The general categories of treatment include separation, oxidation, filtration, and membrane filtration or de-ionization. Professional car wash reclaim systems use water treated in one or more of these manners although technology may differ from installation to installation. It is important to note that choosing the wrong combination of cleaning solutions or treatment processes can create more problems than it solves. It is imperative for the professional car wash operator to understand each element of the reclaim system and its intended use.

It is worth noting that both self-service and in-bay automatic systems present additional challenges in water reclamation as the separation of wash and rinse water in the pit or tank where the car remains stationary is not practical. Therefore, greater treatment will be necessary to use recycled water in certain professional car wash designs.

One of the biggest benefits from professional car wash reclamation systems to stormwater discharge programs and protection of watersheds may be the reduction in pollutant loading from the grit, and road film washed off the cars and collected in the reclaim tanks and filters.

Responding to Drought

Professional car washes typically use less than one percent of water used in a large or medium size municipality. In addition to year-round conservation achieved through efficient operation, professional car wash operators are able to achieve significant additional water savings during drought. The measures required to reduce water use in an already efficient operation will result in impacts on the quality of the car wash and/or the appearance of the business. Professional car wash industry associations across America have outlined the types of steps professional car wash operations will take to contribute to the water demand reduction during an emergency while being able to continue operating. This report lists the steps available for the different professional car wash types in a form which will facilitate their use by communities facing a drought or other water shortage.

The recognition that the professional car wash industry produces jobs is one reason for drought plans which have a different set of restrictions for professional car washes than for residential car washing. Where operators are already realizing significant efficiencies, across the board mandatory reductions in use can be extremely difficult to achieve. For a very efficient operator, achieving an additional 25-30% reduction in demand, applied as an across the board cutback without recognition of existing efficiencies, may require shutting the business down for several days a week. As an example, by working with local regulators in San Antonio, Texas, the Southwest Carwash Association has developed a plan which ensures that professional car washes which are conserving water year-round are not shut down during a drought.

Retrofitting Existing Car Washes with Reclaim Systems

Retrofitting existing professional car washes to include water reclamation can range from a relatively simple to an extremely complicated task depending on circumstances. The three biggest factors in retrofit are space, plumbing and costs. Where the original construction of the professional car wash included in-ground tanks and left sufficient space for reclaim equipment and collection tanks, the costs beyond the reclaim equipment itself will be relatively minor. The costs of plumbing and tank installation are large. This is most likely to be the case in a professional conveyor car wash operation, and potentially in the newer in-bay automatics. Where insufficient room exists for collector tanks, and/or in the case of a crowded equipment room, changes may be extensive and the costs may be prohibitive.

Industry/Utility Cooperation to Promote Water Conservation

Several utility conservation programs in the United States have developed conservation programs in cooperation with the local professional car wash industry. Two of these programs bear special examination in their potential for being implemented in other locales. In San Antonio, Texas the San Antonio Water System and the Southwest Carwash Association developed the Conservation Certification Program in response to the drought of 1995/ 1996. In Seattle, Washington, the Seattle Public Utilities has given conservation grants to two professional car wash operators to install reclaim systems at their facilities.

Conservation Certification

During the spring of 1996, San Antonio was facing the second year of drought, and aquifer levels were dropping rapidly. Modifications to city code to increase the stringency of the drought restrictions called for the shutting down of professional car washes in the third stage of the drought plan. The Southwest Carwash Association responded by approaching the local regulatory authority, the cityís water and wastewater utility, with a proposal. The result was the creation of the Carwash Conservation Certification Program.

The principal benefit of the program to professional car wash operators is that those who pass an annual certification inspection are protected from shutdown during an advanced drought. The benefit to the city is the guarantee that year-round the majority of car washes in San Antonio are employing conservation techniques.

Next Steps

This report concludes with a number of recommendations for further research and program design to increase conservation and reclaim within the professional car wash industry, and to elevate the visibility of existing conservation and reclaim systems with the general public and the utility/regulatory community. (9)

1. Introduction

In response to the water use restrictions imposed by states in the eastern part of the United States in the summer of 1999, and in anticipation of similar action being taken in other parts of the country. This report is designed to be an analysis of techniques used to conserve water in the professional car wash industry and to define those techniques in a standardized manner.

Public perception and policymaker scrutiny of professional car washes during times of drought have led to aggressive proposals to curtail professional car washes during times of drought. This report summarizes current state of the art water conservation and reclamation practices in the professional car wash industry in the United States of America. It is meant to be used by professional car wash operators and utility staff to ensure that professional car washes are water efficient year-round, and that drought cutbacks result in measurable reductions in water consumption.

Professional car washes typically represent less than one percent of water used in a large or medium size municipality. Day-to-day operation of many professional car washes is already efficient, as operators seek to lower their overhead, or use water reclamation systems to lower their discharge. Where professional car wash operators are being efficient, across the board mandatory reductions in use can be extremely difficult to achieve. For a very efficient professional car wash operator, achieving an additional 25-30% reduction in demand may require shutting the business down for several days a week. In advanced stages of drought methods of operation of many businesses may need to be adjusted, but most drought plans are designed to both reduce non-essential water use and to maintain the local economy.

One means of conserving water growing in popularity in many applications including professional car washes is the re-use of water. Water reclamation systems have been in use in professional car washes for several decades. Various levels of water treatment exist as well as differences in which cycles the reclaim water is used. Use of water reclaim systems in professional car washes also varies depending on the type of professional car wash. National surveys show that professional full-service conveyor car washes are the most likely to use water reclamation with 52.9% nationwide claiming to have a reclaim system. Of the professional exterior-only conveyor systems, 48% use water reclamation, while 27% of professional in-bay automatic and 8.5% of self-service operators reclaim at least part of their water.(9)

Methodology

To develop this report, the International Carwash Association (ICA) convened a “Think Tank” comprised of the car wash industryís experts in water conservation including, professional car wash operators, manufacturers, water reclaim system manufacturers, and professional car wash product suppliers to discuss and determine some of the central terminology and a standard means of addressing water reclamation issues. Since the early 1980s little academic research has been pursued in the realm of water reclamation at professional car washes. Most of the modern advances in equipment have come from manufacturers who are understandably concerned about sharing their technology with competitors. As a result, there are many different car wash water reclaim systems designs and practices, many of which use different principles in water treatment and whose components are not compatible.

This study compiles information from earlier studies, current literature from the industry and the input of the "Think Tank" members to advance the discussion of water reclaim and conservation by:

- defining some of the key terms in professional car wash conservation and reclamation;
- outlining the water use and conservation opportunities in professional car washes;
- organizing the basic components of various water reclaim systems into four separate steps;
- examining drought response capacity of professional car washes;
- reviewing the issues related to retrofitting existing professional car washes with reclaim; and
- looking at two examples of industry/utility cooperation to advance water conservation in the field.

The final section is a series of recommendations, made by the author, for follow on measures the ICA should consider pursuing to promote greater acceptance of water conservation in the industry and by regulators.

Professional car wash industry efforts to evaluate the conservation results of water reclamation systems measure savings as either gallons of water per vehicle or percentage of reclaim water used per cycle. Since the goal of any water conservation effort is to reduce the amount of potable water being used, this report uses the gallons per vehicle method. The diversity of reclaim systems in existence and the ability to adjust flow rates of individual processes within the professional car wash may cause the percentage calculation to misrepresent the actual freshwater water flow per vehicle washed.

(9) 1999 Automatic Survey, Professional Carwashing & Detailing, July 1999; 1999 Self-Serve Statistical Survey, Professional Carwashing & Detailing, February, 1999.

2. Definitions

The International Carwash Association (ICA) “Think Tank” identified water reclamation in professional car washes as a central concept requiring greater definition in order to promote clarity in the professional car wash industry and with regulators. The list of definitions in this section is offered to both clearly define terms for this report and to promote understanding of terminology in a national context. The water treatment definitions included here are based on broader definitions of the same technology from the American Water Works Associationís Water Quality and Treatment Handbook(10), and specifically narrowed to deal with the professional car wash environment. The definitions of the professional car wash types are from the ICA.

The definitions are organized from the more general to the more specific, with water separation techniques followed by oxidation and filtration techniques. The definitions of professional car wash types follows at the end of this section. The following words and terms, when used in this report, shall have the following meanings, unless the context clearly indicates otherwise:

Reclaim - The process of treating water, previously used in the wash and/or rinse cycles, for use in the wash process again. At a minimum this process requires the separation of grit, oils and greases from the water prior to being reused in the professional car wash. Additional treatment processes such as filtration, flocculation, oxidation, deodorization, and de-ionization can be used to extend the usefulness of reclaimed water through different parts of the professional car wash process.

Conservation - The efficient use of water in the professional car wash. Through the use of low flow nozzles, proper timing, maintenance, and the use of efficient equipment through out the professional car wash facility and in its landscaping, professional car washes can use water supplies efficiently. Reclamation is one conservation tool available to professional car wash operators.

Separation - The first stage in a reclaim operation. Separation uses a settling tank, usually divided into at least three compartments, to allow grit to settle and to separate grease and oils from the water prior to reclaim in the professional car wash or discharge to the sanitary sewer. The tank will typically be located in-ground with the sections designed for gravity sedimentation, grease and oil separation, and with the third section of the tank for final clarification and discharge to reuse in the professional car wash or to the sanitary sewer system. At this point usually particles of up a range of 50 to 100 microns in size are removed, depending upon the size of the settling tank, and resultant residence time of the water. A cyclonic separator may also be used to increase the total amount of suspended solids removed from the water.

Filtration - The process by which suspended solids are removed from the water in order to better utilize the water in a greater number of the professional wash processes. Granular media filters such as sand, glass and olivine are all in use by professional car washes. Bag or sack filters, made of woven material such as cloth or paper, are also in use.

Oxidation - Oxidation in simple chemical terms is the loss of electrons. The purpose of oxidation in water treatment is to convert undesirable chemicals to a form that is neither harmful, nor as objectionable as the original form. In the professional car wash reclaim system, oxidation is used to treat for odor, color or organisms such as bacteria and algae. Common oxidants include chlorine, ozone, and oxygen or air.

Ozonation - The process of treating reclaim water with ozone to remove odor producing hydrocarbons. Ozone is a powerful oxidizing agent and effective as a disinfectant. In water ozone is a powerful bleaching agent, acting more rapidly than chlorine, hydrogen peroxide or sulphur dioxide. Ozone has an additional advantage over chlorine since it does not leave undesirable odors nor produce trihalomethanes - both potential by-products of chlorine use. One common means of producing ozone for injection in reclaim water is corona discharge. Another method is to produce ozone using UV light.

Activated Carbon - An activated carbon filter is used for the removal of dissolved organics, color and odor-causing compounds. Generally high-molecular-weight, nonpolar compounds are adsorbed more effectively than low-molecular-weight, polar compounds.

De-ionization - Ion exchange onto synthetic resins or activated alumina is considered for the removal of mineral ions or hardness in the water. De-ionized water is used in the spot-free rinse by some professional car wash operators.

Reverse Osmosis - Osmosis is defined in terms of water in an ideal state as the transport from a reservoir of pure water through a semipermeable membrane to a reservoir of water containing dissolved solutes. Reverse osmosis (RO) occurs when pressure is increased on the side of the membrane containing the solutes above the osmotic pressure of the solution. In this case water flows from the osmotic side of the membrane to the pure water side. Product water is used in professional car washes for the spot-free rinse. Reject water from the RO unit may be put back through the wash reclaim system in a closed loop system or used in landscaping or other non-potable uses in the professional car wash.

Ultrafiltration - The process of using a membrane to filter out dissolved solids as well as the finest of suspended solids. Unlike reverse osmosis, ultrafiltration is not dependent on overcoming osmotic pressure differential, and can be accomplished at low pressure differences of 5 - 100 psi. The primary mechanism is selective sieving through pores. A useful membrane for professional car wash reclaim water depends on the substances found in the water and the ability to separate them at an economical rate.

Flocculation - The process by which anionic and cationic materials in the reclaim water are removed through use of polymers and/or metal salts. The chemical interactions result in the coagulation and sedimentation of suspended solids smaller than 5 microns. Flocculation can be used to effectively remove turbidity, color and total suspended solids. It is dependent on the proper selection of flocculent, precise control of the dosage and proper design of the hardware.

Contaminants

The primary constituents of concern to professional car wash operators are:

- TSS (Total Suspended Solids)
- TDS (Total Dissolved Solids)
- oil and grease
- BOD (Biochemical Oxygen Demand or Biological Oxygen Demand)
- COD (Chemical Oxygen Demand)
- detergent
- lead
- zinc
- trace amounts of other priority metals

Of these contaminants, the professional car wash operator introduces only the detergent. The oil, grease, grit and metals are washed off the car surfaces. Wastewater characteristics reported in the literature show large variations by season and by region(11). In 1982 the United States Environmental Protection Agency determined that professional car washes were an “insignificant” contributor as a point source of pollution and designated no pretreatment requirements prior to discharge to sanitary sewer systems(12).

Conveyor Car Wash - There are two types: full-service and exterior only. The professional full-service wash cleans the exterior and interior and the customer waits outside the car while the wash proceeds. During the professional exterior only wash, the driver stays in the car while it is being washed. The car moves on a conveyor belt during both types of washes. In addition to the division based on level of service, there are two basic technologies for the wash cycle, friction or frictionless. The friction conveyor uses brushes or other material or curtains made of strips of cloth, while the frictionless conveyor uses high-pressure nozzles for a touchless wash.

In-Bay Automatic Car Wash - Mostly found at gas stations and the coin-operated car wash, the driver pulls into the bay and parks the car. The vehicle remains stationary while a machine moves back and forth over the vehicle to clean it, instead of the vehicle moving through the tunnel. Professional in-bay car washes use nylon brushes or other material, soft cloth strips or touchless automatic washers.

Self-Service Car Wash - This car wash allows the consumers to wash the car themselves. A wand dispenses water and cleanser at varying amounts and pressures. Often a low-pressure brush is offered to assist in the wash cycle.

(10) American Water Works Association, Water quality and treatment: a handbook of community water supplies, 4th Ed., R.R. Donnelley & Sons Co, 1990.

(11) Qasim, S.R. et. al., Water reclamation in commercial carwashes using chemical coagulation processes, UT Arlington, October, 1983.

(12) United States Environmental Protection Agency, Guidance document for effluent discharges from the auto and other laundries point source category, February, 1982. p1,68

3. Water Use and Conservation in Car Washes

3.1 Background. Water use in professional car washes constitutes a highly visible use of water in a professional process. As such it comes under scrutiny from the public and policymakers, especially during times of drought or water shortage.

In addition to the car wash process itself, landscape and, in some professional full-service car washes, domestic water uses are also a characteristic of water consumption. Conservation and reclaim therefore can be and are implemented in all three of these areas within the professional car wash operation. Operators are motivated by water and sewer pricing, environmental responsibility, and/or regulation to implement conservation measures at their locations. There are characteristics of each kind of professional car wash which dictate potential conservation measures as well as universal measures which can be implemented regardless of the type of professional car wash. Water reclaim systems will be dealt with in Section Four of this report.

This section will briefly describe the stages of a professional car wash process and then examine, based on the type of professional car wash, some of the efficiencies which can be obtained.

Steps in a Professional Car Wash Process:

Pre-soak. An automated nozzle or hand held spray.

Wash. High pressure spray or brushes with detergent solution.

Rocker panel/undercarriage. Brushes or high pressure sprays on sides and bottom of vehicle.

First Rinse. High pressure rinse.

Wax and Sealers. An optional surface finish is sprayed on the vehicle.

Final Rinse. Low pressure rinse - with fresh or membrane-filtered water.

Air Blowers. Air is blown over the vehicle to remove water and assist in drying.

Hand Drying. The vehicle is wiped down with towels or chamois cloths on site. In full-service washes these are then laundered in washing machines on-site.

In a professional conveyor car wash, these steps are performed by separate spray arches and/or brushes. In the professional in-bay automatic, there is a set of nozzles though which all processes are performed, except in some cases where brushes may be used for the wash cycle. In professional self-service car washes there may be a brush for the wash cycle, but all other functions are performed through a hand-held wand.

Conservation techniques can be looked at from the perspective of measures that are applicable in any professional car wash, and/or those which are applicable to specific type of professional car wash. The three generic types of professional car washes are:

- Self-service,
- In-bay automatic, and
- Conveyor.

The conservation techniques will be examined first in order of those which can be implemented in all three types of professional car washes. The following sections will go over techniques specific to each of the different types. The final portions of this section will consider other conservation techniques which can be applied to landscape, and water treatment reject water which does not go into a reclaim system.

3.2 Water Conservation Techniques

The following list summarizes in capsule format the steps professional car wash operators can take to reduce water use in their operations. Following the list is a brief set of descriptions of the techniques, divided by those that are applicable to all professional car wash types, and then some specific tips regarding each type of professional car wash. In Section Seven and Appendix B, there is a description of the Carwash Certification program run by the San Antonio Water System, which illustrates one way of organizing a year-round water conservation program for professional car washes.

Specific Measures for Reducing Water Consumption

- Install lower flow nozzles and run at lower pressure.
- Alignment of nozzles should be checked on a regular basis.
- Check for and repair all water leaks as they occur.
- Replace brass or plastic nozzles, which erode more quickly, with stainless steel or hard ceramic nozzles.
- Route reclaim water, or RO reject water to landscaping (be sure plants can tolerate first!).
- Use “water friendly” plants in the landscape.
- Time arches precisely in the conveyor to come on as car arrives and shut off as car moves out from under arches.
- Adjust weep systems to come on at 32^0 F.
- Install positive shut off valves in extractor sinks.
- Create a dwell time for water to run off the vehicle into the reclaim pit before vehicle can exit the bay.
- Install automatic high-level water cut-offs in all towel and chamois washing machines.
- Use less water in towel washing machines by doing fewer but fuller loads.
- Maintain all water using devices to original or improved specifications for the conservation of water.
- Replace all spray nozzles utilized at the vehicle wash regularly to assure maximum efficiency of water used.
- Utilize ultra-low flush toilets at the vehicle wash facility.
- Use positive shut off valves on all hoses or faucets.

3.2.1 Nozzle Size, Pressure and Alignment

Within the professional car wash itself, perhaps the most significant water conservation measure which can be taken is to reduce nozzle size, and apply the appropriate amount of pressure. This measure alone would appear to account for a perceived reduction in water use by self-service car washes from reports done in the late 1970s and early 1980s to today.(13)The drop in consumption

appears to be about 40% from a range of 20 to 30 gallons per vehicle (gpv) to a range of 13 to 17 gpv per wash based on industry literature.

The pressure, nozzle size relationship is expressed in the equation:

$$N = \frac{GPM}{0.015811 * \sqrt{PSI}}$$

where:	N	=	nozzle size (rounded to the nearest .5)
	GPM	=	the desired flow rate of the nozzle in gallons per minute
	PSI	=	pressure in pounds per square inch
	.015811	=	coefficient

A table showing some standard nozzle sizes along with rated flow at different pressures is included in Appendix A. Nozzle sizes can be easily determined using a visual check of the standard numbers etched on the nozzle by manufacturers. The first two or three digits are the angle of the spray, e.g. 15 = 15^{o}, while 110 = 110^{o}. The final two or three digits are the flow rate in gpm at 40 psi, e.g. 06 = 0.6 gpm, while 065 = 0.65 gpm.

3.2.2 Leaks and Maintenance

While no studies have been done specific to car washes, leaks account for an average of 10% of losses in water consumption nationwide. While the car wash equipment is running, visual inspection for leaks should be performed on at least a monthly basis. Visual checks of car wash equipment should be augmented with a monthly meter read in which all equipment is shut down for the night, and a meter reading is recorded at shutdown and in the morning prior to start up of the equipment. This will help indicate if there is an "invisible" leak. Table 1 shows the extent of water lost over a three month period with various size holes.

Proper maintenance of the car wash includes regular replacement of nozzles. In areas with hard water, a brass nozzle may erode within three months. Stainless steel or hard ceramic nozzles are recommended to reduce water lost to erosion of nozzles.

Table 1
Water Leak Rates

Diameter of stream in:	Waste per quarter at 60 psi water pressure in:			
inches	gallons	liters	cubic feet	cubic meters
1/4	1,181,500	4,472,000	158,000	4,475
1/8	296,000	1,120,360	39,400	1,115
1/16	74,000	280,100	9,850	280
1/32	18,500	70,020	2,465	70

3.3 Conveyor/Full-Service

The professional conveyor car wash is marked by its use of a series of arches from which water is sprayed as the car moves through on a conveyor chain. In professional full-service car washes, hand-drying usually follows the conveyor, and sometimes the pre-soak is done by hand-held wands. In professional frictionless car washes, all wash and rinse cycles are accomplished by means of nozzles situated on the arches.

In professional frictionless car washes, the wash cycle is accomplished with brushes or soft cloth curtains. One simple means of saving water in the friction car wash is to reduce the amount of water going to the brushes or curtains, as these will pick up water and detergent from the pre-soak of cars as the day proceeds.(6)

3.3.1 Nozzle Timing and Alignment

Nozzles should be timed to turn on as the vehicle reaches the arch, and shut off as it moves out of range. It is also crucial to ensure that the nozzles are properly aligned to fall on the car. A study of professional automatic car washes in Phoenix cited this issue as being a contributing factor in the difference between a car wash which used 29 gpv and another which used 63 gpv(7).

Another technique for saving water is to create a dwell time for the car after the final rinse. Water which would otherwise be lost to the system can flow back into the reclaim pit, and be reused in the car wash.

3.3.2 Towel Washing Equipment

In a professional full-service conveyor towel drying of the car is one of the services. In an exterior-only conveyor towel drying is rarely offered. In many older car washes towel washing sinks are designed for a constant flow of water through the sink. To cut waste from these appliances, installation of a float ball valve to halt the flow of water when it reaches an optimum level should save a significant amount of water. Where machines do not feature a continuous feed of water, shifting to a front loading machine will cut water consumption by approximately 40%. Another technique for reducing water consumption in the towel washing process is to do fewer but fuller loads.

Table 2
Typical Fresh Water Usage in Conserving Car Washes(8)

Freshwater use in gallons per vehicle (gpv)	Self-Service	In-Bay Automatic	Conveyor	
			Friction	Frictionless
no Reclaim	15	50 - 60	65.8	85.3
Separation Only	n/a	30*	34.8	70
Filtration	n/a	8	7.8 - 13.8	16.8 - 31.8

3.4 In-Bay Automatic

Professional in-bay automatics are characterized by a facility, sometimes coin-operated, in which the customer stays in their car as the car wash equipment uses either spray nozzles or brushes, or a combination of both to process the individual cycles, while the car remains stationary within the car wash bay.

Nozzle alignment, flow rates and timing are all deciding factors in water conservation for in-bay automatic car washes. In addition to water used in the pre-soak and wash cycles, many in-bay automatic operations offer a spot-free rinse. This is typically obtained with reverse osmosis (RO) equipment. Reject water from the RO unit can be utilized in landscape watering where a professional in-bay automatic operation has landscaping.

3.5 Self-Service Car Wash

Professional self-service car washes are typically characterized by a central equipment room, in which water process equipment is housed, along with four to six bays with individual wands and/or brushes for customers to use. A mechanical estimate of water use based on the number of cycles, and the number of cars washed on average in the professional self-service car wash show ranges of 13 - 17 gpv, with an average of 15 gpv(9). Reclaim is not usually a feature of the self-service car wash due to the relatively few gallons used by a properly designed water efficient professional car wash. However, in some cases where no discharge to sanitary sewer is available, and all discharge is restricted, the professional self-service car wash has been designed with a closed loop system(10). In these circumstances only water lost to evaporation and drag-out would be consumed by the operation. The International Carwash Association is currently pursuing a study of evaporation and drag-out that will help quantify these numbers.

In addition to water used in the pre-soak and wash cycles, many self-service operations also offer a spot-free rinse. Like the in-bay automatics, reject water from the RO unit can be utilized in landscape watering where a professional self-service operation has landscaping.

3.6 Water Softeners and Reverse Osmosis Equipment

Hardness in the water leads to the use of greater amounts of detergents and causes scaling in pipes and spray nozzles. As a result water softeners are used in most professional car washes to reduce the need for detergents and reduce spotting on vehicles.(11) Since other solids not removed by water softeners can contribute to spotting, professional car washes in areas with TDS of 350 ppm or higher often use one of the membrane filtration methods to produce a spot-free rinse. Lower TDS also results in lower soap use to produce suds, thus reducing discharge to the sewer system and cost of operation.

Backwash from the water softener and reject water from an RO unit can be used in other non-potable demands in the professional car wash such as landscape watering, or domestic. Although these waters should not present any health concerns when used properly, local or state regulations should be researched to determine the appropriate steps for utilizing backwash or reject water.

3.7 Conservation in the Landscape

Water conserving landscape can benefit the professional car wash operator in a number of ways. The concept of xeriscape, or low-water use landscaping, has been gaining acceptance across the country since the term was coined in Denver in the late 1980s. Currently, communities such as Los Angeles and Las Vegas require low water use landscaping in the ornamental landscape areas fronting businesses. Professional car wash operators have a ready means of irrigating their landscaping, with RO reject water from the spot-free rinse cycle. Car wash operators using RO reject water should check with a local landscape expert to avoid using plants in their landscape which would not tolerate the dissolved solids levels in the water.

If there are circumstances that prevent the use of reclaim or RO reject water in the landscape (as in a car wash which does not have an RO system), car wash operators can irrigate with drip irrigation systems. By applying water at the root zone of the plant, evaporative and run-off losses are minimized.

(13) Qasim, S.R. et. al., Water reclamation in commercial carwashes using chemical coagulation processes, UT Arlington, October, 1983.
DeMarre J., Water Treatment, Auto Laundry News, March 1997.

(6) Kobrick, J.D., et. al., Water uses and conservation opportunities in automatic carwashes: A City of Phoenix study, June 1997.

(7) IBID., June 1997

(8) The raw data for this table was provided by car wash and reclaim system manufacturers, and is based on flow rates of equipment and average time of use for the typical car wash except where noted by *.

In conveyor car washes, the amounts per cycle will vary with the length of the car wash and the speed of the conveyor. These conveyors are assumed to be 130' operating at approximately 60 cars per hour. The ranges of fresh water used with filtration has to do with the level of filtration and the particular cycles in which the filtered reclaim water is used. See Section 4 and Table 3 for a more detailed discussion.

*The 30 gpv is an average arrived at in a water use study performed in Massachusetts (Clark, H., et. al., 1988).

(9) DeMarre J., Water Treatment, Auto Laundry News, March 1997.

(10) Shane Anderson, Gin-San, Personal Conversation, September 27, 1999.

(11) Bacon, R. and Powell, D. Water-Treat it Right, Auto Laundry News, March, 1998.

4. Reclaim

Professional car wash water reclamation has been in use and growing in sophistication for at least three decades. Reclamation is getting more attention in the past several years from regulators and manufacturers as a means of water conservation and quality control. Most reclaim systems that have been installed meet the needs of the individual operator, whether that be to reduce sewer discharge or fresh water consumption, control water and sewer hookup costs, meet regulatory demands or some combination of these factors. The circumstances faced by the operator and the desire to conserve water or reduce discharges will dictate the choice of approach and reclaim equipment installed.

According to industry experts, some of the factors that the operator must consider include:

- the nature of the contamination to be treated
- concentration of contaminants
- volume of water used per day
- flow rate per minute of different processes in the professional car wash
- chemicals and procedures used in the wash or rinse process
- discharge limits (if applicable)
- the intended use of the reclaim water, and the desired quality for its use.(12)

These factors will vary by locality and the combination of solutions lead to different systems installed by diverse operators. It is important to note that choosing the wrong combination of chemicals or treatment processes can create more problems than it solves. It is important for the operator to understand each element of the reclaim system and its intended use.

4.1 Advantages and Challenges of Reclaim

In deciding to install a reclaim system it is important for the professional car wash operator to understand some of the advantages that the system will bring as well as the challenges of maintaining it. One of the first benefits of a reclaim system to the car wash operator is reduced costs. Costs for impact fees are lower in some communities due to lower discharge quantities. The costs for raw materials, water chemical and the sanitary sewer fees are all lower as well. In some communities, the reclaim system will help a car wash operator meet mandatory state requirements for droughts, and insulate against regulation. The professional car wash operator is also poised to take advantage of increasing efficiency of water use in designs. One of the big benefits is to operate a business which is in tune with the desire of the public for environmental protection and the ability of the car wash operator to generate positive public relations because of their efficient use of water.

Just as reclaim systems will bring benefits to the professional car wash operator, there are costs to be balanced as well. Among these are the increased maintenance time, and depending on the design, the cost of maintenance. The equipment requires sufficient space and plumbing. Where operators choose to do the least amount of treatment, there are color and odor concerns. Car wash operators need to understand how the system works and which chemicals are compatible with their system. Car wash operators who purchase soaps and waxes that are incompatible with their treatment systems will experience problems. Where the public comes in contact with the water, at a self-service, or an in-bay automatic, color and odor problems will not be acceptable, and greater treatment levels are a must. Despite these challenges many operators have opted for water reclamation, and many more will weigh the benefits and costs and decide to install water reclaim systems in their professional car wash. Education of car wash operators to the needs of a properly functioning water reclaim system is essential.

4.2 Reclaim in the Professional Car Wash

The process of reclaiming water can be looked at by dividing the process into its component parts. Where the reclaim water is intended for reuse in the car wash will dictate the level of treatment the water receives. The general categories of treatment include:

a. Separation
b. Oxidation
c. Filtration
d. Membrane Filtration or De-ionization

Professional car wash reclaim systems use water treated in one or more of these fashions, although technology may differ from installation to installation. A brief description of each of these treatment options and some of the specific techniques that are applied follows below in Section 4.2. The cycles within the professional car wash operation where the treated water is used falls into several categories based on the level of treatment and is examined in section 4.3.

4.2.1 Separation

The first step in the reclaim process is to separate grit, oil and grease from the wash water. This is usually accomplished in a series of three tanks. Settling and separation tanks must be large enough to allow large particles to settle to the bottom of the tank. A properly designed separation system will consist of three tanks or compartments of approximately equal size. The first tank will have an oil and grease separator. The settling tank is the next compartment, followed by a third tank from which reclaim water is pumped for reuse or further filtration and treatment before use. Discharge to the sewer also may occur from this third tank. (See Figure 1)

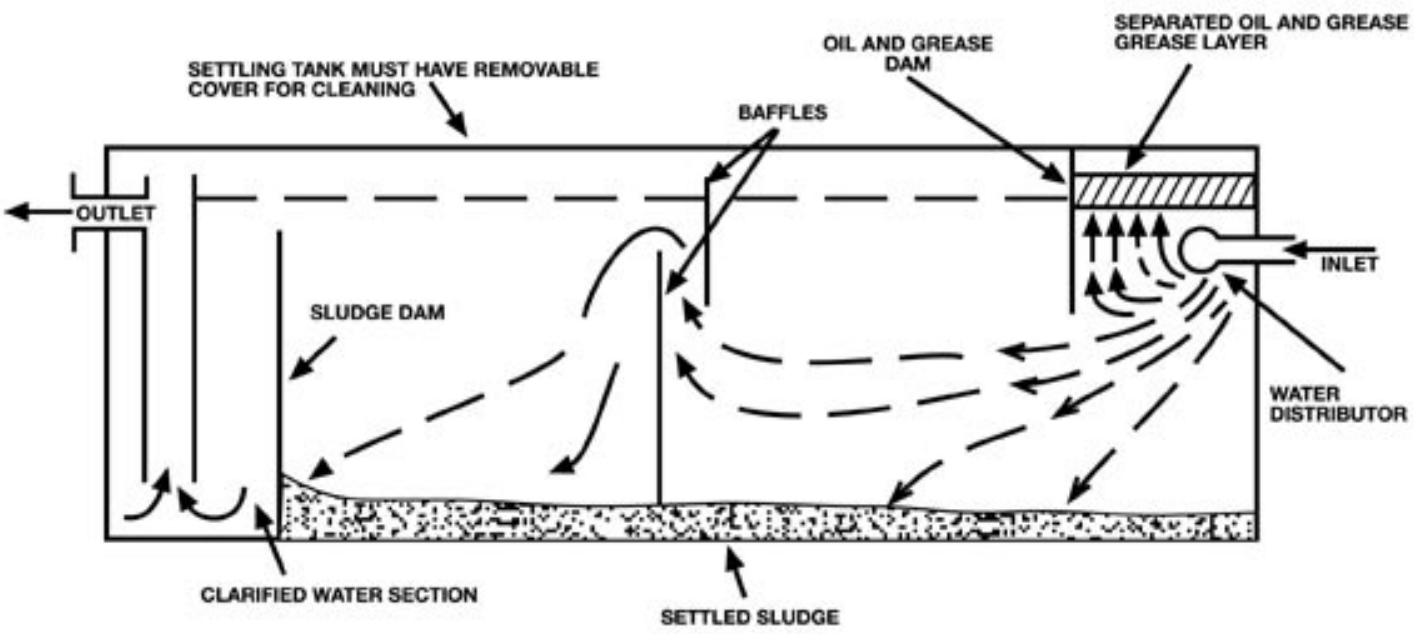

Figure 1. Schematic of a Separation Tank (From Quasim, et al, 1981)

After settling of the solids and skimming of oil and grease, the water is reused in undercarriage, rocker panel cycles and to hose down the inside of the car wash during clean up. Cyclonic separation may also be used to assist in removing particles down to 30 microns in size. In many older systems, the first step in the reclaim process, separation, is the total extent to which reclaim is performed before the water is re-used.

4.2.2 Oxidation

Many professional car wash operators have addressed additional problems with reclaim water such as odor and color. When the reclaim water does not come in contact with the customer as in a professional full-service conveyor, this issue is less critical. Where the customer stays in the car, or in a professional self-service environment, color and odor are concerns.

Color and odor may be caused by bacterial or algal growth in the water, or from hydrocarbons picked up from the cars. Oxidation of the contaminants is the answer. Aeration is one solution - running air through the tanks. Some operators use chemical solutions such as chlorine or chlorinated products. In some cases a deodorant may be used to mask the odor(13). More sophisticated systems use ozone.

Ozone can be generated by corona discharge or by UV light. Both systems require a source of air and a self-contained mixing vessel. Ozone is generated by exposing air to energy in the form of a spark, a current or UV light(14). Since Ozone can be hazardous to the lungs, and is also very reactive, it needs to be mixed with the reclaim water by means that prevents exposure to car wash operators. The oxidizing reaction both removes the odor and color-causing material while neutralizing the ozone. A consideration for those contemplating use of corona discharge is that such a system works best with dry air, and refrigeration is recommended to reduce humidity in the air intake system and increase the net yield of the system.

A technology not currently in use in many professional car washes, but predicted to take hold in the near future is enzyme technology. In use in swimming pools and in European countries, it is an effective means of controlling odor and color. (15)

4.2.3 Filtration

With some additional filtration, such as a bag or media filtration to remove particles above 10 microns in size, the reclaim water may be used in high pressure pumps to perform the wash cycle. Such filtration includes sand and other granular media such diatomaceous earth, glass or olivine. Absorption filters used in this stage of the wash process include cloth, paper or other synthetic materials.

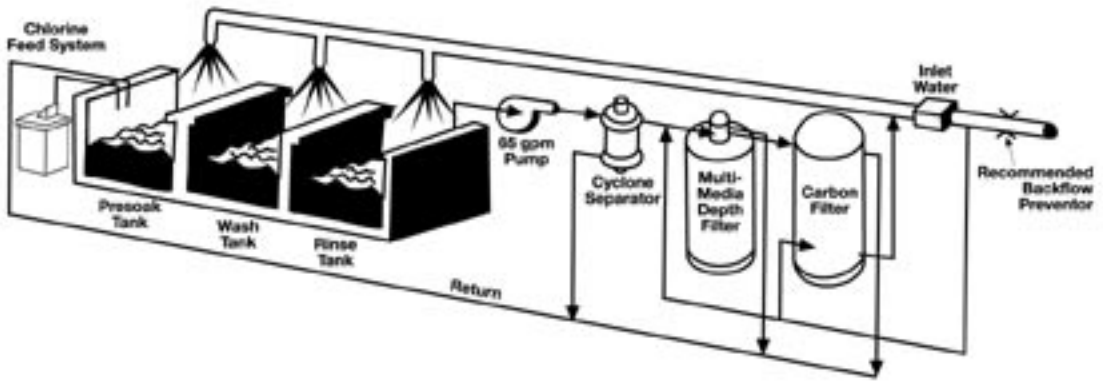

Figure 2. Conceptual design of filtration reclaim system. (From Pero, 1999)

The suspended solids in wash water may cause a variety of problems. Larger suspended particles can affect the vehicle's finish while smaller particles, including dissolved solids, can cause spots. In addition, particles larger than 10 microns can damage high pressure pumps. This has led to the use of more sophisticated filtration equipment in reclaim systems. After the multi-media filter, an activated charcoal filter can remove chlorine and hydrocarbons from the water prior to return to the wash system.

Flocculation can assist in treating the water through breaking down the resistance of very small suspended solids and causing them to bind together in larger particles for filtration. Flocculation is used to control color in some reclaim systems.

Filters must be maintained. Particle media are cleaned and reactivated by backwashing. The backwash both cleans the media and breaks up preferential channels which may have developed over time and reduced the effectiveness of the filter. Closed loop systems route the backwash water into the settling tanks of the car wash. Other systems may route the water to the sanitary sewer system. Properly maintained granular filters may last from one to four years before replacement is necessary. Cloth or paper filter, so-called sack or bag filters, require replacement on a more regular basis. Depending on the dirt load being handled and the size of filter opening, filters may need to be replaced every 300 to 1,000 vehicles. Figure 2 shows one conceptual drawing of a reclaim system that integrates separation, chemical oxidation, and filtration in the reclaim process.

4.2.4 Membrane Filtration/Ion Removal

Membrane filtration or ion removal is used in cases of high total dissolved solids (TDS), to prepare the water for the final rinse. Of the three common techniques, ultrafiltration, de-ionization, and reverse osmosis, the last is used most frequently, according to operators.

Reverse osmosis (RO) provides 95 to 99 percent reduction of dissolved solids in water(16). RO requires pretreatment of the water depending upon the condition of the raw water. Chlorine must be removed as it could damage the RO membrane. This is usually accomplished using an activated carbon filter. Other constituents require specific pre-treatment methods, and the RO manufacturers usually will provide the pre-treatment and RO system as a package. If reclaim water is sent to the RO system additional pretreatment is likely to be necessary.

As it flows through the RO system, water is separated into a product stream or the filtered water, and a reject stream, or a stream of water higher in TDS than the raw water. In cases where fresh water is being used for the spot-free rinse cycle, the TDS level of the reject water is sufficiently low that the reject water can be put to use in alternate systems such as landscape watering, an earlier part of the wash cycle, or a pre-rinse cycle. Since high TDS can result in higher demand for soap, the system should be designed to meet the specific needs dictated by the raw water quality of the local water supply.

The product water goes from the RO system into an atmospheric tank for storage and re-pressurization for use in the final rinse. Adding an RO system to an existing professional car wash can be accomplished very efficiently - most systems require little room and in a crowded equipment room can be installed on the wall. The storage tanks however need sufficient space and this can prove to be difficult in some circumstances.

Ultrafiltration also uses membrane technology. Although the range of particle removal is larger than that removed through RO, ultrafiltration may be acceptable where the water is soft and TDS levels are low. De-ionization is also used by some professional car washes for the spot-free rinse. The ion removal process results in water which is ideally suited for all applications in the professional car wash - although the process may be too expensive for such widespread use.

4.3 Where Reclaim Water is Used

Each of the processes in reclamation of water listed above assist in the reuse of the water at specific points in the professional car wash. The next section will briefly describe which parts of the wash process are appropriate for reclaimed water that has been treated by one of the four general treatment processes listed above. Table 3 shows a typical reclaim water use pattern for car washes depending on the type of reclamation: separation or filtration. The table is useful for a general description of the processes used, but individual operators may have unique setups depending on the design of the system and the practical operating concerns. Table 3 shows conveyors divided by those who use friction versus those who use touchfree processes. Some of the practical concerns are elucidated in each of the following sections. Table 4 shows where the two types of conveyors, as defined by the level of service, full-service and exterior-only, use reclaim water.

It is worth noting that both professional self-service and in-bay automatic systems present additional challenges in water reclamation as the separation of wash and rinse water in the pit or tank is not possible. Therefore, greater treatment will be necessary to use recycled water in certain professional car wash designs.

4.3.1 Separated

Water which is reclaimed through the separation process, in the settling tanks, having had oil and grease skimmed and possibly having had cyclonic separation, is useful in the undercarriage rinse, rocker panel pass, and for washing down the inside of the car wash. Without further treatment it is not useful for high pressure applications. It is also not useful for self-service applications, nor any application where customer contact is likely to occur, such as in-bay automatics or exterior-only conveyor where the customer remains in the car during the wash cycle. This is due to color and odor issues. In conveyor systems that use friction, such as brushes or curtains, separated reclaim water is used to wet the curtains or brushes.

Table 3
Where Reclaim Water is Used in the Car Wash

	Self-Service	**In-Bay**	**Conveyor**	
			Friction	**Frictionless**
Pre-soak	NA	FR?	FR, RO	FR?, RO
Wash	NA	FR	SR, FR	FR?
Rocker panel undercarriage	NA	FR	SR, FR	SR, FR
First Rinse	NA	FR	FR	FR
Wax and Sealers	RO	RO	RO	RO
Final Rinse	RO	RO	RO	RO
SR = Separated Reclaim Water FR = Filtration Reclaim Water FR? = Some debate over this application RO = Reverse Osmosis or De-ionized water				

4.3.2 Filtered or Treated Water

Water that has been filtered down to 10 microns can be used in all of the uses of water from which oil, grease and grit were separated plus high pressure applications. It can be used in the wash and pre-rinse or first rinse cycles. It can also be used in landscape applications where local regulations allow. Water that is filtered in this manner is often treated for odor and color through an oxidation process. Flocculation or activated charcoal are also used in some instances. In some cases, when grit levels measured as parts per million are relatively few for the volume of the water, pump manufacturers will recommend 30 micron as the limit for filtering.(17) Depending upon water hardness and TDS filtered water may be used in the pre-soak cycle. *Professional Carwashing & Detailing* magazine asked respondents to its annual survey of automatics in which car wash cycle(s) they used reclaimed water. The results are divided by full-service versus exterior-only and are shown in Table 4.

Table 4
Where Reclaim Water is Used in the Conveyor Car Wash

	Full-Service	**Exterior-Only**
Don't Recycle Water	47.1%	52.0%
Pre-soak	23.5%	22.0%
Wash	45.6%	32.0%
First Rinse/wax	11.8%	8.0%
Final Rinse	2.9%	2.0%

4.3.3 Fresh Water

Fresh water can be used for the entire process, but in reclaim systems it is preferred for specific applications. The flow rate and timing of these applications is the largest factor in dictating potable water use in a professional car wash which is equipped with a reclaim system. In wash and rinse reclaim systems, fresh water is used in the spot-free rinse (if the raw water is not too hard), the wax, polish and drying agent cycles, and for pre-soak foam generation.

4.3.4 Ion Removal/Membrane Filtration

Ion removal, ultrafiltration and RO are used in cases where fresh water TDS or hardness would cause spotting. Of the professional self-service washes 52.7% use RO water in the rinse cycle as compared to 6.1% that use de-ionized water. This is much higher than in the full-service conveyors where 12.7% of professional full-service car washes use RO and 22.2% of professional exterior-only conveyors use RO.(18)

The reject water from an RO system can be cycled back into the reclaim system as can the ultrafiltration backwash. Depending on the solution used to regenerate the ion exchange unit, usually sent to the sanitary sewer system, where applicable. Ion removal or membrane filtered water can be used in theory for the entire wash but it is probably cost prohibitive to do so. Typically this water will be used in the final spot-free rinse and sometimes in the pre-soak.

4.3.5 Reverse Osmosis Reject Water

Due to the type of process that produces RO, there is a constant stream of reject water as well as product water. While TDS levels will be higher than fresh in this water, it has several uses in the professional car wash. It can be used in the wash cycle, landscaping (if plant materials are tolerant), and in the wax-rinse arch. If the water is soft, then it can be used in foam generation.

4.4 Cleaning Solutions, Detergents, Waxes and Drying Agents

Many professional car washes use a combination of detergents or chemicals in the wash, wax and rinse processes which may cause difficulties for specific reclaim technologies. Rapid fouling of filters, difficulty in flocculation, and degeneration of filter membranes are all potential outcomes of improper combination of chemicals in the professional car wash process. In order to operate a successful car wash reclaim operation the operator must ensure that the chemicals used in the car wash are compatible with each other and with the reclaim systems that are installed.

4.5 Discharge Limits

Although the federal EPA decided in 1982 that professional car washes represent an “insignificant”(19) threat to safe drinking water, and therefore determined not to develop pre-treatment regulations for professional car washes, (20) some states have pretreatment regulations. For example, Florida’s Department of Environmental Protection has established maximum concentration levels in discharge to surface water of 5.0 mg/L for oil and grease, 0.05 mg/L for detergents and 250 mg/L for chlorides(21). Reclaim systems can assist professional car wash operators in meeting these discharge limits.

One of the biggest benefits from professional car wash reclamation systems to stormwater discharge programs and protection of watersheds may be the reduction in pollutant loading from the grit, and road film washed off the cars and collected in the reclaim tanks and filters.

4.6 Maintenance

One cost of operating a reclaim system is increased maintenance. Maintenance issues include cleaning and maintaining the car wash equipment, ensuring that filters are changed or cleaned regularly, and generally paying close attention to the operation of the system to ensure that it is functioning properly.(22) Depending on the size mesh, and the amount of suspended solids in the reclaim water, bag or sack filters may need to be changed on a frequency from daily to twice a week.

Appropriate maintenance will not only ensure that the reclaim equipment works correctly, but that the reclaim water does not cause corrosion of the car wash equipment (23).

4.7 Challenges for Professional Car Wash Reclamation Systems

As more interest grows, the issue of water reclamation in professional self-service washes will need to be addressed. While the public is more environmentally aware than in the past, they may still deposit certain materials into the sumps when the operator is not in attendance the systems will need to be more robust than a typical reclaim system. The low water use of a typical professional self-service wash indicates that the cost/ benefit ratio for introducing reclaim into a professional self-service environment may be an obstacle to wide acceptance by operators.

The variety of technology and the apparent diversity in operational systems suggest that industry-wide criteria or standards would assist in the growth of reclaim in the professional car wash industry. Section Six of this report will look at the potential for retrofit of car washes, and Section Seven will examine two public/private partnership programs with local utilities that have increased the amount of water reclaim being used. The next section examines methods that professional car wash operators can use to respond to drought or water shortages with reductions in water use beyond those accomplished in day to day conservation and reclamation.

(12) DeMarre J., Water Treatment, Auto Laundry News, March 1997.

(13) Pero, S, A declaration for water reclamation, Professional Carwashing & Detailing, August, 1999.

(14) Duplantis, J., Where ozone meets your water, Professional Carwashing & Detailing, March, 1998.

(15) IBID., August, 1999

(16) Bacon, R. and Powell, D. Water-Treat it Right, Auto Laundry News, March, 1998.

(17) Terrsigni, P, Recommended micron filtration for reclaimed water, Giant Industries; General Pump Engineering

(18) Bulletin, Reclaim water usage, January 17, 1997.
1999 Self-Serve Statistical Survey, and 1999 Automatic Survey, Professional Carwashing & Detailing, 1999.

(19) United States Environmental Protection Agency, Guidance document for effluent discharges from the auto and other laundries point source category, February, 1982. p1

(20) IBID., February, 1982. p68

(21) IBID., March, 1998.

(22) Fucini, J., There's a Bright Future for Reclaimed Water, Professional Carwashing & Detailing, March 1996.

(23) IBID. March, 1996.

5. Drought and Water Crisis

In addition to year-round conservation achieved through efficient operation, professional car wash operators are able to achieve significant additional water savings during drought. Drought conditions are triggered by a variety of circumstances depending on one's location in the country, and whether the community's water supply is dependent on a surface water reservoir, groundwater or a combination of the above.

The typical drought plan has several phases or stages that are dictated by the local water supply characteristics. At each progressive stage greater restrictions are placed on water use by local or state authorities. The goal of these plans is to restrict nonessential or discretionary water use first. Typically this includes a definition of essential use as that which is necessary for human health and safety, or which produces an economic good. In many drought plans, these goals are explicitly stated.(24)

Since residential landscape watering and home car washing are not considered essential uses of water, typically there are restrictions placed in early stages of a drought plan on these activities. Professional uses of water in the landscape and car wash industries come into close scrutiny due to the similarity in end-use to the residential uses that are restricted. The recognition that the professional car wash industry produces jobs is one reason for drought plans that have a different set of restrictions for professional car washes than for residential car washing.

However, as droughts lengthen and the water reservoir situation worsens, professional car washes will come under scrutiny for restrictions. As happened in San Antonio, Texas in the drought of 1996, and in Maryland and Kentucky in the drought of 1999, proposals to shut down professional car washes may arise.

Many of the techniques listed in this section are considered by professional car wash operators to have an impact on the quality of the car wash. During droughts or water crises, the public is more likely to accept a professional wash that does not end with a spot-free rinse if there is a sense that the professional car washes are contributing to the cutbacks the public is asked to make during a water shortage.

The following steps for professional car washes to take during a drought was compiled from drought measures practiced by water conserving car washes in Greensboro, N.C. and San Antonio, TX, along with recommendations from the ICA.

5.1 Steps to Utilize During a Drought or Water Crisis:

Self-Service

- Reduce nozzle size.
- Reduce pressure.
- Turn off spot-free rinse.
- Discontinue bay/lot wash down.
- Discontinue landscape water.
- Reduce hours of operation.
- Recycle RO reject water back into the wash process.

In-Bay Automatic

- Cut out soap pass, if more than one pass.
- Reduce nozzle size.
- Eliminate spot-free rinse, underbody rinse, rocker panel pass.
- Increase speed of cycle times.
- Reduce pressure.
- Discontinue bay/lot wash down.
- Discontinue landscape water.
- Reduce hours of operation.

Conveyor

- Utilize all steps from self-service/in-bay automatics.
- Place floats on towel washing machines.
- Speed up the conveyor - Reduce rinse cycles to no more than 40 seconds per car. Increasing conveyor speed is the easiest means of achieving water savings in this manner.
- Turn off one or more arches.
- Reduce prepping, turn off prep guns.
- Re-arrange nozzles on the top and sides of arches - use gravity to assist the wash and rinse process: bigger nozzles placed on top, and smaller nozzles on sides.
- Reduce the amount of water used in rinse or extractor cycles on towel washing machines.
- Reduce tip size and operating pressure in detail prep guns.
- Eliminate part of the rinse or reduce rinse nozzle size to save at least 25% of water used in rinse cycle.
- Ensure that arches are correctly timed to start and end as car passes under them.
- Increase dwell time during the final rinse cycle so as to catch and reclaim more water.

Reduced water pressure on high and low pressure pumps will reduce the amount of water used. See Appendix A. Reducing conveyor time will reduce the amount of water used on each vehicle as it passes through the professional car wash. While it will also result in cars which are less clean, the combination of reduced pressure, nozzle size and timing have been estimated to reduce water consumption by up to 35% in professional conveyor car washes(25).

Perhaps the most important factor for the professional car wash operator is that these efforts be recognized by the public during times of drought and water shortage. To that end, positive publicity for water conservation and reclamation efforts during non-drought times can not be underestimated. The San Antonio Certified Commercial Carwash Program, which is described in Section Seven, assists both professional car wash operators and regulators at the utility who have to explain to the public why they are not allowed to wash their cars at home while the professional establishments are open.

(24) City of San Antonio City Code, Chapter 34, Aquifer Management Plan. City of Philadelphia Drought Plan, Phase 1 & 2.

(25) Greensboro, NC Car wash Operators proposal to City Council, December 14, 1998

6. Retrofitting Existing Professional Car Washes

Retrofitting existing professional car washes to include reclaim can be relatively simple to an extremely complicated task depending on circumstances. The two biggest factors in retrofit are space and plumbing. Where the original construction of the professional car wash left sufficient space for reclaim equipment and collection tanks, the costs beyond the reclaim equipment itself will be relatively minor. This is most likely to be the case in a conveyor car wash operation, and potentially in the newer in-bay automatics. Where insufficient room exists for collector tanks, and/or in the case of a crowded equipment room, changes may be extensive and costly. This is most likely to occur in the self-service environment with older facilities.

6.1 Costs

Costs of retrofitting include design, permits, the reclaim equipment, electrical and re-plumbing the professional car wash facility. In cases where sufficient settling tank volume exists, small concrete cuts may be all that is necessary to route plumbing from the separator tanks back to the equipment room. If tanks are non-existent or undersized for a reclaim system, then tanks will need to be added. If aboveground tanking is impossible due to circumstances, then concrete will have to be cut, and tanks installed. Contractor and construction costs will have to be calculated. In a few instances, most likely only at self-service washes, property acquisition may be required if there is insufficient room to place a tank on existing property. The costs listed all vary widely from region to region. In the research for this report, no source of information was located that compiled such data.

In addition to capital costs listed above, there are operational costs associated with maintaining the reclaim system, increased maintenance of existing car wash equipment, down-time of the car wash while retrofitting is taking place, and clean up time increasing in the daily operation of the professional car wash.

6.2 Savings

Savings associated with retrofit include the reduced costs of soaps, waxes and drying agents, as well as reduced water costs and demand for fresh water. Reclaimed systems also discharge less to the sewer and may result in lower sewer discharge fees. This often requires negotiation with the operator's local utility. In some regulatory environments, where there is no access to sanitary sewer, or where water conservation has become mandatory, operating a reclaim system may afford the operator the only means of staying in business. Finally, after retrofit, the reduced demand for water may allow the car wash operator to operate on a smaller water meter saving in meter fees as well as water and sewer costs. All of these potential savings should be weighed by an car wash operator considering reclaim water.

6.3 Reverse Osmosis

Adding an RO system to an existing professional car wash can usually be accomplished very efficiently - most systems require little room and in a crowded equipment room can be installed on the wall. Since the overall spot-free rinse must be able to work continuously during operating hours the system needs to be installed for automatic operation. This includes the pre-treatment filter equipment that should use an automatic backwashing system. The RO system should also have a low pressure alarm for cases in which water pressure drops to the point the RO process no longer works efficiently. The storage tank for the RO water can provide additional challenges for a car wash with little additional space for the tank. Where structurally sound, some operators have placed an RO water storage tank on the roof of the car wash.

7. Utility/Industry Cooperation

Several utility conservation programs in the United States have developed conservation programs in cooperation with the local professional car wash industry. Two of these programs bear special examination in their potential for being implemented in other locales. In San Antonio, Texas the San Antonio Water System and the Southwest Carwash Association developed the Conservation Certification Program in response to the drought of 1995/ 1996. In Seattle, Washington, the Seattle Public Utilities has given conservation grants to two professional car wash operators to install reclaim systems at their facilities.

7.1 Conservation Certification

During the spring of 1996, San Antonio was facing the second year of drought, and aquifer levels were dropping rapidly. Modifications to city code to increase the stringency of the drought restrictions called for the shutting down of professional car washes in the third stage of the drought plan. The Southwest Carwash Association responded by approaching the local regulatory authority, the city's water and wastewater utility with a proposal. The result was the creation of the Carwash Conservation Certification Program. A detailed description of the program guidelines can be found in Appendix B.

The principal benefit of the program to professional car wash operators is that those who pass an annual certification inspection are protected from shutdown during an advanced drought. The benefit to the city is the guarantee that year-round the majority of professional car washes in San Antonio are employing conservation techniques. More than 100 professional car washes have taken part in the program and are certified as water conserving.

Additional facets to the program include a requirement that Certified Carwash Operators host at least three charity car washes a year, and that local charities are prohibited from doing car washes on local business parking lots. While enforcement of this provision is always a challenge, greater public awareness of the stormwater pollution protection and conservation benefits of the program has grown since its inception.

Car wash operators are also eligible for up to 50% rebate on the costs of initial installation of reclaim and conservation equipment. While this has resulted in some rebates to professional car washes for more efficient nozzle installation during the first year of the program, the most significant rebate program for professional car washes in the nation is run by the Seattle Public Utility.

7.2 Conservation Rebates

Since 1990 the Seattle Public Utilities has run a commercial rebate program for its large commercial customers with unique needs. Unlike toilet rebate programs, prevalent throughout the U.S., Seattle's Water Smart Technology program rebates businesses for unique projects which result in significant water savings. Two professional car washes have taken advantage of the program and installed reclaim equipment receiving a combined $63,034 in rebates for their efforts.

Seattle's program requires professional car wash owners to specify the amount of water anticipated to be saved through professional car wash retrofits. The utility then calculates a simple payback period based on water and sewer costs, and a net benefit to other water customers from avoided costs. The avoided costs looks at the marginal price of water based on the estimated cost of building or buying a new water source for the City of Seattle. This method helps utility ratepayers and the professional car wash operators see the true contribution to the local economy and ratepayers based on the future cost of the water.

Seattle rebated $42,400 to Grayline of Seattle for a $85,000 reclaim system. Grayline has been using 350 gpv to wash its buses, and had expected to reduce water usage to 35 gpv of freshwater with the reclaim system. According to Phil Paschke, who coordinates the Seattle rebate program, a recent spot check of the system found the bus line using only 25 gpv of freshwater to wash the buses. (26) Seattle has also approved a rebate for a professional tunnel car wash with an anticipated use of about 70 gpv of total water and only 17 gpv of freshwater at a local gas station. The rebate for this system was $20,634 of an estimated cost of $41,268.

These two programs show that utilities and professional car wash operators can work together to reduce water consumption. Whether it is a need to reduce stormwater contamination, or manage a water shortage, many utilities will be open to developing partnerships that will benefit both their ratepayers and the professional car wash operator. It is incumbent upon the professional car wash operator to approach regulatory or utility staff about such programs. Since professional car washes represent a small percentage of overall water use for most utilities, it is unlikely that the regulatory focus will be on professional car washes until there is an emergency. During a water supply crisis is not the best time to develop a mutually beneficial conservation program for professional car washes.

(26) Paschke, P., Personal conversation, October 14, 1999

8. Recommendations

The following recommendations are made by the author with some contribution of consultation with the “Think Tank” participants. The recommendations are based on the research that has been developed with the help of the “Think Tank” participants and the experience of working in water conservation efforts for more than ten years.

1.One tool which will assist in the expansion of reclaim is the development of a cost-of-water ruler by which to generate a figure for dollars of savings depending on the reclaim system which an operator installs. This ruler would enable an operator to more quickly calculate when the marginal costs of water and sewer in their area made a reclaim system payback period reasonable.

2. The lack of data to statistically corroborate the various claims of professional car wash operators and manufacturers about the efficiencies of reclaim, and the wide variety of reclaim systems in use suggest several basic research approaches:

a.Develop a statistically valid survey tool to determine the extent of reclaim systems in use, the various components and the most common configurations, the wash cycles in which they are used, and professional car wash operators' estimated water and cost savings and increases in maintenance.

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b. Perform an end-use study to quantify savings from reclaim systems in various professional car wash types. By actually performing end-use studies the industry will be able to move beyond mechanical estimates which are often viewed with skepticism in the regulatory community. The ICA will also find that there may be matching funds from utilities for some of these studies in areas with water shortages or lack of treatment capacity.

c. Develop a study on the contribution to pollution prevention of stormwater of professional car washes. By quantifying the amount of material that runs off a home car wash on a driveway, versus the material caught through the filtering materials of a professional car wash, a contribution to the nation's waterways can be substantiated.

3. Professional car wash operators need to market their conservation efforts to their customers. A successful campaign which emphasizes the benefits to the environment of the conservation and reclaim efforts of the professional car wash operation will help not only protect car wash operators during times of drought, but also educate consumers about tradeoffs that occur with regard to color, odor or rinse water. The ICA might produce a general brochure or pamphlet that can be used by the individual professional operator in their car wash.

4. Education of operators to the needs of a properly functioning reclaim system is essential. The ICA should consider beginning an education program similar to other industries where an individual can receive a “license” or "certificate" which signifies a greater level of training and expertise in reclaim processes. Such training should include both theoretical background material as well practical operating information. The theoretical understanding will assist in avoiding future problems of using incompatible chemicals and treatment techniques which has resulted in some abandoned reclaim systems throughout the country.

5. In addition to certifying operators, the ICA should develop a national certification program for professional car wash operations. Using signage, like the San Antonio program or the EPA's WAVE Program for hotels/ motels, the program will help educate the public about the benefits of reclaim and conservation and the contribution that the Certified Professional Carwashes are making to their communities. Undoubtedly, many local utilities will sign on as partners, as will perhaps a national organization like the EPA or the American Water Works Association.

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Glossary of Acronyms

gpm	**gallons per minute**
gpv	**gallons per vehicle**
micron	**10-6 meter**
psi	**pounds per square inch**
RO	**reverse osmosis**
TDS	**total dissolved solids**
TSS	**total suspended solids**

Appendix A

Sample Nozzle Chart

Volume (GPM at various pressures)

Nozzle Size	Orifice Dim. in.	40 PSI	100 PSI	250 PSI	500 PSI	700 PSI	800 PSI	1,000 PSI
.050	.018	.050	.08	.12	.16	.20	.225	.25
.067	.021	.067	.11	.16	.24	.28	.30	.33
1.0	.026	.10	.16	.25	.35	.40	.425	.50
2	.034	.20	.32	.50	.71	.80	.89	1.0
3	.043	.30	.47	.75	1.10	1.25	1.35	1.5
4	.052	.40	.53	1.00	1.40	1.70	1.80	2.0
5	.057	.57	.79	1.30	1.80	2.10	2.20	2.5
6	.062	.60	.95	1.50	2.10	2.50	2.70	3.0

The equation from section 3.2.1 is restated below for convenience of those wishing to calculate GPM or PSI when the other two variables are known.

Appendix B

SAN ANTONIO WATER SYSTEM

I. CHARITY VEHICLE WASH PROGRAM

PURPOSE

The purpose of this program is to provide a mechanism through which charity organizations may utilize permitted professional vehicle wash facilities for the purpose of sponsoring and benefiting from fund-raiser vehicle washes in a manner that conserves water. On February 22, 1996, the San Antonio City Council recognized that vehicle wash events being held for fund raising at business properties caused a waste of water being pumped from the Edwards Aquifer and was also a violation of the City's storm water and aquifer protection regulations. Based on these findings, the City Council required that all vehicle wash fund-raisers be held at professional vehicle wash facilities that are designed to conserve water and properly return the wash water to the sanitary sewer system. The Southwest Car Wash Association, together with the San Antonio Water System (SAWS), has developed the following guidelines under which charitable organizations may safely and efficiently utilize professional vehicle wash facilities for sponsoring vehicle wash fund-raisers.

REQUIREMENTS

This program requires each professional vehicle wash facility wishing to participate in and be recognized under the San Antonio Water System Vehicle Wash Conservation Program, to allow a minimum of three charity fund-raiser vehicle wash events per year. Each vehicle wash owner/operator would coordinate with and provide revenue to bonafide charity organizations that hold a tax-exempt nonprofit status with Section 501 (c) (3) of the Federal Tax Code, under one of the following methods:

1. The owner/operator would contribute a minimum of five percent of the gross revenues generated by the washing of vehicles during the designated period of time that the charity is sponsoring and actively promoting their vehicle wash fund-raiser; or

2. The operator would provide tokens or certificates at a discount of 15% off regular rates to the charity organization, which can be sold or transferred for donations/charitable contributions to the sponsor of the vehicle wash fund-raiser. All proceeds received from the sale or transfer of tokens or certificates under this option would be retained by the charitable organization for its fund-raising purpose. The tokens or certificates issued by the operator would be valid for a set period of time between three and ten days; or

3. The operator would provide the sponsor of the fund-raising activity with an appropriate area and appropriate amenities (i.e. vehicle wash bay(s) or other suitable area(s), complete with no2zled pressure washing equipment, and area draining to sanitary sewer) which the sponsor of the fund-raiser will utilize for a set period of time not in excess of eight hours on a specified day for the washing of vehicles. The length of time period will be determined by the sponsor of the fund-raiser. Under this option, the sponsor and participants of a vehicle wash fund-raiser activity will be required to sign liability release forms and all revenues in the form of donations or contributions which are collected by the sponsor of the vehicle wash fundraiser will be retained for fund-raising purposes.

In order to quality for recognition by the San Antonio Water System as a vehicle wash facility which conserves water within the San Antonio Community, the vehicle wash owner/operator will be required to host a minimum of three fund-raiser vehicle washes at each of the owner/operator's vehicle wash facilities per year. The owner/operator will only be required to offer the professional vehicle wash facilitates to those charities that have received tax exempt nonprofit status with Section 501 (c) (3) of the Federal Tax Code.

II. VEHICLE WASH CONSERVATION CERTIFICATION PROGRAM

PURPOSE

This program will provide criteria under which a vehicle wash owner/operator may request certification from and be recognized by the San Antonio Water System with regard to water conservation. In order to participate in this program, a vehicle wash facility must meet certain criteria (described below) which are designed to allow the San Antonio Water System to provide incentives to those vehicle wash facilities which have existing conservation technology in place or which are retrofitted to utilize conservation techniques and equipment.

CRITERIA

In order to qualify for certification as a water conserving vehicle wash, the vehicle wash facility must demonstrate to SAWS that each of the following criteria have been satisfied. Also, the owner/operator of the vehicle wash must agree to continue meeting each criteria for the period of certification. The criteria, according to vehicle wash facility type, are as follows:

A. All Vehicle Washes

Reuse water will be utilized in the irrigation of landscape that is associated with the vehicle wash facility when the SAWS Aquifer Management Plan is in effect.

1. All water using devices MUST be maintained to original or improved specifications for the conservation of water.
2. All spray nozzles utilized at the vehicle wash will be replaced annually to assure maximum efficiency of water used.
3. All water leaks of any kind must be repaired as they occur.
4. All toilets utilized at the vehicle wash facility must be replaced with 1.6 gallon type toilets.
5. All hoses or faucets that are in use must be attended or shut off.
6. All driveways and impervious areas should be cleaned by sweeping instead of washing.
7. Driveways may be washed with high pressure, low volume water systems for health and safety purposes ONLY.
8. All spot-free reverse osmosis concentrate (if any used) MUST be reused in the wash water holding tank.

B. Self-Service Vehicle Wash Facilitie

In addition to the above criteria, all self-service vehicle wash facilities must agree to the following items to qualify for certification:

1. All chamois wringer sinks must have positive shut off valves.
2. All high-pressure wash nozzles and pump systems shall be calibrated to flows no greater than 3 gallons per minute. This may be achieved by replacing existing nozzles with a reduced size nozzle and adjusting the pressure generated by the pumps as needed.

C. Full-Service Vehicle Wash Facilities

In addition to meeting all criteria listed above for all vehicle washes, each full-service vehicle wash facility will also be required to comply with the following criteria in order to qualify for certification under the San Antonio Water System Vehicle Wash Conservation Program:

1. Automatic high-level water cut-offs must be installed in all towel and chamois washing machines.
2. A minimum of 50% of water utilized in the rinse phase of automatic washing must be recycled to the collector tanks to be used for the washing phase.

D. Roll-Over/In-Bay Automatic Vehicle Wash Facilities

In addition to meeting the above listed criteria for all vehicle washes, each roll-over/in-bay vehicle wash facility will also be required to comply with the following criteria in order to obtain certification under the San Antonio Water System Vehicle Wash conservation Program:

1. All chamois wringer sinks must have positive shut off valves.
2. Some mechanical means must be used to create at least a 5-second dwell time for water to run off the vehicle into the sanitary sewer before vehicle can exit the bay.
3. Spray bars must be renozzled and/or calibrated to use no more than 1.75 gallons per nozzle per minute (average).

3. CERTIFICATION

To obtain certification, a vehicle wash facility must first submit a completed application form to the San Antonio Water System requesting certification. The facility will then be subject to inspection by a representative of the San Antonio Water System to determine whether the facility meets all appropriate specifications. If approved for certification, the owner/operator of the facility must then execute a certificate indicating they have read, understood and agreed to abide by the criteria requirements of the program.

Certified facilities are subject to inspection without notice by SAWS. Deficiencies discovered during inspection will be reported to the owner/operator who will be provided 14 calendar days to correct the same. A facility's certification (and benefits obtained therefore) will be revoked by the SAWS if reported deficiencies are not corrected within the time period allowed. During Stage IV of the SAWS Aquifer Management Plan, a wash facility may not operate until deficiencies are corrected.

4. BENEFITS OF CERTIFICATION

A vehicle wash facility which has been certified for water conservation by the San Antonio Water System pursuant to this program will be entitled to the following benefits:

Display appropriate signage (approved by the San Antonio Water System) advertising the fact that the vehicle wash facility has been certified as a water conservation facility by the San Antonio Water System.

Be identified, by business name and address, in a list of vehicle wash facilities which have been certified for water conservation compliance published by the San Antonio Water System on an annual basis.

Participate in the water conservation vehicle wash retrofit program sponsored by the San Antonio Water System (as follows in Part III of this document).

May utilize a logo or approved phrase in advertising, mail outs, and other promotional material, directing attention to the fact that the vehicle wash facility is certified as a water conservation vehicle wash.

III. VEHICLE WASH CONSERVATION RETROFIT INCENTIVE PROGRAM

PURPOSE

Pursuant to direction by the San Antonio City Council provided on February 22, 1996, the Commercial Vehicle Wash Water Conservation Incentive Program provides incentive to professional vehicle wash owners/operators for retrofitting existing vehicle washes for utilization of conservation and water saving techniques and technology. Under this program, the San Antonio Water System provides economic benefits and other incentives to vehicle wash owners/operators who facilitate water conservation at professional vehicle washes, promote the water conservation vehicle wash certification program, and lessen the burden on existing professional vehicle washes which do not currently utilize water conservation techniques or technology. This program will have a limited duration during which vehicle wash owners/operators will be provided incentives for retrofitting existing vehicle wash facilities.

INCENTIVES

The San Antonio Water System will provide the following incentives to the owners/operators of professional vehicle washes, during the period of the incentive program:

A one time $2.00 rebate for each lower flow spray nozzle retrofitted to self-service wands, full-service rinse arches, or roll-over/in-bay automatic spray bars. The rebate will be in the form of a credit on each facility's SAWS account.

Facilities are eligible for a $75 rebate per toilet under the existing "Kick the Can" program.

A rebate of 50% of the parts/labor/installation cost, in the form of a credit on the facility's SAWS account. The maximum rebate credit is $1,000.00 per vehicle wash facility.

In order to qualify for the above rebates, all repairs performed at an existing vehicle wash facility must be approved in advance by the San Antonio Water System. In order to be approved, the owner/operator must provide the San Antonio Water System with a copy of the original invoice for equipment purchased and related installation cost or labor charges, along with a brief narrative explaining the type of repairs performed and establishing the water conservation extent the equipment modifications will achieve water conservation. All information shall be submitted on a form provided by the San Antonio Water System.