FRASER RIVER ACTION PLAN

Chemical Use And Pollution Prevention Practices For Commercial Car And Truck Wash Facilities

Final Report

Canada

DOE FRAP 1995-06

Environment Canada Environnement Canada

CHEMICAL USE AND POLLUTION PREVENTION PRACTICES FOR COMMERCIAL CAR AND TRUCK WASH FACILITIES

FINAL REPORT

DOE FRAP 1995-06

Prepared for:

Environment Canada
Environmental Protection
Fraser Pollution Abatement
North Vancouver, B.C.

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June 1995

DISCLAIMER

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ACKNOWLEDGEMENTS

UMA Environmental would like to thank those helping us to complete this study for their generous assistance. In particular, we thank Ms Christina Jacob, P.Eng. and Mr. Dave Ferguson of the Greater Vancouver Regional District (GVRD) for the loan of sampling equipment and their comments/assistance with the study; Mr. Peter Deutsch, P.Eng., also of the GVRD, for information on the enforcement of the Regional District's Sewer Use Bylaw; Mr. Steve Neville and Ms Joanne DiCaro of the Ontario Ministry of Environment for their time spent discussing the progress of source control and BMP initiatives in Ontario; Ms. Christie True and Mr. Dave Holyoke of Metro Seattle for information regarding water pollution control initiatives in King County; and Mr. Bert Kooi of Environment Canada for his advice and direction.

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1.0 INTRODUCTION

1.1 BACKGROUND

Numerous organizations are working together to advance the environmental, economic and social sustainability of the Fraser River Basin. The Basin is a valuable resource -- while covering only 25% of B.C.'s land area, it contributes 80% towards the gross provincial product and over 60% towards total household income. The health of the Basin however is being strained as a result of population increases, resource extraction and rapid economic growth.

As part of the Fraser River Action Plan, a federal government initiative addressing the pressures facing the Basin's health and sustainability, effort is being made to identify and control contaminants within the Basin.

Vehicle washes are suspected to be a potential source of pollution, either as a result of surface run-off or inappropriate sewer discharge (ie. discharge of contaminated water to the storm sewer or the discharge of restricted or prohibited wastes to the sanitary sewer). While the majority of municipalities in the Fraser River Basin have prescribed restrictions on the use of local sewers in the form of Sewer Use Bylaws, very few of the Bylaws are actively enforced. Even in the Greater Vancouver Regional District (GVRD), where the bylaw is actively enforced, most commercial washes have not been specifically addressed. In addition, in B.C., there is no current document which has investigated vehicle wash wastewaters and provided operational guidelines.

A number of other factors specific to the car and truck wash industry are contributing to make this study into their chemical use and pollution prevention necessary at this time. The population in the Fraser River Basin has undergone substantial growth in recent years, resulting in an increase in the number of vehicles washed and in turn the amount of wastewater generated. The use of commercial wash facilities is also on the rise, as people in many areas are no longer able or permitted to wash their cars at home -- either they are living in apartment complexes, water use restrictions have been imposed or wastewater discharges have been restricted. The washing of vehicles at commercial facilities provides regulators with better opportunities to control vehicle wash water discharges. Finally, the increasing use of a variety of chemicals at these washes, in conjunction with the pollutants washed off of vehicles (in particular commercial vehicles), has increased the need and interest in investigating the discharges from this industry.

This report documents the study's activities in two parts. For Part I, an inventory of the vehicle wash industry in the Fraser River Basin was conducted to determine current practices in the industry (ie. wash processes, chemical use, water use, wastewater pretreatment, wastewater discharge, etc.). Six facilities were then selected for further investigation. These sites were assessed and raw and pretreated wastewater samples were collected. A review of existing vehicle wash water characterization data, Best Management Practices (BMPs) and Best Available Technology in Canada and the U.S. was conducted through literature search and interviews with regulatory agencies. This work culminated in the development of a BMP manual applicable to vehicle washes in B.C. The BMP manual comprises Part II of this document.

1.2 INDUSTRY DESCRIPTION

Car Washing

Commercially, four types of wash operations are typically available: i) tunnel wash, ii) rollover wash, iii) wand wash and iv) hand wash. Most commercial car wash operations are owned or sponsored by major oil corporations and use the tunnel type process.

The tunnel wash consists of a conveyor system which pulls the vehicle through the length of the building, passing it through the washing, rinsing, waxing and drying areas. Wash water is usually collected in a trench which runs the length of the building. By installing a dam in the trench, wash and rinse waters can be kept separate, facilitating treatment. A typical tunnel wash has the capacity to handle 80-120 cars per hour, although the actual number of cars processed is usually much lower. A facility not recycling its wastewater uses approximately 230 - 320 L per vehicle.

At a rollover wash, the vehicle remains stationary while the equipment passes over the car. This type of wash may average 75 vehicles per day to a maximum of approximately 150. Rollover washes use approximately 115 - 205 L of water, depending on the length of a cycle and the number of passes of the equipment. Wastewater is collected in a single trench under the car.

The wand wash facilities are typically do-it-yourself operations. Water use may range from 90 - 140 L depending on the customer. Wastewater is usually collected in a single trench or sump in the wash bay. However, depending on the wash bay design, not all water may be collected because the customer may be able to direct the flow from the wand to areas where the water can not reach the sump.

Hand washing of vehicles may take place commercially or domestically. It is difficult to estimate the water use from hand washing. However, if a common garden hose can deliver 60 L/min at full bore and it is assumed that the hose is used for 5 minutes to wash and rinse a vehicle, then on average more water is used by hand washing than by the other types of washes. In addition, the wastewater from hand washing is generally not collected, flowing straight to the storm sewer system and discharging to watercourses without treatment.

Cleaning agents used at car wash facilities may include: soaps, synthetic detergents, heavier degreasers and engine cleaners, waxes, mag cleaners, tire cleaners and rust inhibitors.

Truck Washing

Truck washing may include not only the washing of the cabs, but also the interiors and exteriors of box trailers and tanker trailers. Truck cleaning is performed either i) by for-hire mobile or non-mobile operations which typically service a variety of clients or ii) through the in-house vehicle maintenance programs of manufacturers or carriers.

Truck washing, in particular tanker truck washing, is generally performed for at least one of the following reasons:

- vehicle inspection, maintenance and/or repair; or
- to prevent material contamination when switch loading or, in dedicated service trucks, when cargo purity is of concern.

Cleaning procedures usually consist of:

- determining the previous cargo;
- determining the subsequent cargo;
- draining the heel for resale/reuse or disposal;
- rinsing, washing and again rinsing the truck; and
- drying the truck.

The cleaning steps may vary depending on the cleaning equipment and the cargoes -- a hot or cold water rinse may be sufficient or the use of detergent, a heavier degreaser, solvent, steam, caustic or acid may be required.

The water used for the exterior cleaning of trucks is typically small in comparison to the water used for the washing of truck interiors (particularly tankers). Average volumes used for tanker cleaning are estimated to be approximately 2000 L. However, the amount of water used can be highly variable, depending on factors such as tank size, cleaning method or the presence of persistent residues.

2.0 FIXED CAR & TRUCK WASH INVENTORY

2.1 INVENTORY PROCESS

The purpose of the inventory was to locate and obtain information on the operation of non-mobile car and truck washes within the Fraser River Basin. While the focus was primarily on commercial vehicle wash facilities, municipal operations and select industrial facilities were also of interest. The publication *Water in Sustainable Development: Exploring Our Common Future in the Fraser River Basin* provided a listing of incorporated communities within the Basin (see Table 2.1). The questionnaires and cover letters sent to the commercial, municipal and industrial operations are provided in Appendices A, B and C, respectively.

Commercial

The principal sources of information regarding commercial vehicle washes in the Basin were the Yellow Page directories for the respective communities. Municipalities, the head offices of the major oil companies and the Canadian Car Wash Association were also contacted for information regarding the location of vehicle washes.

Once the list of fixed, commercial vehicle washes was completed, each facility was contacted to request cooperation with the inventory. Owners and managers were informed of the goals of the project and subsequently the need for information regarding their facility. Key information for the mailing or the faxing of the questionnaires was obtained over the phone. Responses to many of the operations questions however could typically not be obtained at this time due to the lack of readily available answers.

Municipal

Questionnaires were mailed to the public works supervisors of each of the communities listed in Table 2.1.

Industry

The vehicle maintenance programs of four industry sectors were selected for the inventory, based on either their higher potential for contaminant release, information regarding past problems with their vehicle washing practices or the predominance of that industry in B.C. The industries approached were: milk processing, petroleum, waste management and logging. Names of specific operations within each industry were obtained from the *Contact Target Marketing Directory*, industry associations and general knowledge.

Table 2.1: Incorporated Communities within the Fraser River Basin and the Burrard Inlet Drainage Basin

Regional District/ Municipality	Fraser Basin Region	Regional District/ Municipality	Fraser Basin Region
Buckley-Nechako		Greater Vancouver	
Burns Lake	Upper Fraser	Burnaby	Lower Fraser
Fort St. James	Upper Fraser	Coquitlam	Lower Fraser
Fraser Lake	Upper Fraser	Delta	Lower Fraser
Vanderhoof	Upper Fraser	New Westminster	Lower Fraser
		N. Vancouver (City, Dist.)	Lower Fraser
Cariboo		Port Coquitlam	Lower Fraser
Quesnel	Middle Fraser	Port Moody	Lower Fraser
Williams Lake	Middle Fraser	Richmond	Lower Fraser
100 Mile House	Thompson	Surrey	Lower Fraser
Central Fraser Valley		Vancouver	Lower Fraser
Abbotsford	Lower Fraser	West Vancouver	Lower Fraser
Langley (City, District)	Lower Fraser	White Rock	Lower Fraser
Matsqui	Lower Fraser		
Columbia-Shuswap		North Okanagan	
Salmon Arm	Thompson	Enderby	Thompson
		Lumby	Thompson
		Spallumcheen	Thompson
Dewdney-Alouette		Squamish-Lillooet	
Maple Ridge	Lower Fraser	Lillooet	Middle Fraser
Mission	Lower Fraser	Pemberton	Lower Fraser
Pitt Meadows	Lower Fraser	Whistler	Lower Fraser
Fraser Cheam		Thompson-Nicola	
Chilliwack	Lower Fraser	Ashcroft	Thompson
Hope	Lower Fraser	Cache Creek	Thompson
Kent	Lower Fraser	Chase	Thompson
Harrison Hot Springs	Lower Fraser	Clinton	Thompson
		Kamloops	Thompson
Fraser-Fort George		Logan Lake	Middle
McBride	Upper Fraser	Lytton	Thompson
Prince George	Middle Fraser	Merritt	Thompson
Valemount	Upper Fraser		

2.2 INVENTORY RESULTS SUMMARY

Due to the poor initial response from the mail-out of questionnaires, a number of follow-up calls were made. These efforts resulted in a final 25% response level (34 out of 139) from the commercial facilities and 23 responses or a 49% response level from the municipalities. From the industries contacted, information was received from 47%, which included at least one response from each industrial group.

Even prior to initiating the inventory, the potential for poor response levels was recognized. There was not only little positive incentive to commercial and industrial owners, operators and managers to cooperate with this project, there was significant disincentive due to fear of regulation. Every effort was made to ease concerns through attempting to discuss the purpose of the project and through providing a formal letter of explanation. The level of response would likely have been significantly higher if anonymity could have been assured.

The information collected has been compiled in databases, hard copies of which are presented in Appendices A, B and C for the commercial, municipal and industrial sectors respectively. All facilities contacted are listed, irregardless of whether or not a response was obtained. The responses from the six facilities assessed during this project were removed from the database in order to protect their anonymity; their names and addresses however remain as part of the data base. Table 2.2 summarizes select data from the inventory.

Commercial

Survey results varied considerably. Many owners/managers simply did not have the required information or accurate information (ie. water use data, client numbers, quantities of chemicals used, etc.) or they were unsure of i) the design/operation/maintenance of their pretreatment facilities or ii) of the discharge locations (ie. sanitary vs. storm sewer). In compiling the database, some interpretation of the responses was required to provide a more realistic description of on-site activities.

In general, it appears that the majority of commercial facilities are connected to the sanitary sewer and have some form of sump, sediment pit or oil/water separator through which the wash water flows prior to discharge. Some owners however, believe their facilities are connected to the storm sewer. Chemicals used at vehicle washes include detergents, heavier degreasers and engine cleaners, waxes, wheel polishing agents, rust inhibitors, caustics and acids (the latter two, primarily at truck washes). The most commonly used manufacturers of these products are:

- Metrovan Hotsy Equipment
- Diversey
- Savolite
- Ostrem Chemicals
- Zep Alcare
- Car Brite
- Blue Coral
- Ducan Sales
- Star Tech Chemicals
- Ecolab

Table 2.2: Summary of Select Inventory Data

	No. of Facilities	No. of Surveys Distributed	No. of Respondants	No. Permitted	Sanitary Sewer Discharge	Storm Sewer Discharge	Ground Discharge (ie. rock pit, gravel lot, ditch)	Watercourse Discharge	Unknown Discharge Location	Water Recycle
Commercial [3]	166	139	34	-	26	4	-	-	4	-
Lower Fraser	132	108	24	-	19	2	-	-	3	-
Middle Fraser	16	14	2	-	2	-	-	-	-	-
Upper Fraser	-	-	-	-	-	-	-	-	-	-
Thompson	18	17	8	-	5	2	-	-	1	-
Industrial [1,2]	19	19	8	4	4	1	1	-	1	1
Lower Fraser	8	8	6	3	4	1	-	-	1	-
Middle Fraser	-	-	-	-	-	-	-	-	-	-
Upper Fraser	-	-	-	-	-	-	-	-	-	-
Thompson	2	2	2	1	-	-	1	-	-	1
Municipal	49	47	23	n/a	6	5	9	3	-	-
Lower Fraser	26	24	10	n/a	4	3	3	-	-	-
Middle Fraser	5	5	1	n/a	-	1	-	-	-	-
Upper Fraser	6	6	3	n/a	1	-	1	2	-	-
Thompson	12	12	8	n/a	1	1	5	1	-	-

1 Only major operations within the Petroleum, Logging, Milk Processing and Waste Management industrial sectors were contacted.

2 The locations of the wash facilities of industries not responding to the survey are in some cases unknown.

3 The listing of imperial Oil wash facilities was not received until after the preparation of the final report and were thus not surveyed.

Based on the response from Petro Canada and discussions with Imperial Oil, it appears that while the washes sponsored by the major oil companies likely use a greater variety of detergents, waxes and other chemicals, they also have well-established guidelines for the pretreatment and discharge of wastewater and the clean-out of pretreatment units.

Municipalities

At the majority of municipalities, municipal staff wash vehicles, including waste collection vehicles, on-site. Some municipalities do however contract mobile wash companies or take their vehicles to a fixed commercial car wash.

The wastewater pretreatment units and discharge locations at on-site wash locations generally fall into two categories: either i) there is some form of sump, sediment pit, catch basin or oil/water separator which discharges to the storm or sanitary sewer or ii) the wastewater is simply discharged to ground. For the most part, the larger municipalities have at least some form of wastewater separation taking place prior to discharge to the sewer.

Manufacturers whose vehicle cleaning products are being used by the municipalities include:

- Van Waters and Rogers
- Total Wash
- Texas Refinery
- Admiral Sanitation
- Share Corporation
- Ostrem
- Slipco Industries
- Metrovan Hotsy Equipment
- Citri-Safe
- Guardian Chemicals

Industry

Information was obtained from three milk processing facilities. Two of the facilities wash tank trucks on-site at a dedicated wash facility, the third contracts the washing of their trucks to a mobile washer. Both acids and caustics, in addition to detergents, are typically used in the wash process to prevent bacterial growth in the tanker trucks, disinfect the trucks and to maintain the shine on metal exteriors. While the chemical agents used for washing tanker trucks are harsher than those used at typical car washes, wastewater discharges from milk processing facilities in the Greater Vancouver area are regulated by the Regional District. Therefore, wash water and any other wastewater generated by these plants is pretreated prior to discharge to the sanitary sewer if it does not meet the local discharge limits. At at least one of the facilities, this has necessitated pH adjustment. More detailed information regarding the wash activities at milk processing facilities was obtained during the site assessments and is documented in Section 3.2.

Information regarding wash practices at two waste management companies was obtained through discussions with the respective maintenance mangers. One company has a dedicated wash facility and a wastewater pretreatment system for the wastewater generated from all on-site activities, including truck and container washing and vehicle maintenance. Effluent discharges to the sanitary sewer are monitored by the GVRD. The other company contracts the washing of their waste collection vehicle exteriors to Triple A Envirowash, a mobile wash company. Water from this activity is discharged directly to the storm sewer. At this site, the insides of the trucks are apparently never washed, nor are the containers. Containers are however washed off-site, at a facility with an approved pretreatment system.

Weyerhaeuser Canada responded to the questionnaire for their sawmill in Vavenby and their sawmill in Merritt. At the Vavenby site, vehicles are pressure washed on-site. Wastewater is discharged to ground and periodically the mud is "collected and spread when dry". The Merritt mill has a dedicated wash site with a water recycle system, recycling approximately 85% of the water used (the remainder is vapourized or otherwise lost in the system or discharged). Wash water drains into a separator and then into a flocculation tank, where the pH is adjusted and chlorine, an oil/solids flocculant and air are injected. Treatment units at the Merritt mill are cleaned once every three months and the waste is spread on the log yard. Both mills have established contingency plans in the event of a spill.

3.0 SITE ASSESSMENT

3.1 SITE SELECTION

Three car and three truck wash facilities were selected for further investigation based on criteria chosen to cover a number of operational aspects of interest. Collectively the selected facilities address each of the criteria and are believed to be representative of the variety of operations within the Fraser River Basin. It should be noted that due to time and budget constraints, only sites in the Greater Vancouver area were under consideration.

Site selection criteria included:

- high volume wash facilities;
- wash facilities offering a variety of cleaning services (ie. engine cleaning, waxing, shampoo, etc.), but specifically not auto repair as this could bias results;
- wash facilities using materials other than just detergents/water/waxes (ie. solvents, acids, caustics, degreasers);
- different types of car washes (ie. tunnel, hand wash, wand wash);
- commercial truck washes with a variety of clients;
- car washes licensed by a major oil company; and
- industrial wash facilities (ie. dairy, waste management, petroleum, logging).

Eight sites were presented to Environment Canada for the selection of six. The list did not however include the wash sites for the logging and petroleum industries -- the sites of the former are not within the Greater Vancouver area and petroleum industry's tanker trucks are generally washed on-site at the refineries, where the wash water is part of the overall site drainage plan.

The following sites were chosen for assessment:

Site A - milk processing facility washing tanker truck exteriors and interiors on-site
- facility uses acids, caustics, detergents and foams in wash process
- on-site wastewater pretreatment

Site B - do-it-yourself pressure (wand) wash
- facility open to cars, trucks and motor homes
- individual wash bays
- high volume facility (~ 1450 vehicles washed in a busy month)

Site C - multiple locations
- automatic wash, hand wash
- offers wax, polish, upholstery & vinyl top cleaning
- large private company

Site D - truck wash facility
- services a variety of clients, including dairy and petroleum tanker trucks, cement trucks, meat hauling trucks
- uses acids, soaps, degreasers

Site E - municipal yard
- interiors and exteriors of waste collection vehicles washed daily

Site F - tunnel wash
- offers interior and exterior cleaning, wax
- large, high volume facility
- new facility, beginning operation in mid-1994
- licensed by major oil company

3.2 SITE VISITS

Summaries of the observations made at each of the six facilities assessed are provided below, as are the results of the wastewater analyses. The complete chemical analysis reports are provided in Appendix D.

It should be noted that with some samples difficulties were encountered with the total oil and grease test -- the solvent extraction produced white crystals. While these crystals are not typical and are perhaps associated with detergents or natural organics in the wastewater, they were included in the oil and grease results and are likely responsible for elevated oil and grease concentrations. A mineral oil and grease analysis performed on one such sample appeared to confirm this hypothesis; the mineral oil & grease result was a fraction of the total oil & grease measurement (8%). The samples in which the white crystals were formed are marked accordingly in the tables below.

Site A
tanker truck washing at milk processing facility

Site A is a milk processing facility in Greater Vancouver. The interiors and exteriors of 4-5 tanker trucks having carried raw milk are washed on-site daily, seven days per week. Truck maintenance is not carried out on-site, nor is any engine cleaning.

The wash process for the tank interiors consists of three steps: i) pre-rinse, ii) wash and iii) final rinse. Following the off-loading of the milk in the covered wash area, the 300 second pre-rinse cycle of fresh, cold water bursts begins. This water is continually pumped from the truck during the rinse cycle. As part of the daily wash, a recycled caustic solution heated to a temperature of 140-160 °C is used. Approximately 1/3 of the tank is filled with the solution, which is circulated within the tank for 20 minutes. The purpose of the heated caustic is to remove remaining product from the tank and kill bacteria. Once per week, the caustic solution is replaced with an acid solution. The recycled acid solution is used to remove the minerals associated with milk from the tank and to prevent corrosion of the tank. After the caustic or acid is pumped out, the final rinse begins. Like the pre-rinse, it consists of short bursts of cold water for 300 seconds.

The truck exteriors are pressure washed with detergent and on occasion foam.

The chemicals used in the wash process, and a number of other cleaning agents used in the plant, are stored in the wash area behind sliding panels. The chemical storage area does not have secondary containment for the chemicals, nor is the area bermed. There are however a number of spill kits in the area. The chemicals used in the wash process or stored in the wash area are as follows:

HC-10

purpose:	(dry form) detergent used for exterior wash; used interchangeably with LiquidFleet
stored:	200 kg
usage:	~150 g/truck
contents:	incl. phosphates, carbonates, alkali, wetting agent (active), chlorine
manufacturer:	ECOLAB

Liquid Fleet

purpose:	liquid detergent used for exterior wash; used interchangeably with HC-10
stored:	204 L
usage:	~100 mL/truck
contents:	incl. chlorine, alkali
manufacturer:	ECOLAB

Redi Clean Plus

purpose:	foaming chlorinated alkaline cleaner used nightly to clean wash area
stored:	204 L
contents:	includes active wetting agents, tetrapotassium tyrophosphate, sodium hypochlorite, potassium hydroxide
manufacturer:	ECOLAB

AC-Special

purpose: acid used in wash cycle for mineral removal and corrosion protection
stored: 1150 L
usage: ~200 mL/truck
contents: incl. nitric & phosphoric acid
manufacturer: ECOLAB

Principal

purpose: caustic used in wash cycle for disinfection
stored: 204 L
usage: ~1L/450 L water; ~200 mL/truck
contents: incl. potassium hydroxide, caustic potash, sodium hypochlorite, potassium silicate, tripolyphosphate
manufacturer: ECOLAB

MIP Liquid 123-1

purpose: caustic used for disinfection of the pasteurizing unit in plant
stored: 1350 L
contents: incl. sodium hydroxide, antifoaming agent, sequestriants, surfactants
manufacturer: ECOLAB

The layout of the wash area is depicted in Figure 3.1. The wash area floor is sloped to a trench drain which runs across the wash area entrance. This drain collects the wastewater from the exterior wash and any spills. The trench discharges to a sediment pit, which flows to a grease trap and finally the sanitary sewer. Wastewater from spills and exterior washing could however also flow out the wash area exit if care is not taken in the wash down of the area. This water would then flow to catch basins, leading to a grease trap which discharges to the storm sewer and eventually a nearby creek. All rinse water and spent caustic and acid solutions (after approximately 1-2 weeks recycle) are sent to holding tanks where they are combined with the plant's process wastewater. Here the pH is adjusted prior to release to a grease trap and subsequently the sanitary sewer.

The sediment pit is approximately 0.6m x 0.6m x 1.2m (depth). The outlet is approximately 0.3m above the bottom of the pit. Clean-out of the sediment generally occurs once every four months, based on sediment volume -- typically after the discharge line becomes plugged with sediment. A.A. Anderson has been contracted for the clean-out of the pit.

The grease trap is approximately 3.0m x 2.4m x 3.7m (depth) and is cleaned one per month, also by A.A. Anderson.

The quality and quantity of the wastewater discharged from the site is regulated by a GVRD permit. The permit stipulates limits on pH, oil & grease, suspended solids, BOD and COD. Samples are collected once per month at the sanitary sewer connection. The wastewater generally meets permit requirements.

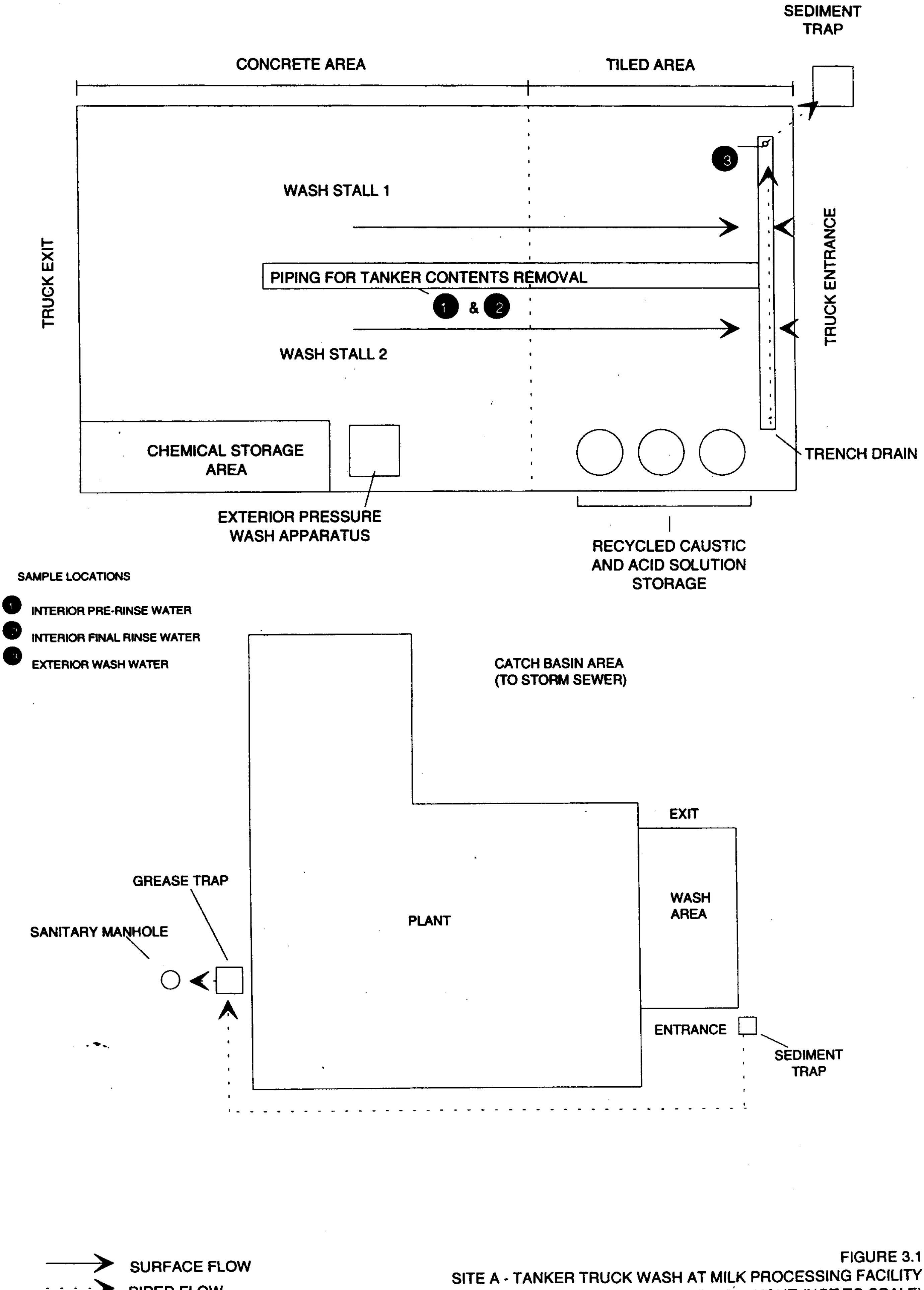


FIGURE 3.1
SITE A - TANKER TRUCK WASH AT MILK PROCESSING FACILITY

For this study, wastewater samples were collected of the i) pre-rinse water throughout the rinse cycle, ii) final rinse water, again, throughout the rinse cycle and iii) exterior wash water from the trench drain throughout the wash period. Sample locations are shown in Figure 3.1. Samples of the interior wash water following pretreatment could not be obtained, as it is combined with the process wastewater from the plant. A sample of the exterior wash wastewater following sedimentation could also not be obtained, as there was insufficient water in the pit for a representative sample. Flow data was unavailable, as the meters in the wash area were not operational and flow rates were unknown. Results of the chemical analyses are presented in Table 3.1.

Because it was not possible to obtain samples of the wash water following pretreatment, a direct comment on the effectiveness of the system can not be made. However, the wastewater generated from the washing of tanker trucks at milk processing facilities within the GVRD is monitored by the GVRD Source Control Department. Therefore, any water not suited for discharge to the storm sewers must be discharged to the sanitary system, with pretreatment if it exceeds the local sewer use limits. Thus, the interior rinse waters and acid and caustic solutions must be pretreated to the GVRD standards. And while the exterior raw wash water appears to be quite toxic to fish (96h LC50 of 4.5%) and high in BOD (exceeding the GVRD limit), it does still undergo on-site pretreatment (sediment pit and grease trap) prior to sanitary sewer discharge.

With respect to management practices at the facility, there is a need for a regular maintenance program for the sediment pit to ensure its efficient operation and prevent blockage of the sewer lines. Some form of secondary containment for the chemicals stored in the wash area is recommended to help prevent any chemicals from entering the sewer system in the event of a spill. A second trench drain or a speed bump sized berm at the wash area exit, to prevent the accidental wash out of wastewater or spillage to the catch basin area, is also recommended.

Site B
do-it-yourself pressure wash

Site B, built in the 1950's, is a do-it-yourself pressure wash facility with six wash bays. The vehicles washed at this location include cars, vans, pick-up trucks, motorcycles and small buses. While the number of vehicles washed varies dramatically, dependent primarily on the weather, approximately 20-30 vehicles may be washed here daily, 900 monthly and 10 800 annually. The busiest day is typically Saturday (approximately 40-50 vehicles); the busiest month, January; and the busiest season, winter. The facility is open for washing 24 hours per day, 7 days per week, except during freezing conditions when hours are limited to 10 am - 5 pm.

The hand-held pressure wash "wands" can be set to supply either a soap/water or wax/water mixture or fresh rinse water. A foam brush supplies a foam and water mixture. Engine cleaning and wheel cleaning is permitted on the premises and while the clean out of truck cargo areas is not permitted, it has been noted that some customers are dumping truck contents into the wash bay catch basins (ie. food left-overs from catering trucks).

TABLE 3.1: Wastewater sampling results for Site A.

Pollutant	Units	GVRD Sewer Use Bylaw	Sample #1 initial rinse (interior)		Sample #2 final rinse (interior) (ave. of 2 analyses)		Sample #3 exterior wash	
Physical Tests								
temperature	°C	65	14		28		10	
pH		5-11	7.3		11.0		9.4	
D.O.	mg/L		4.6		<1.0***		5.5	
suspended solids	mg/L	2400	1280		6		1140	
total solids	mg/L		3070		174		5030	
turbidity	NTU		1900		4.45		930	
Organic Parameters								
BOD	mg/L	2000	1380		n/a		2050	
COD	mg/L		7420		<20		3160	
surfactants (LAS)	mg/L		1.08		0.09		15.3	
Extractables								
O & G (total)	mg/L	600	940 **		<5		210	
TEH (C9-40)	mg/L		78.7		1.1		23.6	
TEH (C10-30)	mg/L		16.9		<1.0		11.5	
Nutrients								
ammonia	mg/L N		0.14		0.012		1.06	
nitrites & nitrates	mg/L N		0.033		0.11		0.011	
Halogenated Volatiles								
Bromodichloromethane	mg/L						<0.001	
Bromoform	mg/L						<0.001	
Carbon Tetrachloride	mg/L						<0.001	
Chlorobenzene	mg/L						<0.001	
Chloroethane	mg/L						<0.001	
Chloroform	mg/L						0.002	
Chloromethane	mg/L						<0.001	
Dibromochloromethane	mg/L						<0.001	
1,2-Dichlorobenzene	mg/L						<0.001	
1,3-Dichlorobenzene	mg/L						<0.001	
1,4-Dichlorobenzene	mg/L						<0.001	
1,1-Dichloroethane	mg/L						<0.001	
1,2-Dichloroethane	mg/L						<0.001	
cis-1,2-Dichloroethylene	mg/L						<0.001	
trans-1,2-Dichloroethylene	mg/L						<0.001	
1,1-Dirchlorethylene	mg/L						<0.001	
Dichloromethane	mg/L						<.01	
1,2-Dichloropropane	mg/L						<0.001	
cis-1,3-Dichloroporpylene	mg/L						<0.001	
trans-1,3-Dichloropropylene	mg/L						<0.001	
1,1,1,2-Tetrachloroethane	mg/L						<0.001	
1,1,2,2-Tetrachloroethane	mg/L						<0.001	
Tetrachloroethylene	mg/L						<0.001	
1,1,1-Trichloroethane	mg/L						<0.001	
1,1,2-Trichloroethane	mg/L						<0.001	
Trichloroehtylene	mg/L						<0.001	
Trichlorofluoromethane	mg/L						<0.001	
Vinyl Chloride	mg/L						<0.001	
Non-halogenated Volatiles								
Benzene	mg/L						<0.0005	
Ethylbenzene	mg/L						<0.0005	
Styrene	mg/L						<0.0005	
Toluene	mg/L						<0.001	
meta- & para-Xylene	mg/L						<0.0005	
ortho-Xylene	mg/L						<0.0005	
Metals			total	diss.	total	diss.	total	diss.
aluminum	mg/L	200	<2.0	<2.0	<0.2	<0.2	8.12	2.2
antimony	mg/L		<2.0	<2.0	<0.2	<0.2	<0.2	<0.2
arsenic	mg/L	4	<2.0	<2.0	<0.2	<0.2	<0.2	<0.2
barium	mg/L		<0.10	<0.10	<0.01	<0.01	0.421	0.106
beryllium	mg/L		<0.05	<0.05	<0.005	<0.005	<0.005	<0.005
bismuth	mg/L		<1	<1	<0.10	<0.10	<0.1	<0.1
boron	mg/L	200	<1	<1	<0.10	<0.10	<0.1	<0.1
cadmium	mg/L	0.8	<0.1	<0.1	<0.01	<0.01	0.021	0.016
calcium	mg/L		21.3	21.3	1.75	1.73	61.1	57.1
chromium	mg/L	16	<0.15	<0.15	<0.015	<0.015	0.033	<0.015
cobalt	mg/L	20	<0.15	<0.15	<0.015	<0.015	<0.015	<0.015
copper	mg/L	8	<0.1	<0.1	0.019	0.016	0.595	0.537
iron	mg/L	40	<0.3	<0.3	0.105	0.06	12.4	3.88
lead	mg/L	4	<0.5	<0.5	<0.050	<0.050	0.222	0.188
lithium	mg/L		<0.15	<0.15	<0.015	<0.015	<0.015	<0.015
magnesium	mg/L	20	2.05	2.05	0.152	0.151	5.27	2.76
manganese	mg/L		<0.05	<0.05	<0.005	<0.005	0.635	0.456
molybdenum	mg/L	4	<0.3	<0.3	<0.03	<0.03	<0.03	<0.03
nickel	mg/L	8	<0.2	<0.2	<0.02	<0.02	0.04	0.033
phosphorous	mg/L		16.1	13.6	10.2	9.95	23.5	23
potassium	mg/L		29	29	35	34.8	25.9	23.8
selenium	mg/L		<2	<2	<0.2	<0.2	<0.20	<0.20
silicon	mg/L		1.59	1.58	6.15	6.03	9.47	3.43
silver	mg/L	4	<0.15	<0.15	<0.015	<0.015	<0.015	<0.015
sodium	mg/L		<20	<20	19.5	19.2	794	763
strontium	mg/L		<0.01	<0.01	0.009	0.009	0.242	0.173
thallium	mg/L		<1	<1	<0.10	<0.10	<.1	<0.10
tin	mg/L		<3	<3	<0.30	<0.30	<.3	<0.3
titanium	mg/L		<0.1	<0.1	<0.02	<0.01	0.137	0.043
tungsten	mg/L		<1	<1	<0.1	<0.1	<.10	<0.1
vanadium	mg/L		<0.30	<0.30	<0.03	<0.03	<0.03	<0.03
zinc	mg/L	12	0.08	0.08	0.008	0.008	1.48	1.28
Toxicity (96h LC50)	%						4.5	

Note: TEH - total extractable hydrocarbons

n/a not available, due to the toxic effect of the caustic in the rinse water on the bacteria

< less than the detection limit indicated

** the natural organic oils in milk are likely responsible for the elevated levels, not petroleum products

*** effectiveness of preservative is suspect

[boxed cell] pollutant exceeds limit sitpulated in the GVRD sewer use bylaw (grab sample)

The chemicals used are stored in a locked room on-site. No spill control measures are in place. It is not known to where the floor drain in the room connects. Only water, soap and wax are supplied to the customers. Customers however have been bringing in their own engine degreasers, mag cleaners, tire brighteners and white wall cleaners. The chemicals in storage were as follows:

400 Wax

purpose:	spray wax
stored:	20 L
usage:	1L /100 L water; ~ 20 L/3 months
contents:	incl. ethylene glycol monobutyl ether, petroleum distillate, quarternary ammonium chloride
manufacturer:	Hotsy

Breakthrough

purpose:	detergent
stored:	20 L
usage:	20 L/3-4 weeks
manufacturer:	Hotsy

Liquid Foamer

purpose:	detergent
stored:	20 L
usage:	20 L/month
contents:	incl. sodium dodecylbenzene, sulphonate
manufacturer:	Hotsy

No wastewater recycle occurs. The water meter readings indicate a water use rate of 4.9 m^3 per day, 146 m^3 per month and 1750 m^3 per annum.

The site layout is depicted in Figure 3.2. Photographs are presented in Figure 3.2a. The site is completely paved. Each wash bay has its own catch basin (0.5m x 0.5m x 0.6m). The catch basins in Bays 4, 5 and 6 drain directly to the main sump; the catch bains in Bays 1, 2 and 3 drain to two catch basins in series prior to entering the main sump. The main sump in turn drains to the sewer system, however, it is unknown whether this is a sanitary or storm connection. The majority of the surface runoff from the site appears to flow to the two central catch basins.

The main sump consists of four chambers (for dimensions, see Figure 3.2). Chamber #1 receives the drainage from the wash areas. From this chamber it appears that water flows under a wooden barrier (through the bottom sludge) to Chamber #2, which is approximately only 15 cm wide. From #2 the water percolates through the sludge and under another wooden barrier to Chamber #3. From here the water can exit to the sewer system. The water in Chambers #1 through #3 had a light brown, slightly foamy, floating oil layer. Throughout these Chambers the water was oily and dark brown/black in colour. Chamber #4 is separated from the first three by a concrete wall. The source of the water in this chamber is unknown, however it also does drain to the sewer. The only inlets to this chamber appear to be a series of 5 cm diameter pipes across one wall. The water in this chamber is much clearer than in the other chambers, however, it does have an oily sheen. The water level in Chamber #4 apparently does not change significantly, nor does there appear to be much of a sediment build up in the bottom.

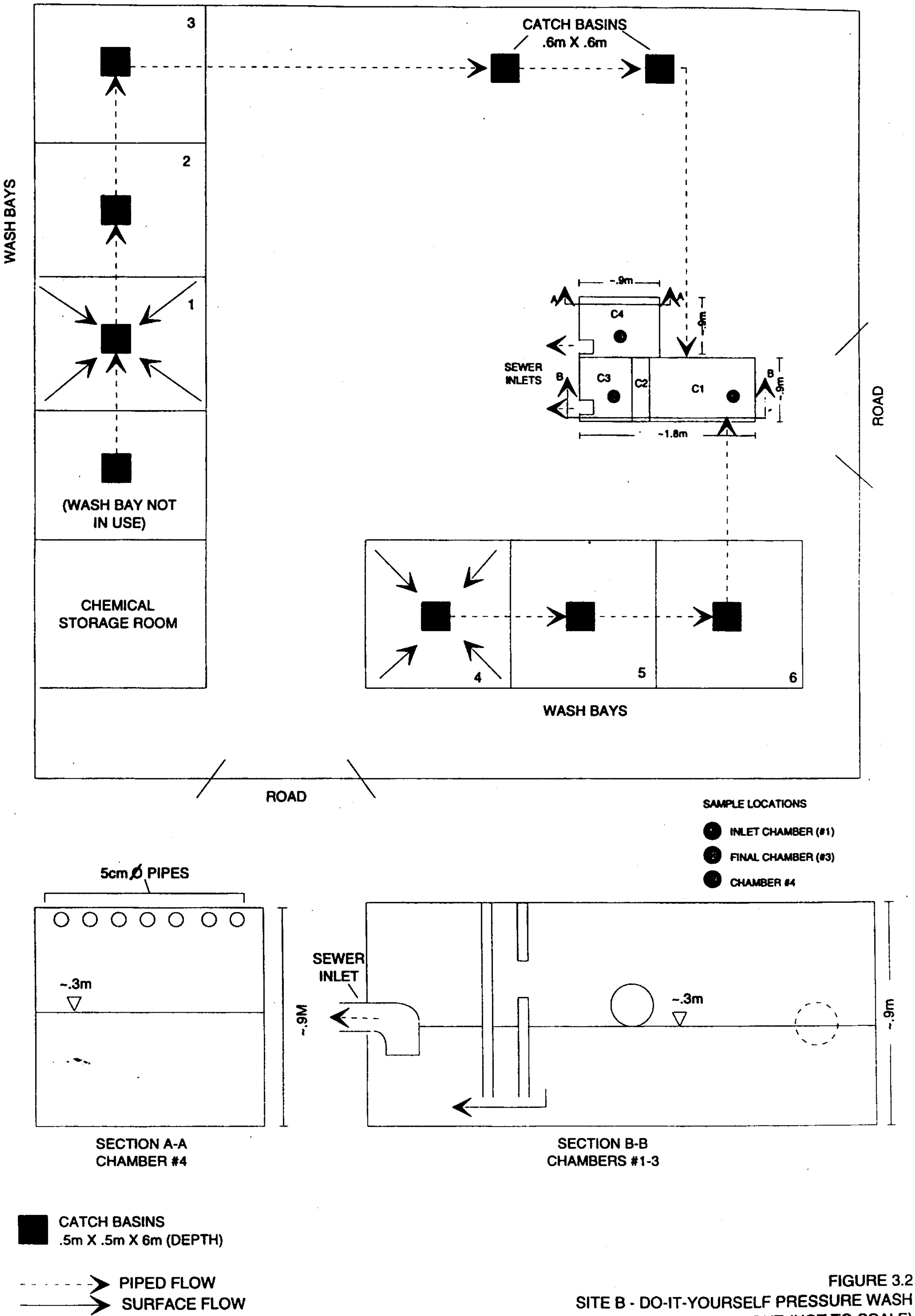


FIGURE 3.2
SITE B - DO-IT-YOURSELF PRESSURE WASH

The sludge in each of the wash bay catch basins is shovelled out by the owner almost every day. The sludge from the main sump is removed by the owner once per month. All sludge is disposed of in a City of Vancouver waste disposal bin.

This site does not have a wastewater discharge permit, nor have wastewater analyses been conducted in the past.

In an effort to determine the efficacy of the sump and the quality of the water being discharged to the sewer, grab samples were taken of the sump's first and final chambers (#1 and #3). Care was taken to exclude the floating oil/grease layer from the sample. In addition, a sample was collected from Chamber #4 to help determine the source of the water. The results of the analyses are presented in Table 3.2.

Based on the analysis results, the water quality does not appear to improve in quality as it progresses through the chambered sump to the sewer inlet. In the final chamber, the water contained oil & grease and iron above the GVRD limits for grab samples. In addition, total solids, surfactants, COD and a number of metals (zinc, copper, lead, magnesium, silicon and sodium) were present in notable quantities. For example, raw domestic wastewater typically contains 1-20 mg/L surfactants and the water in the final chamber of the sump contained 64 mg/L. The water in the first chamber was toxic to rainbow trout at a concentration of 11.4% (96h LC50).

It is evident that the intention of the sump was to reduce sediment concentrations. However, because of its inadequate design (individual chamber volume, overall volume, weir height) and maintenance (sludge build-up) and the nature of the wastewater (extremely oily), it can only accomplish this purpose to a limited extent. In addition, because of the current practices on-site (ie. engine cleaning, dumping), more sophisticated pretreatment is required. At a minimum, this should include oil & grease separation. Ideally, engine cleaning should be prohibited and the wash facility supervised so that activities compromising the effectiveness of the pretreatment system do not take place.

Because of the high levels of metals and oil & grease in the wastewater, the bottom sludge in the sump likely also contains high levels of the same. While the sludge is probably not a Special Waste, it is likely a contaminated waste and should be disposed of by an approved waste management company, not in City of Vancouver waste collection bins.

The water in Chamber #4 is of significantly better quality. It contains much less in the way of oils & grease, suspended solids and organic content. It does however also contain relatively substantial levels of sodium and calcium.

MAIN SUMP:
CHAMBERS 1-4

CHAMBER 1 AND OUTLET
FROM WASH BAYS 4, 5, 6

CHAMBER 3
AND SEWER INLET

FIGURE 3.2a
SITE B –
WASTE WATER PRETREATMENT UNITS

TABLE 3.2: Wastewater sampling results for Site B.

Pollutant	Units	GVRD Sewer Use Bylaw	Sample #1 first chamber (#1)		Sample #2 final chamber (#3)		Sample #3 isolated chamber (#4) (ave. of 2 analyses)	
Physical Tests								
temperature	°C	65	n/a		n/a		n/a	
pH		5-11	n/a		n/a		n/a	
D.O.	mg/L		<1.0*		4.6		3.7	
suspended solids	mg/L	2400	570		1480		165	
total solids	mg/L		1230		2530		849	
turbidity	NTU		750		1450		165	
Organic Parameters								
BOD	mg/L	2000	172		***		66	
COD	mg/L		256		3270		160	
surfactants (LAS)	mg/L		39.4		63.9		10.1	
Extractables								
O & G (total)	mg/L	600	2680**		980		29	
TEH (C9-40)	mg/L		54.6		1400		40	
TEH (C10-30)	mg/L		49.9		1330		37	
Nutrients								
ammonia	mg/L N		1.99		2.26		3.25	
nitrites & nitrates	mg/L N		0.35		0.099		0.039	
Halogenated Volatiles								
Bromodichloromethane	mg/L				<0.001			
Bromoform	mg/L				<0.001			
Carbon Tetrachloride	mg/L				<0.001			
Chlorobenzene	mg/L				<0.001			
Chloroethane	mg/L				<0.001			
Chloroform	mg/L				0.002			
Chloromethane	mg/L				<0.001			
Dibromochloromethane	mg/L				<0.001			
1,2-Dichlorobenzene	mg/L				<0.001			
1,3-Dichlorobenzene	mg/L				<0.001			
1,4-Dichlorobenzene	mg/L				<0.001			
1,1-Dichloroethane	mg/L				<0.001			
1,2-Dichloroethane	mg/L				<0.001			
cis-1,2-Dichloroethylene	mg/L				<0.001			
trans-1,2-Dichloroethylene	mg/L				<0.001			
1,1-Dirchlorethylene	mg/L				<0.001			
Dichloromethane	mg/L				<0.005			
1,2-Dichloropropene	mg/L				<0.001			
cis-1,3-Dichloroporpylene	mg/L				<0.001			
trans-1,3-Dichloropropylene	mg/L				<0.001			
1,1,1,2-Tetrachloroethane	mg/L				<0.001			
1,1,2,2-Tetrachloroethane	mg/L				<0.001			
Tetrachloroethylene	mg/L				<0.001			
1,1,1-Trichloroethane	mg/L				<0.001			
1,1,2-Trichloroethane	mg/L				<0.001			
Trichloroehtylene	mg/L				<0.001			
Trichlorofluoromethane	mg/L				<0.001			
Vinyl Chloride	mg/L				<0.001			
Non-halogenated Volatiles								
Benzene	mg/L				0.0019			
Ethylbenzene	mg/L				0.0142			
Styrene	mg/L				<0.0005			
Toluene	mg/L				0.0288			
meta- & para-Xylene	mg/L				0.0895			
ortho-Xylene	mg/L				0.049			
Metals			total	diss.	total	diss.	total	diss.
aluminum	mg/L	200	6.41	<.20	22.2	<0.2	1.78	<0.20
antimony	mg/L		<0.2	<.2	<1.0	<0.2	<0.2	<0.2
arsenic	mg/L	4	<0.2	<.2	<1.0	<0.2	<0.2	<0.2
barium	mg/L		0.581	0.137	1.89	0.154	0.234	0.166
beryllium	mg/L		<0.005	<.005	<0.02	<0.005	<0.005	<0.005
bismuth	mg/L		<0.10	<.1	<.5	<0.10	<0.1	<0.1
boron	mg/L	200	<0.1	<.1	0.57	<0.10	<0.1	<0.1
cadmium	mg/L	0.8	0.018	<.01	0.08	<0.01	<.01	<.01
calcium	mg/L		21.3	16.5	69.8	19.7	38	36
chromium	mg/L	16	0.035	<.015	0.13	<0.015	<0.015	<0.015
cobalt	mg/L	20	<0.015	<.015	<0.075	<0.015	<0.015	<0.015
copper	mg/L	8	0.536	0.076	6.06	0.042	0.176	0.01
iron	mg/L	40	11	0.271	48.3	1.15	11.3	0.274
lead	mg/L	4	0.234	<.05	3.32	<0.050	0.162	<.05
lithium	mg/L		<0.015	<.015	<0.075	<0.015	<0.015	<0.015
magnesium	mg/L	20	4.06	1.29	15.6	1.54	2.94	2.22
manganese	mg/L		0.478	0.254	2.34	0.369	0.44	0.385
molybdenum	mg/L	4	<0.03	<.03	<.15	<0.03	<0.03	<.03
nickel	mg/L	8	0.068	0.032	0.29	0.036	0.043	0.027
phosphorous	mg/L		2	0.53	9.5	0.59	0.41	<.3
potassium	mg/L		3.2	2.2	<10	2.5	0.38	3.7
selenium	mg/L		<0.20	<.2	<1	<0.2	<0.20	<0.20
silicon	mg/L		8.57	1.93	18.9	2.17	3.69	1.84
silver	mg/L	4	<0.015	<.015	<0.075	<0.015	<0.015	<0.015
sodium	mg/L		272	265	284	260	193	189
strontium	mg/L		0.113	0.083	0.32	0.092	0.154	0.147
thallium	mg/L		<0.10	<.1	<.5	<0.10	<.1	<0.10
tin	mg/L		<0.30	<.3	<1.5	<0.30	<.3	<0.3
titanium	mg/L		0.275	<.01	0.73	<0.01	0.071	<.01
tungsten	mg/L		<0.10	<.1	<.5	<0.1	<.10	<0.1
vanadium	mg/L		<0.03	<.03	<.15	<0.03	<0.03	<0.03
zinc	mg/L	12	1.53	0.673	10.9	0.774	0.497	0.156
Toxicity (96h LC50)	%		11.4					

Note: TEH - total extractable hydrocarbons

* effectiveness of preservative is suspect

< less than the detection limit indicated

** pollutant (perhaps detergent) interference is likely contributing to the elevated levels

*** BOD could not be determined, likely due to a toxic effect on bacteria

n/a pH & temperature measurements could not be taken due to the oily nature of the sample

[boxed cell] pollutant exceeds limit stipulated in GVRD sewer use bylaw (grab sample)

Site C
privately owned, hand and tunnel car wash

Site C is a "semi-automated" tunnel wash -- it offers both hand and automated washing. The types of vehicles washed include cars, vans and pick-up trucks. The number of vehicles washed may vary from 50-60 on a rainy day to 400-500 on a sunny day. The busiest days tend to be Friday, Saturday and Sunday; the busiest months, November until March; and the busiest season, winter.

The wash process typically consists of an initial pressure rinse with a soap/hot water mixture from hand held wands. The vehicle is then drawn past tire and body brushes and is subsequently washed with hand "mits" before being rinsed with cold water. Window interiors are also cleaned. Spray wax is optional. Oversized vehicles are hand washed on a pad adjacent to the tunnel wash. No engine cleaning is performed.

Chemicals are stored in a room on-site. While the room has no spill containment features, there is also no floor drain in the room. In addition, most chemicals are in dry form and if spilled are swept up dry. The chemicals in storage were:

Duraclean 46

purpose:	white-wall cleaner
stored:	50 kg
usage:	50 kg/3 months
manufacturer:	Diversey

Wunrub 13

purpose:	tire cleaner
stored:	20 kg
usage:	20 kg/mn
manufacturer:	Diversey

LSP243

purpose:	steam cleaning compound
stored:	180 kg
usage:	180 kg/mn
manufacturer:	Diversey

LSP189

purpose:	detergent used in hand wash
stored:	160 kg
usage:	160/6 months
manufacturer:	Diversey

Auto Dri

purpose:	spray wax
stored:	3 x 22 L
usage:	22 L/wk
manufacturer:	Diversey

Clothclean

purpose:	washing of coveralls and wash cloths
stored:	22 L
usage:	indefinite period
manufacturer:	Diversey

D'Germ

purpose:	cleaning of washrooms
stored:	22 L
usage:	indefinite period
manufacturer:	Diversey

Ammonia

purpose:	window cleaning

Water use has been estimated at approximately 3.8 gal/vehicle (17 L), based on water consumption records and the number of vehicles washed. This appears to be unrealistically low when compared to information from the Canadian Car Wash Association: 230-320 L/vehicle at a typical tunnel wash and 90-140 L/vehicle at a wand wash.

Figure 3.3 shows the layout of Site C. Wash water from the semi-automated section drains to a central trench, which leads to the main sediment pit (1.4m x 3.0m x 3.7m - depth). This pit is connected to the sanitary sewer. Wash water from the hand wash area to the left of the sediment pit drains first to a smaller sump (0.5m x 0.5m) and then also to the main sediment pit. The sump and pit are cleaned at least once per year by A.A. Anderson. Only a slight oily film was evident on the water in the two chambers.

Duplicate wastewater samples were collected from the main sump at the level of the sewer inlet. The results of the analysis are provided in Table 3.3. Contaminant concentrations were all found to be well below the GVRD limits, with the exception of pH, which was approaching the grab sample limit of 11. The 96 h LC50 was 25%.

Because a raw wastewater sample could not be obtained, the improvement in water quality achieved by the sediment pit can not be determined. However, with the exception of pH, this facility is well within the GVRD local limits. In terms of solids, surfactants, oil & grease, nutrients and organic content (ie. BOD and COD) it is comparable or better than a moderately strong domestic wastewater. This is likely attributable to the volume of the sediment pit, the quantities of chemicals used and the fact that engine cleaning is not performed on-site. A recommendation for this site is that absorbents be on hand in the event of a spill or a significant oil layer in the sediment pit.

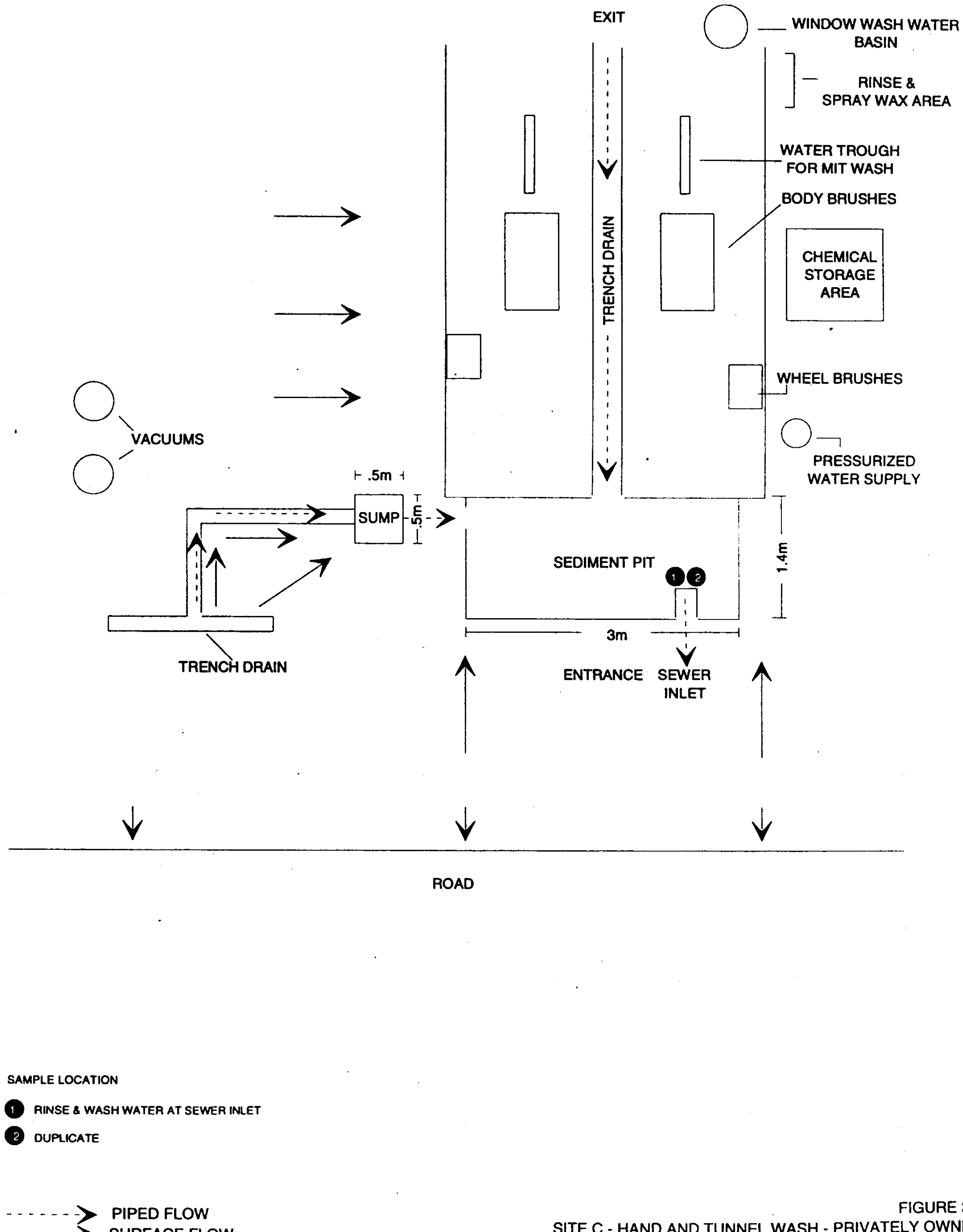


FIGURE 3.3
SITE C - HAND AND TUNNEL WASH - PRIVATELY OWNED
SITE LAYOUT (NOT TO SCALE)

TABLE 3.3: Wastewater sampling results for Site C.

Pollutant	Units	GVRD Sewer Use Bylaw	Sample #1 separator (ave. of 2 samples)	
Physical Tests				
temperature	°C	65	9.9	
pH		5-11	10.4	
D.O.	mg/L		17.2	
suspended solids	mg/L	2400	148	
total solids	mg/L		520	
turbidity	NTU		106	
Organic Parameters				
BOD	mg/L	2000	26	
COD	mg/L		73	
surfactants (LAS)	mg/L		10.4	
Extractables				
O & G (total)	mg/L	600	27*	
Nutrients				
ammonia	mg/L N		0.596	
nitrites & nitrates	mg/L N		0.3	
Metals			total	diss.
aluminum	mg/L	200	2.9	0.48
antimony	mg/L		<0.2	<0.20
arsenic	mg/L	4	<0.2	<0.20
barium	mg/L		0.191	0.014
beryllium	mg/L		<0.005	<0.005
bismuth	mg/L		<0.10	<0.10
boron	mg/L	200	<0.10	<0.10
cadmium	mg/L	0.8	<.010	<0.010
calcium	mg/L		6.49	3.28
chromium	mg/L	16	0.016	<0.015
cobalt	mg/L	20	<0.015	<0.015
copper	mg/L	8	0.305	0.049
iron	mg/L	40	7.24	0.238
lead	mg/L	4	0.086	<0.050
lithium	mg/L		<0.015	<0.015
magnesium	mg/L	20	1.21	0.324
manganese	mg/L		0.137	0.015
molybdenum	mg/L	4	<0.03	<0.030
nickel	mg/L	8	0.023	<0.020
phosphorous	mg/L		6.71	6.21
potassium	mg/L		<2.0	<2.0
selenium	mg/L		<0.20	<0.20
silicon	mg/L		6.74	4.12
silver	mg/L	4	<0.015	<0.015
sodium	mg/L		126	119
strontium	mg/L		0.032	0.014
thallium	mg/L		<0.10	<0.10
tin	mg/L		<0.30	<0.30
titanium	mg/L		0.1	<0.010
tungsten	mg/L		<0.10	<0.10
vanadium	mg/L		<0.03	<0.030
zinc	mg/L	12	0.306	0.025
Toxicity (96h LC50)	%		25.5	

Note: < less than the detection limit indicated

* a non-petroleum product (possibly detergent) is contributing to this result

Site D
truck wash facility

The clientele at this facility varies considerably. In general, it consists of trailer trucks or tanker trucks, however, these trucks may carry a variety of materials including vegetable oils, fuel, soil, meat and cement. On occasion, school buses, vans and cars are washed at this site also. Operating hours are 8 am - 5 pm in the winter and 7 am - 9 pm in the summer, 7 days per week. Approximately 15-30 vehicles may be washed on a sunny day; rainy days are typically not as busy.

The wash process begins with a pressurized rinse of fresh, cold water. Subsequently, either a soap/water or an acid/water mixture is sprayed on the truck and the truck is scrubbed. Finally, the truck is rinsed again with fresh, cold water. The acid mixture is only used on trucks with a shiny, metal exterior. The interiors of box trailers may be washed depending on the materials previously hauled; if the trailer contained any hazardous goods or highly odorous goods, it will not be cleaned. No tank interiors are washed on-site. Some engine cleaning takes place using degreasers and hot water.

Chemicals are stored in a locked building on-site. Empty chemical containers are however stored on both the grassy and paved areas outside of the storage building. These containers, because they are not completely capped, are collecting rain water. The chemicals used in the various wash processes are as follows:

Product 31

purpose:	soap
stored:	22 L
usage:	150:1; 22 L/2 weeks
contents:	incl. sodium metasilicate, complex phosphates, stabilizing agents, surfactants, lubricants, corrosion agents
manufacturer:	Hotsy

Ripper 1

purpose:	soap (stronger than Product 31)
stored:	~55 gal
usage:	100:1; 55 gal/1-2 months
manufacturer:	Hotsy

Formula 50

purpose:	all purpose cleaner and degreaser
stored:	22.7 L
usage:	22.7 L/month
manufacturer:	Zep Allcare

Aluminum Brightener

purpose:	acid to clean brighten metal exteriors
stored:	~55 gal
usage:	55 gal/1-2 months
contents:	incl. ammonium hydrogen fluoride, sulphuric acid, quaternary ammonium chloride, solvents and surfactants
manufacturer:	Hotsy

No data was available on water use.

The layout of Site D is depicted in Figure 3.4; site photographs are presented in Figures 3.4a. While the majority of the site is paved, only a portion is covered. Because the cover serves to reduce the amount of rain water coming into contact with the contaminated wash water, this area is équipped as the primary wash location. A section of the paved area around the covered wash area is bermed, so that on dry days trucks may be washed in this area and the wash water can still be routed to the pretreatment system.

There is a considerable discrepancy between the owner's perception of the wastewater pretreatment system and discharge location, the site drawings at the City of Burnaby's Building Department and the observations of the UMA assessors:

- The owner believes that the wash water flows from Catch Basin #1 to Catch Basin #2 and then to the separator. He does not believe the wash water is discharged to the sewer, but rather that it is held on-site, in tanks, for biweekly removal by A.A. Anderson.

- The site drawings on file at Burnaby City Hall show only Catch Basin #1 and the separator. The catch basin is connected to a three chambered oil/water separator, which discharges to the sanitary sewer.

- The site assessment revealed that the separator consists of only two chambers. It is apparent that water is draining from the separator, as during the inspection the water level was not increasing despite a heavy inflow. The separator has two inflow points: one pipe extending into the separator and a second, flush against the wall. Heavy flow from the second inlet was observed on a day when Catch Basin #1 was full with sediment and overflowing. It is therefore speculated that Catch Basin #2 is connected to Inlet #2 and Catch Basin #1 is connected to Inlet #1.

Samples were obtained from the site on two separate occasions. On the first occasion, samples were collected of the flow entering the separator from Inlet #2 and of the water in the separator itself at the location of the sewer inlet. While a great number of trucks had been washed on the weekend, only one truck was washed that morning. Catch Basin #1 was full, virtually to the top, with sediment. Because there was also considerable rainfall the morning of the sampling, a large portion of the sample likely consisted of surface run-off. The second sampling occasion occurred on a dry day, after clean-out of the catch basins and separator. Samples were collected from Catch Basin #1 (at the height of the outlet, ~ 0.7 m from the bottom) and the separator (at the location of Inlet #1). All sample locations are shown on Figure 3.4. Sample results are presented in Table 3.4.

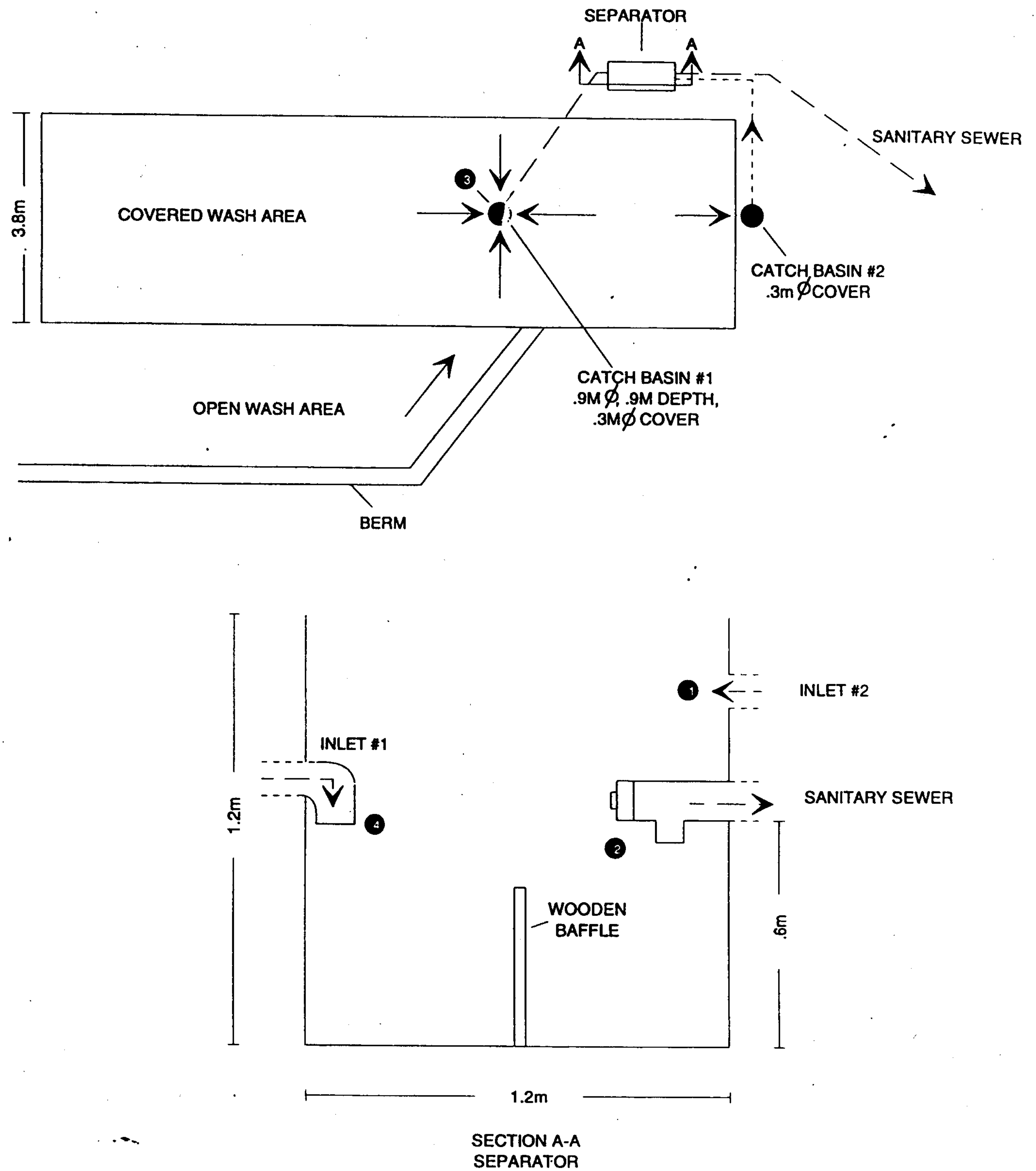


FIGURE 3.4
SITE D - TRUCK WASH FACILITY
SITE LAYOUT (NOT TO SCALE)

COVERED WASH AREA

SEPARATOR

EMPTY CONTAINER STORAGE

FIGURE 3.4a
SITE D – SITE PHOTOGRAPHS

TABLE 3.4: Wastewater sampling results for Site D.

Pollutant	Units	GVRD Sewer Use Limits	Sample #1 inlet #2		Sample #2 sump at sewer inlet (ave. of 2 analyses)		Sample #3 catch basin #1		Sample #4 sump at inlet #1	
Physical Tests										
temperature	°C	65	7.6		7.8		6.6		6.5	
pH		5-11	7.6		7.9		7.5		7.4	
D.O.	mg/L		12		12.4		5.4		4	
suspended solids	mg/L	2400	518		1910		2890		2360	
total solids	mg/L		574		2185		4340		3220	
turbidity	NTU		312		1230		2040		2090	
Organic Parameters										
BOD	mg/L	2000	<5		30		146		250	
COD	mg/L		34		42		454		795	
surfactants (LAS)	mg/L		0.33		0.64		12.4		6.24	
Extractables										
O & G (total)	mg/L	600	7		53		44		53	
TEH (C9-40)	mg/L				19.1					
TEH (C10-30)	mg/L				15.6					
Nutrients										
ammonia	mg/L N		0.017		0.014		2.55		1.56	
nitrites & nitrates	mg/L N		0.012		0.016		0.008		0.008	
Halogenated Volatiles										
Bromodichloromethane	mg/L				<0.001					
Bromoform	mg/L				<0.001					
Carbon Tetrachloride	mg/L				<0.001					
Chlorobenzene	mg/L				<0.001					
Chloroethane	mg/L				<0.001					
Chloroform	mg/L				<0.001					
Chloromethane	mg/L				<0.001					
Dibromochloromethane	mg/L				<0.001					
1,2-Dichlorobenzene	mg/L				<0.001					
1,3-Dichlorobenzene	mg/L				<0.001					
1,4-Dichlorobenzene	mg/L				<0.001					
1,1-Dichloroethane	mg/L				<0.001					
1,2-Dichloroethane	mg/L				<0.001					
cis-1,2-Dichloroethylene	mg/L				<0.001					
trans-1,2-Dichloroethylene	mg/L				<0.001					
1,1-Dirchlorethylene	mg/L				<0.001					
Dichloromethane	mg/L				<0.005					
1,2-Dichloropropane	mg/L				<0.001					
cis-1,3-Dichloroporpylene	mg/L				<0.001					
trans-1,3-Dichloropropylene	mg/L				<0.001					
1,1,1,2-Tetrachloroethane	mg/L				<0.001					
1,1,2,2-Tetrachloroethane	mg/L				<0.001					
Tetrachloroethylene	mg/L				<0.001					
1,1,1-Trichloroethane	mg/L				<0.001					
1,1,2-Trichloroethane	mg/L				<0.001					
Trichloroehtylene	mg/L				<0.001					
Trichlorofluoromethane	mg/L				<0.001					
Vinyl Chloride	mg/L				<0.001					
Non-halogenated Volatiles										
Benzene	mg/L				<0.0005					
Ethylbenzene	mg/L				<0.0005					
Styrene	mg/L				<0.0005					
Toluene	mg/L				<0.0005					
meta- & para-Xylene	mg/L				<0.0005					
ortho-Xylene	mg/L				<0.0005					
Metals			total	diss.	total	diss.	total	diss.	total	diss.
aluminum	mg/L	200	4.92	<.20	13.8	<0.20	20.8	1.58	19.7	0.79
antimony	mg/L		<0.2	<0.20	<0.2	<0.20	<0.20	<0.20	<0.20	<0.2
arsenic	mg/L	4	<0.2	<0.20	<0.2	<0.20	<0.20	<0.20	<0.20	<0.2
barium	mg/L		0.145	0.016	0.548	0.034	0.839	0.063	0.768	0.13
beryllium	mg/L		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
bismuth	mg/L		<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.1	<0.1
boron	mg/L	200	<0.10	<0.10	<0.10	<0.10	0.17	0.17	0.12	0.11
cadmium	mg/L	0.8	<0.010	<0.010	0.021	<0.010	0.138	0.054	0.084	0.036
calcium	mg/L		10	5.84	42	11.9	62.5	21.9	49.4	25.6
chromium	mg/L	16	<0.015	<0.015	0.04	<0.015	0.052	<0.015	0.047	<0.015
cobalt	mg/L	20	<0.015	<0.015	<0.015	<0.015	0.018	<0.015	0.018	<0.015
copper	mg/L	8	0.053	<0.010	0.16	<0.010	0.71	0.226	0.413	0.089
iron	mg/L	40	5.84	0.062	16.2	0.037	19.8	2.02	20.2	1.65
lead	mg/L	4	0.073	<0.050	0.2	<0.050	0.322	<0.050	0.207	<0.050
lithium	mg/L		<0.015	<0.015	0.022	<0.015	0.041	0.023	0.036	0.023
magnesium	mg/L	20	2	0.219	7.89	0.409	8.03	2.34	8.09	2.35
manganese	mg/L		0.165	0.024	0.557	0.073	1.38	0.607	1.22	0.636
molybdenum	mg/L	4	<0.030	<0.030	<0.03	<0.03	<0.030	<0.030	<0.030	<0.030
nickel	mg/L	8	<0.020	<0.020	0.025	<0.020	0.064	0.025	0.042	<0.020
phosphorous	mg/L		0.56	<0.30	2.09	<0.30	12.4	7.49	6.46	3.05
potassium	mg/L		<2.0	<2.0	3.1	<2.0	8.8	7.5	13.5	10.1
selenium	mg/L		<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
silicon	mg/L		5.55	0.529	12.9	0.731	29.7	12.8	32.1	7.5
silver	mg/L	4	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015
sodium	mg/L		5	4.6	11.7	11	422	402	670	626
strontium	mg/L		0.042	0.022	0.143	0.049	0.231	0.093	0.208	0.114
thallium	mg/L		<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
tin	mg/L		<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
titanium	mg/L		0.195	<0.010	0.399	<0.01	0.468	0.018	0.698	<0.010
tungsten	mg/L		<0.10	<0.10	<0.10	<0.1	<0.10	<0.10	<0.10	<0.10
vanadium	mg/L		<0.03	<0.030	0.3	<0.03	0.035	<0.030	0.031	<0.03
zinc	mg/L	12	0.309	0.025	0.811	0.025	2.25	1.02	1.43	0.627
Toxicity (96h LC50)	%		non-toxic		non-toxic		24		39.9	

Note: TEH - total extractable hydrocarbons

< less than the detection limit indicated

[boxed cell] pollutant exceeds limit stipulated in GVRD sewer use bylaw (grab sample)

The low concentration of contaminants in the sample from Inlet #2 confirms that this inlet was contributing primarily surface run-off to the separator. While the water in the separator had higher concentrations of solids, organics and oils & grease, the water was clearly being diluted. On the second sampling occasion, the solids, organic, surfactant and metals levels were markedly higher in the Catch Basin #1 sample and the separator. It appears that the separator is helping to reduce the solids content, but only to slightly below the GVRD limit; due to sample variability the actual suspended solids content could well be higher than the limit. The water from the first sampling occasion was found to be non-toxic to rainbow trout; however, on the second sampling occasion, the 96h LC50 was found to be 24% and 29% for the catch basin water and the separator water, respectively.

The catch basin/separator system appears to be undersized for the quantity of water and sediment flowing through and not frequently enough cleaned to avoid blockage. While the pH, metals and oil & grease measurements were well within the GVRD limit, the facility is not equipped to deal with large quantities of metals and oil in the wastewater, nor significant fluctuations in pH. Therefore, if the frequency of engine cleaning increases or the use of acids increases beyond the buffering capacity of the detergents, regular exeedance of GVRD limits may be evidenced.

Closer attention needs to be given to the frequency of sediment clean-out from the catch basins and the separator to reduce pretreatment system overloading. Empty chemical containers should be stored on the paved area, tightly capped or covered to prevent the collection of rain water in the containers.

Site E
waste collection vehicle wash at municipal yard

At Site E, municipally owned and operated waste collection vehicles, packers and load-alls, are washed. On occasion, dump trucks or other tandem or single axle vehicles may be washed. Both the interiors and exteriors of waste collection trucks are washed, at a rate of approximately 10 per day over two shifts, from 7 am until 11 pm. It is estimated that approximately 6000 vehicles are washed here annually.

The cleaning process consists of first shovelling any remaining waste from the vehicle. The truck's interior is then rinsed with fresh, cold water. If particularly odorous, a pressure washer emitting a water/detergent mixture may be used. On occasion, bleach has been used to clean the interiors of trucks, notably in the summer when problems with insect infestation have occurred. The exteriors of the vehicles are pressure washed with a detergent/water mixture and rinsed with fresh water. Engine cleaning only occurs at this site when the pressure washer in the maintenance area of the yard is broken.

In addition to bleach, only one other chemical is used in the wash process:

Citri-Safe Contact Cleaner

purpose:	cleaner/degreaser for exterior and occasional interior wash
stored:	800 L
usage:	1:20 - 1:5, 560 L/mn
manufacturer:	Citri-Safe Enviro Products

Water use rates were unavailable.

The layout of Site E is presented in Figure 3.5. Vehicle interiors are cleaned at the edge of the ramped pit. Vehicle exteriors are washed in the covered (open-sided) area adjacent to the pit. The entire wash area is paved. Wastewater from exterior washing is collected in the trench drain at the entrance to the covered area and is discharged to the ramped pit. The pit contains debris from the vehicle interiors, solids residue from the vehicle exteriors and a water/detergent mixture. The wastewater from the pit flows through a screen, with approximately 1.5 cm openings, to the sanitary sewer. The solid waste in the pit is transferred daily to a collection vehicle which takes the waste to the landfill. On occasion a pumper truck (used for catch basin cleaning) removes the sediment/water mixture from the trench.

Duplicate samples were collected of the wastewater in the sediment pit, just below the water surface (the water in the pit was approximately 25 cm deep). The sample location is shown in Figure 3.5. The results are presented in Table 3.5.

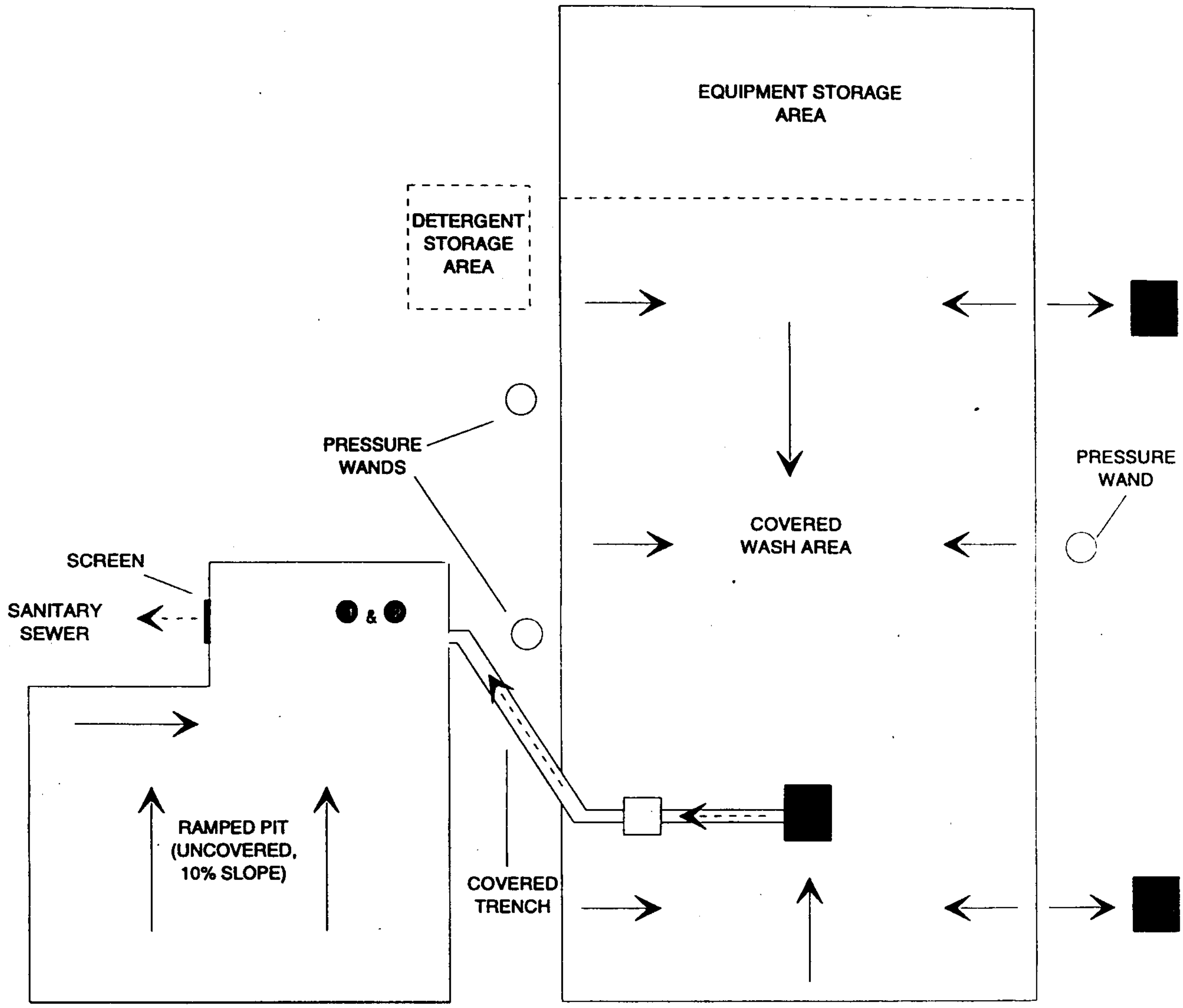
There is great potential for a wide variety of pollutants in the wastewater, due to the variety of materials collection vehicles may carry. While the pollutants found in the wastewater at this site were all well below the GVRD limits, the water had a 96h LC50 of 3.8% -- the most toxic of all the wastewaters sampled in this study. The only pollutant tested for that was found to be at levels higher than those of the samples from other locations (with the exception of Site A) was BOD. While the wastewater samples were aerated during the course of the 96 hour toxicity test period, the dissolved oxygen levels in some cases dropped to below 4.5 mg/L (the minimum dissolved oxygen level required for survival), possible contributing to fish deaths.

Due to the potential for high BOD levels and a variety of pollutants in the wash water from collection vehicle interiors, it is particularly important that this water be directed to the sanitary sewer for further treatment.

Site F
tunnel car wash licenced by major oil company

At this fully automated facility, cars, vans and pick-up trucks are washed, 7 days per week. On average 75 vehicles may be washed per day. Typically, Thursday to Saturday is the busiest. The busiest months are generally December to April. On-site services include the car wash, a gas station and a convenience store.

The wash process consists of a pre-soak, wash, rinse, an optional wax and drying. The pre-soak is achieved with a pressurized wand emitting a fresh, cold water/soap mixture. The vehicle then passes through two moving "curtains" where additional soap and water are sprayed onto the vehicle. The subsequent body brushes and wheel brushes also emit a soap/water mixture. Following the wash cycle, the car is rinsed with a mixture of fresh cold water and wax. The wax is added to aid in water beading and run-off and thus, the drying process. The hot wax is optional.



SAMPLE LOCATION

1 RINSE AND WASH WATER (& MISC. WASTE)

2 DUPLICATE

■ CATCH BASINS

- - - - -> PIPED FLOW

———> SURFACE FLOW

FIGURE 3.5
SITE E - WASTE COLLECTION VEHICLE WASH AT MUNICIPAL YARD
SITE LAYOUT - WASH AREA (NOT TO SCALE)

TABLE 3.5: Wastewater sampling results for Site E.

Pollutant	Units	GVRD Sewer Use Bylaw	Sample #1 ramped pit (ave. of 3 analyses)	
Physical Tests				
temperature	°C	65	7.2	
pH		5-11	8.7	
D.O.	mg/L		5.9	
suspended solids	mg/L	2400	466	
total solids	mg/L		946	
turbidity	NTU		689	
Organic Parameters				
BOD	mg/L	2000	341	
COD	mg/L		996	
surfactants (LAS)	mg/L		0.88	
Extractables				
O & G (total)	mg/L	600	45	
TEH (C9-40)	mg/L		78	
TEH (C10-30)	mg/L		27.9	
Nutrients				
ammonia	mg/L N		1.71	
nitrites & nitrates	mg/L N		0.298	
Halogenated Volatiles				
Bromodichloromethane	mg/L		<0.001	
Bromoform	mg/L		<0.001	
Carbon Tetrachloride	mg/L		<0.001	
Chlorobenzene	mg/L		<0.001	
Chloroethane	mg/L		<0.001	
Chloroform	mg/L		0.01	
Chloromethane	mg/L		<0.001	
Dibromochloromethane	mg/L		<0.001	
1,2-Dichlorobenzene	mg/L		<0.001	
1,3-Dichlorobenzene	mg/L		<0.001	
1,4-Dichlorobenzene	mg/L		<0.001	
1,1-Dichloroethane	mg/L		<0.001	
1,2-Dichloroethane	mg/L		<0.001	
cis-1,2-Dichloroethylene	mg/L		<0.001	
trans-1,2-Dichloroethylene	mg/L		<0.001	
1,1-Dirchlorethylene	mg/L		<0.001	
Dichloromethane	mg/L		<0.005	
1,2-Dichloropropane	mg/L		<0.001	
cis-1,3-Dichloroporpylene	mg/L		<0.001	
trans-1,3-Dichloropropylene	mg/L		<0.001	
1,1,1,2-Tetrachloroethane	mg/L		<0.001	
1,1,2,2-Tetrachloroethane	mg/L		<0.001	
Tetrachloroethylene	mg/L		<0.001	
1,1,1-Trichloroethane	mg/L		<0.001	
1,1,2-Trichloroethane	mg/L		<0.001	
Trichloroehtylene	mg/L		<0.001	
Trichlorofluoromethane	mg/L		<0.001	
Vinyl Chloride	mg/L		<0.001	
Non-halogenated Volatiles				
Benzene	mg/L		<0.0005	
Ethylbenzene	mg/L		<0.0005	
Styrene	mg/L		<0.0005	
Toluene	mg/L		<0.001	
meta- & para-Xylene	mg/L		<0.0005	
ortho-Xylene	mg/L		<0.0005	
Metals			total	diss.
aluminum	mg/L	200	5.35	<0.20
antimony	mg/L		<0.2	<0.20
arsenic	mg/L	4	<0.2	<0.20
barium	mg/L		0.171	0.031
beryllium	mg/L		<0.005	<0.005
bismuth	mg/L		<0.10	<0.10
boron	mg/L	200	<0.10	<0.10
cadmium	mg/L	0.8	<0.01	<0.01
calcium	mg/L		21.5	16.9
chromium	mg/L	16	0.163	0.064
cobalt	mg/L	20	<0.015	<0.015
copper	mg/L	8	0.124	0.016
iron	mg/L	40	8.75	1.67
lead	mg/L	4	0.08	<0.050
lithium	mg/L		<0.015	<0.015
magnesium	mg/L	20	2.55	1.19
manganese	mg/L		0.244	0.127
molybdenum	mg/L	4	<0.03	<0.03
nickel	mg/L	8	<0.02	<0.02
phosphorous	mg/L		2.83	1.7
potassium	mg/L		18.4	17.7
selenium	mg/L		<0.2	<0.2
silicon	mg/L		14.4	7.86
silver	mg/L	4	<0.015	<0.015
sodium	mg/L		45.4	44.4
strontium	mg/L		0.104	0.077
thallium	mg/L		<0.10	<0.10
tin	mg/L		<0.30	<0.30
titanium	mg/L		0.239	0.011
tungsten	mg/L		<0.1	<0.1
vanadium	mg/L		<0.03	<0.03
zinc	mg/L	12	0.446	0.093
Toxicity (96h LC50)	%		3.8	

Note: TEH - total extractable hydrocarbons

< less than the detection limit indicated

The chemicals stored in the wash area and used in the wash process were:

Truck'N Bus

purpose:	detergent used in pre-soak stage
stored:	2 x 113 L
usage:	~ 3 x 113 L/y
manufacturer:	Savolite

Coast 302

purpose:	optional "buff & polish degreaser" (detergent) used at first curtain
stored:	113 L
usage:	113 L/3 months
manufacturer:	Savolite

Exult Hi-Foam

purpose:	detergent used in tunnel wash
stored:	3 x 113 L
usage:	~ 113 L/2 months
manufacturer:	Savolite

Power Wash HA

purpose:	detergent used in tunnel wash
stored:	5 x 113 L
usage:	113 L/mn
manufacturer:	Savolite

Shine Rinse

purpose:	wax used to aid in drying process
stored:	213 L
usage:	3-5 x 213 L/y
manufacturer:	Savolite

Hot Wax

purpose:	hot wax
stored:	213 L
usage:	213 L/9 months
manufacturer:	Savolite

Wheel Brite

purpose:	wheel cleaner
stored:	22 L
manufacturer:	Savolite

The water use rate is typically in the order of 160 L per car.

The site layout is shown in Figure 3.6. All wastewater flows from the tunnel wash are collected in a trench that runs the length of the tunnel wash. The trench has a high point at approximately the mid-point of the trench length, to keep separate the wash area waste flows from the rinse/wax area waste flows. The wash area wastewater flows from the trench to the first chamber of a four chambered separator; the final rinse water flows to the final chamber of the separator. Any sediment or other debris which accumulates in the trench is shovelled to the high point of the trench, where it is stored until disposal.

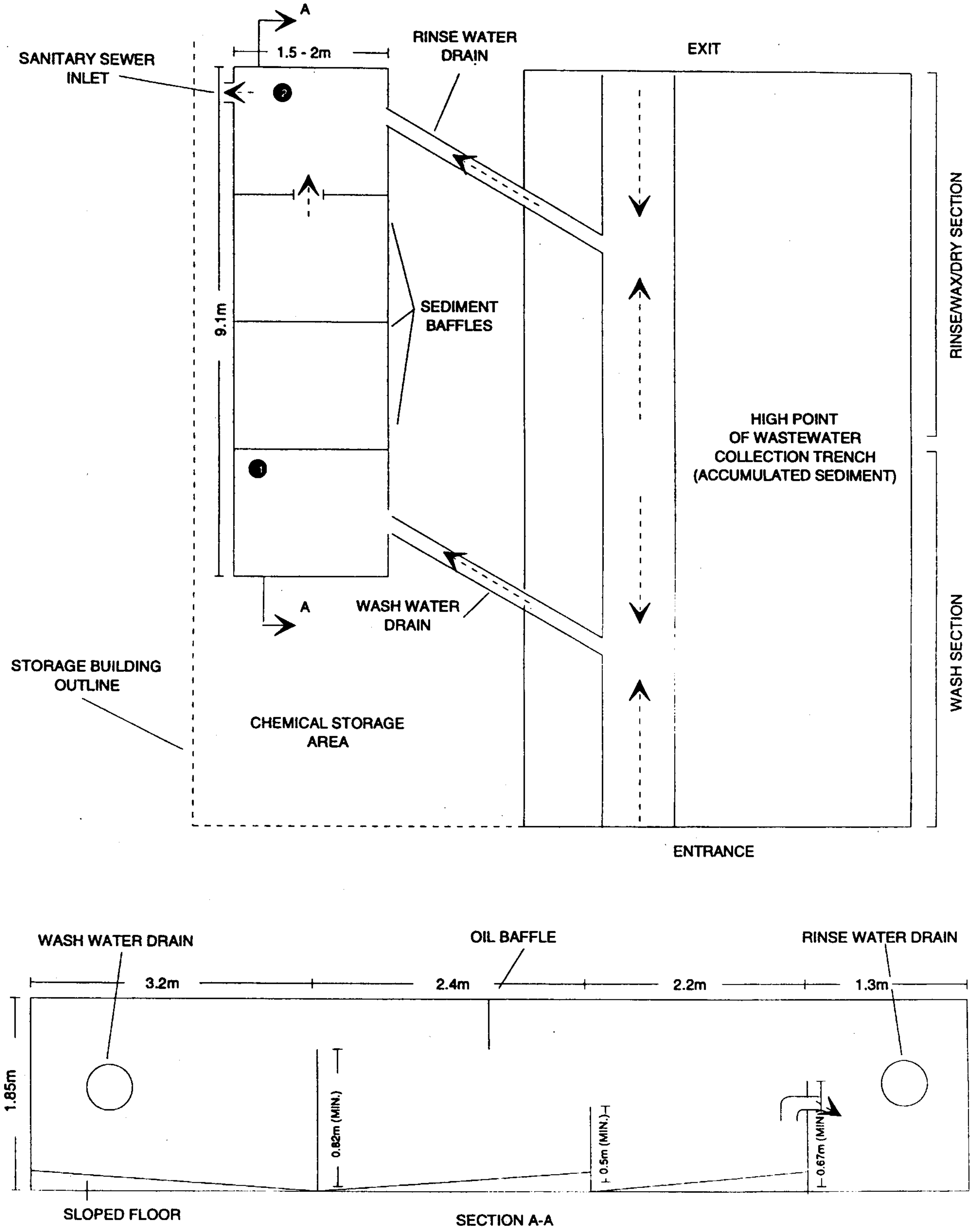
A schematic of the separator is provided in Figure 3.6. The dimensions of the separator, given by the design drawings, are 1.85 m (depth) x 9.1 m (length) x 1.5-2 m (width, estimate.). The separator is divided into four chambers by three baffles of varying height. The floors of the separator are sloped to aid sedimentation. The removal of floating oils is achieved with a baffle suspended from the top of the separator. With the exception of the final chamber, water flows from chamber to chamber over the baffles. Water flows into the final chamber through a pipe. The water contained in each of the chambers was free of floatables and did not have an oily sheen. The water present in the final chamber was visibly clearer than that in the first chamber.

Wastewater from the final chamber of the separator is discharged to the sanitary sewer. All sediment and miscellaneous debris/oils accumulating in the separator and the trench are removed by Western Waste Management twice yearly.

Wastewater samples were collected from the first and final chambers of the separator, in close proximity to the inlet and outlet respectively. The sample locations are shown in Figure 3.6. The chemical analysis of the water is presented in Table 3.6. In general, all results were well below the GVRD sewer use bylaw limits.

The separator at this facility was designed to act as a sediment pit and to aid in the removal of free oils. Comparison of the grab samples shows that the suspended solids and oil & grease levels decreased from the first to the final chamber. However, the suspended solids level was already quite low in the first chamber (3% of the GVRD limit) and the decrease amounts to only 18 mg/L thus, likely also attributable to sample variability. Both oil & grease analyses produced white crystals in the extraction phase, not typical of petroleum products. A mineral oil and grease analysis showed that only 8% of the total oil & grease results consisted of petroleum product. The laboratory has found that this is often the case with wastewater samples from wash facilities and speculates that the detergents might be contributing to this effect.

The toxicity of the wastewater from this site was quite high (96h LC50 of 12% in the first chamber and 7.5% in the final chamber) and increased from the first to the final chambers. The cause of this result could be attributed to a number of factors: for example, the high level of surfactants in the water (45 mg/L), wax deposits on the fish gills, a pollutant not tested for or the variability associated with the toxicity test.



SAMPLE LOCATION

1 FIRST CHAMBER

2 FINAL CHAMBER

- - - - > PIPED FLOW

FIGURE 3.6
SITE F - TUNNEL WASH - OIL CO. LICENSED FACILITY
SITE LAYOUT (NOT TO SCALE)

TABLE 3.6: Wastewater sampling results for Site F.

Pollutant	Units	GVRD Sewer Use Bylaw	Sample #1 first chamber		Sample #2 final chamber	
Physical Tests						
temperature	°C	65	11.7		11	
pH		5-11	7.4		7.2	
D.O.	mg/L		7.6		3.5	
suspended solids	mg/L	2400	68		50	
total solids	mg/L		272		296	
turbidity	NTU		78		75.5	
Organic Parameters						
BOD	mg/L	2000	17		24	
COD	mg/L		300		347	
surfactants (LAS)	mg/L		45.5		45.5	
Extractables						
O & G (total)	mg/L	600	679*		107*	
O & G (mineral)					9	
Nutrients						
ammonia	mg/L N		<0.005		0.005	
nitrites & nitrates	mg/L N		<0.005		<0.005	
Metals			total	diss.	total	diss.
aluminum	mg/L	200	1.59	0.27	1.77	0.3
antimony	mg/L		<0.20	<0.20	<0.20	<0.20
arsenic	mg/L	4	<0.20	<0.20	<0.20	<0.20
barium	mg/L		0.1	0.017	0.097	0.017
beryllium	mg/L		<0.005	<0.005	<0.005	<0.005
bismuth	mg/L		<0.10	<0.10	<0.10	<0.10
boron	mg/L	200	<0.10	<0.10	<0.10	<0.10
cadmium	mg/L	0.8	<.010	<0.010	<0.01	<0.010
calcium	mg/L		4.82	3.81	5.04	4.25
chromium	mg/L	16	<0.015	<0.015	<0.015	<0.015
cobalt	mg/L	20	<0.015	<0.015	<0.015	<0.015
copper	mg/L	8	0.273	0.237	0.247	0.191
iron	mg/L	40	2.57	0.36	2.61	0.547
lead	mg/L	4	<0.05	<0.050	<0.050	<0.050
lithium	mg/L		<0.015	<0.015	<0.015	<0.015
magnesium	mg/L	20	0.563	0.21	0.623	0.254
manganese	mg/L		0.075	0.043	0.082	0.054
molybdenum	mg/L	4	<0.03	<0.030	<0.030	<0.030
nickel	mg/L	8	0.035	<0.020	0.026	0.025
phosphorous	mg/L		2.02	1.73	2.37	2
potassium	mg/L		4	3.9	4.5	4.1
selenium	mg/L		<0.20	<0.20	<0.20	<0.20
silicon	mg/L		6.25	4.11	6.7	4.4
silver	mg/L	4	<0.015	<0.015	<0.015	<0.015
sodium	mg/L		27.5	26.9	35	35
strontium	mg/L		0.026	0.019	0.027	0.021
thallium	mg/L		<0.10	<0.10	<0.10	<0.10
tin	mg/L		<0.30	<0.30	<0.30	<0.30
titanium	mg/L		0.086	<0.010	0.093	<0.010
tungsten	mg/L		<0.10	<0.10	<0.10	<0.10
vanadium	mg/L		<0.03	<0.030	<0.030	<0.030
zinc	mg/L	12	0.51	0.414	0.52	0.452
Toxicity (96h LC50)	%		12		7.5	

Note: TEH - total extractable hydrocarbons

< less than the detection limit indicated

* detergents likely contibuting to elevated levels, not necessarily petroleum products (see mineral O&G analysis)

[box] pollutant exceeds limit stipulated in GVRD sewer use bylaw (grab sample)

4.0 REVIEW OF DOCUMENTED PRACTICES

A search for documents detailing vehicle wash water characteristics, the treatment technologies applicable to vehicle wash water and management practices for vehicle wash facilities was conducted. The following databases were searched for relevant publications: NTIS for U.S. government publications and Aqualine, Pollution Abstracts, Waternet, Environmental Abstracts and Water Resources Abstracts for commercial publications.

4.1 WASTEWATER CHARACTERIZATION

The results of wastewater characterization studies of both raw and (pre)treated effluent at car and truck wash facilities is presented below. Brief summaries of the respective sampling programs and the findings and relevant conclusions of each data source are also provided.

Municipality of Metro Toronto
Canada, 1990

In 1990, Metro Toronto conducted wastewater sampling at five service stations with car washes. The results are presented in Table 4.1, however, the supporting documentation for this data is currently unavailable.

Table 4.1: Wastewater Characterization Data From Five Service Stations with Car Washes.

PARAMETER	1	2	3	4	5
	mg/L (except pH)				
BOD	N/A	200	175	160	95
Total Oils & Grease	17	25	55	60	26
Mineral Oils & Grease	2	8	30	60	26
Phenols	40	8	4	N/A	N/A
Suspended Solids	230	140	160	220	300
pH	7.9	6.5	7.2	6.8	6.9
Sampling Point	final stage of settling pit	last stage of interceptor	N/A	last stage of 4 stage settling tank	last stage of 5 stage interceptor

Note: Shading signifies exceedance of local sewer use bylaw discharge limits.

Palo Alto, Vehicle Service Facility Waste Minimization Program
Uribe & Associates for Palo Alto Regional Water Quality Control Plant
U.S.A., February 1994

As part of the Palo Alto Clean Bay Business Program, extensive sampling of wastewater from the automobile service industry was conducted. The data is presented in Table 4.2. The same data was presented under primary business activity and primary waste generating activity, because it was found that there is no direct correlation between the type of business and the waste generating activity. For example, a general repair shop may discharge significant quantities of wastewater as a result of washing vehicle exteriors and engine cleaning. Most samples were collected from the last chamber of a 2 or 3 chambered sump. In some cases the sample may have been collected from a sewer clean-out downstream of the discharge, but prior to dilution with other discharges.

As a result of the sampling program it was discovered that while a number of vehicle wash discharges violated metals limits, none of the violations occurred at commercial car washes.

Guidance Document for Effluent Discharges from the Auto and Other Laundries; Point Source Category
U.S. Environmental Protection Agency
U.S.A., February 1982

For the 1982 U.S. EPA study into effluent discharges from the car wash industry, extensive wastewater sampling was conducted at tunnel, roll-over and wand type car washes. In selecting the sampling sites, only facilities considered representative of the industry were selected. The data from the report is presented in Table 4.3.

The study revealed that the type of cleansing process used is a key determinant of the concentration of pollutants in the wastewater. This is as a result of the differing amounts of water used and the differing degrees of thoroughness with each wash process. However, regardless of the wash process used, the quantity and type of soil on the vehicles also directly impacts the wastewater contaminant concentrations. Both the quantity and type of soils, and in turn the quantity of water used in the wash process, can also be affected by seasonal and geographic differences.

Based on the median and mean concentrations and the number of pollutants found, it was concluded that wand type car wash wastewater is more heavily polluted than wastewater from tunnel or roll-over type car washes. Overall however, the BOD_5, TOC and phosphorous in car wash wastewater were found to be below the typical concentration range found in domestic wastewater; COD, TSS and Oil & Grease concentrations were found to be equal or less than the concentrations found in domestic wastewater. Lead, zinc, copper and nickel were the only metals of relative significance found in virtually all of the samples. While several toxic organics were found in the wastewater from car washes, almost all had mean concentrations below 0.05 mg/L. Average toxic metals loadings were found to be less than 0.17 kg/d/facility for tunnels, less than 0.12 kg/d/facility for wands and less than 0.15 kg/d/facility for rollovers.

TABLE 4.2: Wastewater characterization - Document 2

TITLE	*1993 Summary Report, Vehicle Service Facility Waste Minimization Program*
AUTHOR	-
PERFORMING AGENCY	*Uribe & Associates for Palo Alto Regional Water Quality Control Plant*
PUBLICATION	-
DATE OF PUBLICATION	*February 1994*

Constituent	Limit	Primary Business Activity	Waste Generating Activity	
		Car Washing	Exterior Vehicle Washing Only	Engine Cleaning or Ext. Vehicle & Eng. Cleaning
	mg/L			
Cadmium				
# of Samples		10	18	28
Range		0.0006-0.02	0.0011-0.03	0.002-0.23
Mean	0.1	0.02	0.01	0.1
Std. Dev.		0.01	0.01	0.37
Violations		0 (0%)	0 (0%)	1 (4%)
Chromium				
# of Samples		10	18	28
Range		0.011-0.043	0.0027-0.20	0.005-0.49
Mean	2.0	0.021	0.03	0.08
Std. Dev.		0.01	0.04	0.12
Violations		0 (0%)	0 (0%)	0 (0%)
Copper				
# of Samples		10	19	28
Range		0.17-0.81	0.0410-16.0	0.012-20.1
Mean	2.0	0.39	1.35	1.12
Std. Dev.		0.2	3.6	3.75
Violations		0 (0%)	3 (16%)	2 (7%)
Lead				
# of Samples		10	19	28
Range		0.031-0.150	0.008-32.0	0.030-12.34
Mean	0.5	0.1	1.82	0.81
Std. Dev.		0.04	7.31	2.47
Violations		0 (0%)	2 (11%)	3 (11%)
Nickel				
# of Samples		10	19	28
Range		0.042-0.230	0.008-2.5	0.0032-0.5
Mean	1.0	0.14	0.21	0.14
Std. Dev.		0.06	0.56	0.012
Violations		0 (0%)	1 (5%)	0 (0%)
Zinc				
# of Samples		10	19	28
Range		0.43-1.93	0.23-47.0	0.08-40.01
Mean	2.0	1.04	4.17	3.08
Std. Dev.		0.48	10.54	7.72
Violations		0 (0%)	6 (32%)	5 (18%)

TABLE 4.3: Raw Wastewater Characterization Data - Document 3.

TITLE	*Guidance Document for Effluent Discharges from the Auto and Other Laundries. Point Source Category*
AUTHOR	-
SPONSORING AGENCY	*U.S. Environmental Protection Agency*
PUBLICATION	-
DATE OF PUBLICATION	*February 1982*

Pollutant	Tunnel													
	Raw Wash Water					Raw Rinse Water					Combined Wastew			
	sample #	min.	max.	median	mean	sample #	min.	max.	median	mean	sample #*	min.	max.	median
		(mg/L)					(mg/L)						(mg/L)	
pH	15	7.1	10	8	8.3	13	7.3	9.4	8	8.1	4	7.5	9	8.7
BOD_5	15	18	191	45	59	13	8	153	53	59	17	<6.0	147	42
COD	14	96	653	204	261	12	64	376	166	184	16	61	517	178
TOC	14	16	210	66	70	12	11	100	27	32	16	16	169	31
TSS	15	28	882	121	195	13	19	153	54	62	17	36	848	101
O & G	15	4.8	655	17	68	13	5.8	114	43	39	17	5.7	239	20
Phosphorous	14	0.4	27	2.3	4	12	<0.2	18	0.92	2.8	16	0.38	24	1.9
Antimony											1/1		0.0045	
Arsenic											4/17		0.016	<0.01
Beryllium											0/17			
Cadmium											17/17		0.066	0.014
Chromium											17/17		1.7	0.026
Copper											8/8		0.3	0.1
Lead											17/17		2.2	0.55
Mercury											6/17		0.0005	<0.0001
Nickel											17/17		0.69	0.13
Selenium											0/1			
Silver											0/1			
Thallium											0/1			
Zinc											17/17		1.5	0.55
Chloroform														
Fluoranthene														
Methylene Chloride											1/1		0.011	
Dichlorobromomethane														
Trichlorofluoromethane														
Chlorodibromomehtane														
Napthalene														
4-nitrophenol											1/1		0.011	
2,4-dinitrophenol														
Bis(2-ethylhexyl) phthalate											1/1		0.027	
Butyl benzyl phthalate														
Di-n-butyl phthalate														
Di-n-octyl phthalate														
Benzo(a)anthracene														
Benzo(a)pyrene														
Benzo(k)fluoranthene														
Anthacene														
Phenanthrene														
Pyrene														
Trichloroethylene														

Note: * Ratio indicates the number of samples in which pollutant was found, compared to the total number of samples analyzed.

l Wastewater			Rollover						Wand					
median	mean	ave. loading	sample #*	min.	max.	median	mean	ave. loading	sample #*	min.	max.	median	mean	ave. loading
L)		(kg/d/facility)		(mg/L)				(kg/d/facility)		(mg/L)				(kg/d/facility)
8.7	8.5		6	6.2	7.7	7.7	7.3		6	6.4	8.3	7.4	7.5	
42	51		6	8	132	20	37		6	29	220	69	90	
178	216		4	102	254	135	156		4	167	1120	238	442	
31	52		4	24	173	31	65		4	29	160	79	86	
101	165		6	30	576	158	199		6	186	2970	659	929	
20	38		6	6	188	9.4	45		6	20	404	90	126	
1.9	3.2		4	0.25	1.9	0.41	0.74		4	0.8	3.2	2.8	2.4	
			2/2		0.0025	0.0022	0.0022	0.000025	2/2		0.017	0.014	0.014	0.00028
<0.01	0.0018	0.00014	1/6		0.0005	<0.0005	0.00008	0.0000091	3/6		1.6	0.0014	0.26	0.0052
			0/6					0.00015	1/6		0.016	<0.001	0.0027	0.000054
0.014	0.022	0.0017	5/6		0.04	0.008	0.013	0.00031	6/6		0.092	0.029	0.043	0.00036
0.026	0.14	0.011	5/6		0.11	0.013	0.027	0.0013	6/6		0.27	0.054	0.099	0.002
0.1	0.15	0.011	4/4		0.23	0.09	0.11	0.0057	4/4		0.86	0.48	0.54	0.011
0.55	0.78	0.059	6/6		1.1	0.47	0.5	0.0000011	6/6		4.2	1.6	2	0.04
<0.0001	0.00011	0.0000083	1/6		0.0006	<0.0001	0.0001	0.0013	4/6		0.026	0.00055	0.0048	0.000096
0.13	0.19	0.014	6/6		0.2	0.11	0.11		6/6		0.39	0.12	0.15	0.003
			0/2						0/6					
			0/2						0/6					
			0/2						0/6					
0.55	0.7	0.053	6/6		1	0.42	0.42	0.0048	6/6		2.4	1.5	1.5	0.03
			1/2		0.037		0.018	0.0002	1/2		0.083		0.042	0.00084
									1/2		0.014		0.007	0.00014
			1/2		0.47		0.24	0.0027	2/2		0.64		0.33	0.0066
									1/2		0.033		0.016	0.00032
									1/2		0.12		0.06	0.0012
									1/2		0.012		0.006	0.00012
									1/2		0.17		0.085	0.0017
			1/2		0.015		0.0075	0.000086	1/2		0.014		0.007	0.00014
									1/2		0.019		0.0095	0.00019
			1/2		0.031		0.016	0.0018	2/2		1		0.54	0.011
									2/2		0.031		0.022	0.00044
									1/2		0.015		0.0075	0.00015
			1/2		0.016		0.008	0.000091	1/2		0.016		0.008	0.00016
									1/2		0.012		0.006	0.00012
									1/2		0.012		0.006	0.00012
									1/2		0.012		0.006	0.00012
									1/2		0.017		0.0085	0.00017
									1/2		0.017		0.0085	0.00017
									1/2		0.011		0.0055	0.00011
									1/2		0.013		0.0065	0.00013

The final conclusions from this study were that no further effort would be given to developing regulations for this industry as "the amount and toxicity of each pollutant in the discharge does not justify developing national regulations" and "the toxicity and the amount of incompatible pollutants (taken together) introduced by such point sources into treatment works that are publicly owned is so insignificant as not to justify developing a pretreatment regulation".

Supplemental Manual on the Development and Implementation of Local Discharge Limitations under the Pretreatment Program -- Residential and Commercial Toxic Pollutant Loadings and POTW Removal Efficiency Estimation

U.S. Environmental Protection Agency
U.S.A., May 1991

Part 1 of this two-part document provides information on toxic pollutant loadings from residential and commercial sources, including car washes and truck cleaners. For the former, data was submitted from 11 facilities in three cities; for the latter, data was submitted from six facilities in two cities. The data is presented in Table 4.4.

It was cautioned that consistent sampling techniques may not have been used by each of the cities. Further, the data submitted was obtained by sampling at the sewer connections, downstream of any pretreatment units at a facility. Thus, the data reflects the level of pretreatment, if any. Since, the document did not classify the data as either raw or treated, the data should be considered as reflective of the discharge levels being received at the treatment works.

The report found that the pollutants discharged at the highest levels from car washes included COD, zinc, lead and copper; the latter three pollutants were identified as characteristic of the wastewater sources. From the truck cleaning facilities, the pollutants detected at the highest average levels included COD, total dissolved solids, cyanide, phosphate, phenol, zinc and aluminum. With the exception of aluminum, all of these pollutants plus lead, chromium and copper were considered characteristic of this wastewater source. In the truck cleaning wastewater, the average levels of metals were found to be at least three times the corresponding average residential/commercial trunk line levels for these pollutants.

TABLE 4.4: Wastewater Characterization Data - Document 4.

TITLE	*Supplemental Manual on the Development & Implementation of Local Discharge Limitations under the Pretreatment Program -- Residential & Commercial Toxic Pollutant Loadings and POTW Removal Efficiency Estimation*
AUTHOR	-
SPONSORING AGENCY	*U.S. Environmental Protection Agency*
PUBLICATION	-
DATE OF PUBLICATION	*May 1991*

Pollutant	Car Washes					Truck Cleaners				
	# of Detections	# of Samples	min.	max.	ave.	# of Detections	# of Samples	min.	max.	ave.
			mg/L					mg/L		
COD	3	3	34	250	126.33	63	63	35.3	17850000	36478
TDS						5	5	361	11700	3364
Aluminum						4	4	4.8	13.1	7.7
Antimony						6	17	0.01	0.64	0.09
Arsenic						9	23	0.002	0.85	0.068
Beryllium						1	15	0.001	0.1	0.013
Cadmium	21	33	<0.002	0.07	0.017	59	71	0.001	0.427	0.027
Copper	29	33	0.03	0.39	0.139	72	74	0.007	1.8	0.233
Cyanide						5	9	0.005	250	55.587
Nickel	17	26	0.02	0.25	0.08	53	65	0.01	1.05	0.177
Chromium (T)	18	29	0.01	0.24	0.074	46	79	0.004	0.98	0.12
Lead	29	34	0.002	0.99	0.162	56	85	0.005	6.4	0.353
Phosphate						5	5	0.09	34.2	7.85
Selenium						5	22	0.001	0.05	0.012
Silver	3	12	<0.001	<0.05	0.018					
Thallium						2	14	0.005	0.13	0.042
Zinc	37	37	0.02	3	0.543	83	83	0.09	80.98	4.416
Phenol						78	83	0.005	62	1.881

Preliminary Data Summary for the Transportation Equipment Cleaning Industry
U.S. Environmental Protection Agency
U.S.A., September 1989

This 1989 report investigates the contaminants in the wastewater from cleaning tanker truck interiors. The washing of truck exteriors was believed to contribute only minor quantities to the total wastewater generated at tank cleaning facilities. Three tank truck cleaning facilities were sampled. Samples of both raw and treated wastewater were obtained from all facilities on two separate days. At Facility A, grab samples were taken; at Facilities B & C, 24 hour composite samples were taken. The results are presented in Table 4.5.

The data from Facility A showed considerable variation in the concentration of organic pollutants between the two raw wastewater samples. There was however, no apparent correlation between the raw wastewater and the materials last contained in the trucks before the sampling was conducted. It was thought that the lack of correlation may be due to the lack of specificity in the descriptions of tank cargo.

Several organic pollutants were found at high levels in the raw wastewater from Facility B. Some of these pollutants (acetone, methylene chloride, orthodichlorobenzene, 2-butanone, isobutyl alcohol and ethyl methacrylate) correlated with the cargoes last contained in the tanker trucks. The higher readings of several semi-volatile organic pollutants in the effluent in comparison to the raw sample (Day 1) was attributed to the laboratory dilution of the raw wastewater sample, raising the pollutant detection limits.

Approximately 30 organic pollutants were reported in the various samples taken from Facility C. The only readily apparent correlation between cargo and detected wastewater contaminants were for 2,4-diaminotoluene and chromium.

Development of a Water Management Program for a Tank Truck Washing Terminal
Wood, W.C., et al.
Proceedings of the 28th Industrial Waste Conference, Purdue University
U.S.A., May 1973

Sampling of tank truck wash water was conducted at the Liquid Transporters Inc. terminal in Louisville, Kentucky. This facility typically washed tank trucks used to transport a variety of liquid products including whiskey, molasses, oils and fuels, paints and glycols. The waste flow from the wash down of the exteriors of the vehicles was considered negligible in comparison to the contributions from interior washing. Thus, only waste flows from interior washing were sampled.

The interior wash operation was typically conducted in three phases. The dump and flush phase consisted of opening the truck's dump valve and discharging any remaining product along with flush water. The wash was performed using either a strong soap solution or a caustic strip solution, depending upon the product to be washed from the truck. The final phase, the rinsing phase, involved opening the dump valve and rinsing the tank with water.

TABLE 4.5: Wastewater Characterization Data - Document 5.

TITLE	*Preliminary Data Summary for the Transportation Equipment Cleaning Industry*
AUTHOR	-
SPONSORING AGENCY	*U.S. Environmental Protection Agency*
PUBLICATION	-
DATE OF PUBLICATION	*September 1989*

Pollutant	Units	Facility A				Facility B							Facility C								
		Tap Water	Day1	Day 2		Tap Water	Day 1		Day 2		Sludge	TCLP Extract	Tap Water	Day 1			Day 2			Sludge	TCLP Extract
			raw	raw	effluent		raw	effluent	raw	effluent				raw	equal. tank eff.	effluent	raw	equal. tank eff.	effluent		
Volatile Organics																					
acetone	µg/L	-	-	124	-	-	-	140526	9169	-	-	1543	-	1170410	6624200	6524200	-	-	228336	-	658
alpha-picoline	µg/L	-	-	-	-	-	-	54	-	-	-	-	-	-	-	-	-	-	-	-	-
benzene	µg/L	-	6961	4574	5566	-	96	29	32	19	670	42	-	64	-	-	-	-	-	-	-
chlorobenzene	µg/L	-	-	53	-	-	-	-	12	-	-	-	-	70	-	-	125	-	-	-	-
diethyl ether	µg/L	-	-	-	-	-	-	-	-	-	585	-	-	-	-	-	-	-	-	-	-
ethylbenzene	µg/L	-	3257	3184	1064	-	10144	685	1414	1102	7798	313	-	125	659	2018		1087	126	-	584
isobutyl alcohol	µg/L	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	235	-	-
methylene chloride	µg/L	-	-	98	-	-	116649	13730	2854	7474	514117	14176	-	84	-	-	127	81	95	-	81
n,n-dimethylformamide	µg/L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7830	-	-	-	-
tetrachloroethene	µg/L	-	-	573	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
toluene	µg/L	-	4884	1082	534	-	169000	15295	10246	25869	164032	7448	-	-	-	-	-	1712	201	-	1819
trichloroethene	µg/L	-	-	39	-	-	86	79	93	68	660	58	-	8608	-	-	132	-	-	-	-
1,1,1-trichloroethane	µg/L	-	-	83	-	-	1407	582	599	284	5723	305	-	17245	-	73	-	-	26	-	-
1,2-dichloroethane	µg/L	-	-	-	-	-	-	-	12	-	702	-	-	-	-	-	-	-	-	-	-
2-butanone	µg/L	-	-	814700	7699	-	86072	19477	-	12600	-	-	-	501770	184407	181040	77368	-	-	519258	175
isobutyl alcohol	µg/L	-	-	-	-	-	5626	1148	137	614	26862	742	-	-	-	-	-	-	-	-	-
methyl methacrylate	µg/L	-	-	-	-	-	1232	-	11	-	-	-	-	-	-	-	-	-	-	-	-
1,2,3-trichloropropane	µg/L	-	-	-	-	-	186	-	-	-	-	72	-	-	-	-	-	-	-	-	-
Semi-volatile Organics																					
acenaphthene	µg/L	-	-	-	-	-	-	17	-	-	-	-	-	-	-	-	-	-	-	-	-
acenaphthylene	µg/L	-	-	-	-	-	-	-	39	-	8511	-	-	-	-	-	-	-	-	-	-
anthracene	µg/L	-	-	-	-	-	-	-	-	-	53479	-	-	-	-	-	-	-	-	-	-
benzidine	µg/L	-	-	-	-	-	-	81	-	-	-	-	-	-	-	-	-	-	-	-	-
benzoic acid	µg/L	-	-	-	-	-	-	-	913	-	-	-	-	-	-	-	-	-	-	-	-
biphenyl	µg/L	-	4452	43	-	-	-	-	-	15	-	-	-	-	-	-	-	-	-	-	-
bis(2-chloroethyl) ether	µg/L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	26
bis(2-ethylhexyl) phthalate	µg/L	-	5403	31	-	-	-	164	-	-	23287	-	-	-	-	-	-	4142	-	-	-
butyl benzyl phthalate	µg/L	-	-	-	-	-	-	13	-	-	-	-	-	-	-	-	-	-	-	-	-
diethyl phthalate	µg/L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	18
di-n-butyl phthalate	µg/L	-	-	-	-	-	-	27	-	-	75149	-	-	-	-	-	-	-	-	-	-
di-n-octyl phthalate	µg/L	-	3433	24	-	-	-	114	-	-	10809	-	-	-	-	-	-	-	-	-	-
fluoranthene	µg/L	-	-	-	-	-	-	-	21	-	-	-	-	-	-	-	-	-	-	-	-
fluorene	µg/L	-	-	10	-	-	-	17	50	-	-	-	-	-	-	-	-	-	-	-	-
hexanoic acid	µg/L	-	-	-	-	-	-	-	-	-	-	86	-	-	-	-	-	-	-	-	-
isophorone	µg/L	-	-	-	-	-	-	295	-	477	52351	-	-	-	-	-	-	-	-	-	-
n-docosane	µg/L	-	-	-	-	-	-	47	-	-	-	-	-	-	-	-	-	-	-	-	-
n-eicosane	µg/L	-	-	215	-	62	-	195	-	-	-	-	-	-	-	-	-	-	-	-	-
n-hexacosane	µg/L	-	-	-	14107	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
n-hexadecane	µg/L	-	14859	44	2426	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
n-tetradecane	µg/L	-	-	-	-	-	-	39	-	-	-	-	-	-	-	-	-	-	-	-	-
napthalene	µg/L	-	8024	54	1939	-	4538	81	-	175	17266	-	-	15401	-	-	-	7951	-	-	197
phenanthrene	µg/L	-	-	-	-	-	-	20	56	-	71404	-	-	-	-	-	-	-	-	-	-
phenol	µg/L	-	5484	-	-	-	-	-	22	-	-	-	-	-	-	-	-	-	-	-	-
pyrene	µg/L	-	-	-	-	-	-	-	48	-	-	-	-	-	-	-	-	-	-	-	-
styrene	µg/L	-	22325	277	5231	-	-	91	-	113	182330	-	-	-	-	-	-	-	-	-	-
thioxanthone	µg/L	275	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1,2-dichlorobenzene	µg/L	-	-	-	-	-	10790	159	4952	152	81926	-	-	-	-	-	-	-	-	-	-
1,4-dichlorobenzene	µg/L	-	-	-	-	-	-	-	128	-	36543	-	-	-	-	-	-	-	-	-	-
1-methylfluorene	µg/L	-	1488	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Pollutant	Units	Facility A				Facility B							Facility C								
		Tap Water	Day1	Day 2		Tap Water	Day 1		Day 2		Sludge	TCLP Extract	Tap Water	Day 1			Day 2			Sludge	TCLP Extract
			raw	raw	effluent		raw	effluent	raw	effluent				raw	equal. tank eff.	effluent	raw	equal. tank eff.	effluent		
Pesticides & Herbicides																					
heptachlor epoxide	µg/L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	751	-	-
leptophos	µg/L	-	838	-	1020	-	-	-	-	-	-	-	-	-	-	-	16178	-	6460	-	-
propachlor	µg/L	-	-	-	-	-	-	-	-	-	-	-	-	70000	-	-	27500	10800	14000	-	-
2,4-dichlorophenoxyacetic acid	µg/L	-	990	1920	1380	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
dichlorprop	µg/L	-	110	350	240	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
coumaphos	µg/L	-	-	359	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
demeton (mixed)	µg/L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5763	-
diazinon	µg/L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	58386	4270	8681	5189	-
azinphos ethyl	µg/L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3418	1709	2517	45284	-
azinphos methyl	µg/L	-	-	-	2130	-	-	-	-	-	-	-	-	-	-	-	-	9137	7410	-	-
MCPA	µg/L	-	-	-	260	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HMPA	µg/L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2407	-	-
naled	µg/L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5540	-	-
dioxathion	µg/L	-	-	2752	-	-	-	-	-	-	-	-	-	-	-	-	9838	3282	4922	106726	-
Dioxins/Furans	µg/L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Metals																					
calcium	µg/L	31000	110000	75000	47000	12000	42000	34000	18000	300000	42400	232000	9670	104000	249000	405000	130000	196000	506000	7610	213000
magnesium	µg/L	9200	75000	40000	25000	960	3100	3700	1900	2200	3560	15100	2550	4150	8530	4480	5970	6610	4640	306	4820
sodium	µg/L	4800	1900000	3000000	2400000	2000	260000	230000	200000	300000	4610	1430000	175000	1900000	3890000	1440000	1700000	3370000	3070000	6270	1350000
aluminum	µg/L	150	39000	27000	93000	40	240000	1400	110000	840	6040	947	280	255000	617000	2910	294000	368000	1040	21300	1810
manganese	µg/L	-	160	130	55	1	350	120	93	320	115	1740	19	227	484	241	340	349	307	41.8	1060
lead	µg/L	-	210	180	80	-	2100	120	780	260	571	214	-	-	719	-	500	520	-	-	-
vanadium	µg/L	-	10	7	3	-	12	2	6	-	-	-	-	96	126	-	110	103	-	6	-
boron	µg/L	23	330	200	220	11	1500	2200	280	3500	276	1160	225	4350	7580	5200	4040	6050	5370	40	644
barium	µg/L	19	190	160	69	19	680	80	190	100	364	2180	191	342	476	-	655	240	-	82	97
beryllium	µg/L	-	1	1	-	-	-	-	-	-	-	-	-	6	13	-	10	10	-	0.5	
cadmium	µg/L	-	6	12	-	-	210	12	56	16	152	57	-	-	16	5	21	9	-	1.8	8
molybdenum	µg/L	-	-	-	12	-		17		19			-	-	133	-	-	-	-	-	-
tin	µg/L	-	-	-	-	-	43	-	-	-	212	104	-	-	-	-	-	-	-	4.5	-
cobalt	µg/L	-	30	23	6	-	96	54	13	8		92	-	58	248	86	76	170	82	4	51
chromium	µg/L	-	38	37	16	-	1200	44	2300	140	2000	234	-	1170	1120	-	7190	969	-	41.4	256
copper	µg/L	3	260	470	210	-	2200	41	610	55	442		-	314	825	-	1160	597	-	28.4	
iron	µg/L	-	9300	6800	2200	110	53000	12000	8900	30000	14700	312000	-	4880	16100	8000	8510	12100	5740	8370	5130
nickel	µg/L	-	41	41	22	-	140	29	59	28	55	210	-	117	1860	275	244	1180	353	69	1860
titanium	µg/L	10	440	270	170	20	5200	61	3200	63	202		-	112	299	-	232	216	-	26.8	
zinc	µg/L	2	5700	3700	2400	17	2300	150	1500	1000	1030	3240	28	787	2310	425	1240	1660	443	77.8	700
silver	µg/L	-	-	-	-	-	19	1	1.8	-	4.5	-			-	-	3.1	-	-	-	-
arsenic	µg/L	-	137	69	2020	-	120		60	-		-	454	446000	16800	2200	985	31800	2100	19	634
antimony	µg/L	-	-	-	30	-	-	28	-	12	-	-	-	-	-	-	-	-	140	-	-
mercury		-	-	-	-	-	0.9	-	0.7	-	1.5	-	-	-	-	-	-	0.3	-	-	-
Conventional Pollutants																					
residue, non-filterable	mg/L	-	8700	2600	8300	-	9600	230	8100	250	-	-	-	2300	9000	150	4000	6500	100	-	-
BOD_5	mg/L	-	1400	4200	3800	-	1400	900	1600	1600	-	-	-	3900	7200	3000	1500	4700	2400	-	-
O&G, ttl. recoverable	mg/L	-	1000	230	59	-	310	92	310	86	-	-	-	3100	2600	89	980	3000	56	-	-
pH		-	11.2	12.4	9.6	-	6.2-10.6	6.2-10.9	8.0-10.7	7.2-10.8	-	-	7.2	9.5-12.4	7.7-8.5	7.4	8.0-9.3	6.6	7.2-7.3	-	-
Non-conventional Pollutants																					
residue, filterable	mg/L	-	10000	16000	13000	-	8700	2400	9800	2800	-	-	-	7600	13000	13000	7700	12000	12000	-	-
fluoride	mg/L	-	2	1.9	0.65	-	-	0.38	-	0.28	-	-	-	9.1	21	0.79	5.1	8	0.76	-	-
ammonia-N	mg/L	-	11	7.7	10	-	2.1	1.9	1.4	4	-	-	-	1.4		2.6	8.4	-	3.1	660	-
nitrogen, Kjeldahl, ttl.	mg/L	-	33	9.2		-	49	24	29	23	2000	-	-	11	290	200	230	210	180	8800	-
nitrate-nitrite, N	mg/L	-	0.96	1	0.85	-	0.11	0.12	0.44	0.21	-	-	-	0.64	-	-	-	-	-	1.5	-
ttl. phosphorous-P	mg/L	-	6	3.2	0.22	-	-	0.87	-	0.38	-	-	-	6.6	3.5	4.6	8.5	6.2	3.9	-	-

Pollutant	Units	Facility A				Facility B							Facility C								
		Tap Water	Day1	Day 2		Tap Water	Day 1		Day 2		Sludge	TCLP Extract	Tap Water	Day 1			Day 2			Sludge	TCLP Extract
			raw	raw	effluent		raw	effluent	raw	effluent				raw	equal. tank eff.	effluent	raw	equal. tank eff.	effluent		
Cargo Types Accepted/Not Accepted		*- most trucks accepted, with the exception of those having carried phenols, heavy metals and poisons*				*- most trucks accepted, with the exception of those with highly odourous residues, residues with a high BOD and highly coloured residues*							*- most trucks accepted for cleaning (typically carry a wide variety of organic cpds.); the occasional truck exterior is washed*								
Wash Process		*- may incl. cold water, hot water, steam & caustic solution*				*- may incl. cold water, hot water, caustic wash and presolve steps*							*- may incl. cold water, hot water, detergent, caustic, solvent, steam cleaning*								
Treatment Process		*- equalization, batch pH adjustment with sulphuric acid & alum coagulation prior to dissolved air floatation*				*- initial settling & equilization, coagulation and settling in a Dorr-Oliver reactor clarifier using ferric chloride & alum as coagulants*							*- pH adjustment with sulphuric acid, equalization, coagulation-sedimentation and filtration through a 40 m paper filter*								

Samples were collected of the dump and flush flows, the rinse flows and from the two wastewater settling ponds on-site. Samples of the dump and flush operation included a sample of the initial dump proper, the start of flushing and the end of flushing. Samples were also collected at the beginning, middle and end of the rinsing operation. All samples were obtained and composited on a time-flow basis. A total waste flow composite was obtained by taking a time-flow proportional amount of the flush and rinse samples. It should be noted that during the sampling period, the majority of the trucks washed had been used to transport latex type material. The results of the analyses are presented in Table 4.6.

The analyses showed that the strength and composition of the flush and dump wastes differed significantly from that of the rinse waters. In addition, because the flows from the flush and rinse operations were of the same order of magnitude (on a volume basis), it was concluded that the optimum approach to the treatment of these wastewaters, either for discharge or for recycle, would entail segregation of these streams.

Automatic Car Wash Recycle System

Heinke, G.W. et al.
Proceedings of the 29th Industrial Waste Conference, Purdue University
U.S.A., May 1974

One hundred samples over 38 days were collected from four car wash operations with recycle systems. The car washes were all tunnel type washes and were located in Richmond, B.C. and Bridgeport, Sarnia and Toronto, Ontario. Samples were generally taken of the flood rinse, brush rinse and final rinse and at the settling tank inlet and outlet. The parameters measured were:

- total solids
- suspended solids
- COD
- TOC
- conductivity
- pH
- chlorides

Due to the differences between the car washes surveyed and the seasonal and geographical differences, it was deemed misleading to provide a summary table for comparison of data. Instead a general discussion of the results was provided.

It was found that total solids, both suspended and dissolved, are contributed from the soil washed off of cars, detergents, soaps, waxes and chlorine. However, it was estimated that the suspended solids contribution from cars averages 0.1-0.25 kg/car during the summer and the fall and as high as 2.5 kg/car in the winter. The variation in the amounts was attributed to differences in climate, season, geography and extent of urbanization.

While the suspended solids concentrations in settling tanks increased with the number of cars washed, they tended to level off at approximately 200 mg/L, when regular pump-out of sludge was carried out. Dissolved solids rarely exceeded 500 mg/L in the summer and fall.

TABLE 4.6: Wastewater Characterization Data - Document 6.

TITLE	*Development of a Water Management Program for a Tank Truck Washing Terminal*
AUTHOR	*Wood, W.C. et al.*
SPONSORING AGENCY	-
PUBLICATION	*Proceedings of the 28th Industrial Waste Conference, Purdue University*
DATE OF PUBLICATION	*May 1973*

Pollutant	Truck Dump	Flush Start	Flush End	Flush Composite	Rinse Start	Rinse Middle	Rinse End	Rinse Composite	Total Composite	Settling Pond 1	Settling Pond 2
	mg/L										
BOD										750	730
COD	65936								24553	87000	87150
COD (filtered)				408				446			
COD (unfiltered)				32000				845			
Ttl. Solids	119773	3155	5079	13232	1077	433	410	800	6901	73880	27780
Ttl. Dissolved Solids	920	1629	317	464	918	343	306	448	1993	1430	1475
SC		430	390	710	525	450	400	700	1650	2250	2050
Suspended Solids	118853	1626	4763	12768	159	91	103	350	4907	72450	31305
Volatile Solids	7434	1596	154	12411	66	112	30	372	6406	3774	2274
Volatile Suspended Solids				10640				193			
Oil & Grease	2020								43415	3038	2194
Phenols									0.1		
pH	7.6	9.4	7.9	7.7	9.2	8.3	8.1	11.1	11.0	8.2	10.4
Alkalinity	520			320		96	90	216	680	1080	1240
Hardness				420		162	162	82			
Turbidity				64000				160			
Colour				00				00			
Odour				20				3			
Organic-N										17.4	15.58
NH_3										4.8	12
NO_3											10.4
SO_4		162	14	80	14	14	94	60			
PO_4		45	1.8	4.1	8.2	1.8		2.9	3.4	4	4.2
Ca		43	43	72	16	45	38	48			
Cl				60				39			
Cu				00				00			
Fe				0.8				0.1			
Mg				58				8.2			
Mn				00				00			
ABS				3.5		0.4	0.1	00			

Note: ABS - Alkylbenzene sulphonates

Summer chloride levels in Bridgeport and Richmond were always less than 100 mg/L. In Toronto, summer chloride levels fluctuated frequently due to the intermittent addition of bacteriostatic agents containing hypochlorite.

The data collected indicated that the final rinse effluent did not exert a significant organic load on the sewer system.

The pH of the wastewater varied with the location, water supply, use of bacteriostatic agents and possible microbial activity.

4.2 TREATMENT TECHNOLOGY

The extent and type of treatment required at a vehicle wash will be closely linked to:

- the types of clients served (ie. personal vehicles, tanker trucks and the types of goods hauled);
- services offered (ie. engine cleaning, exterior wash, interior wash);
- wash process used (ie. tunnel, roll-over, wand wash; hot water, cold water, water recycle);
- chemicals used (ie. engine degreasers, acids, caustics, waxes);
- geographic location (ie. snow, unpaved roads, distance to closest sewer system connection);
- local sewer use regulations;
- sewage treatment plant limitations; and
- economic considerations.

The above factors can cause significant variability in the composition and strength of the wastewater within a wash facility, in addition to between wash facilities. As a result, the treatment techniques appropriate for one vehicle wash may not necessarily be applicable to others, particularly between car and truck washes.

Wastewater treatment needs for direct discharge of wastewater differ considerably from the wastewater pretreatment needs for typical sanitary sewer discharges. Treatment for the direct discharge of wastewater typically requires a combination of physical-chemical treatment and on-site biological control. Given the local sewer and direct discharge regulations in B.C. and economic considerations, direct discharge of wastewater from most vehicle washes is not necessary, practical nor feasible.

A number of proven (implemented) pretreatment technologies are available for the reduction of a variety of wastewater constituents. Other potentially applicable pretreatment technologies are also available. These may not currently be being used on a commercial scale either due to economic considerations, space limitations, maintenance requirements, etc. Table 4.7 presents a summary matrix of the contaminants typically found in wash water and corresponding proven methods of treatment.

TABLE 4.7: Matrix of Applicable Treatment Technologies for Various Pollutants

Treatment Technology / ***Pollutant Category***	Large Objects	Suspended Solids	Free Oil & Grease	Emulsified Oil & Grease	Acidity/Alkalinity	Metals	BOD/COD	Volatile Organics	Semi-Volatile Organics
Bar Screen	x								
Catch Basin/Sediment Pit/Holding Tank		x	(x)						
Gravity Oil/Water Separation		(x)	x						
Coalescing Plate Separator		(x)	x	(x)					
pH Adjustment					x				
Precipitation						x			
Coagulation		x		x		(x)	(x)		(x)
Dissolved Air Floatation		x		x			(x)	(x)	(x)
Filtration		x							

Note: **BOD/COD, metals and semi-volatile organics may be associated with suspended solids, therefore their levels may also be reduced by suspended solids removal methods**

x = technology is applicable to pollutant category
(x) = technology is applicable to a limited exent; additional treatment is most likely required

based on: ***Preliminary Data Summary for the Transporation Equipment Cleaning Industry***

The following Section presents a discussion of the purpose and basic principles of operation of the proven wash water pretreatment technologies. Some potentially applicable methods of pretreatment are also noted. Examples of treatment trains deemed suitable for vehicle wash water pretreatment prior to sanitary sewer discharge and one example of a treatment train acceptable for the direct discharge of effluent in the U.S. are also provided in this Section. The details of treatment methods suitable for direct discharge are however not provided. These operations are highly application dependent and as mentioned above, not necessarily feasible at most vehicle washes.

4.2.1 Specific Treatment Technologies

Bar Screens

Bar screens are applicable to situations in which large objects may find their way into the wastewater stream (ie. plastic licence plate frames, miscellaneous materials dumped at unsupervised washes). Bar screens consist of flat steel bars welded in a grid pattern to form rectangular spaces, typically approximately 6 mm by 20 mm in area. Bar screens allow free flow of the effluent while removing the larger objects. Bar screens are usually cleaned by hand.

Catch Basins, Sediment Pits & Holding Tanks

Treatment technologies such as catch basins and sediment pits are primarily intended for the removal of solids. However they may also accomplish, to a limited extent, the equalization of effluent temperature and a reduction in oil & grease. Temperature equalization occurs through heat exchange with the surroundings during detention. During detention, the free or non-emulsified portion of the total oil & grease may also be gravity separated from the water by virtue of the difference in their respective densities. The floating oils may then be skimmed from the surface of the water. Oil & grease in colloidal or emulsified form can generally not be stabilized within reasonable detention times. It should be kept in mind that the primary purpose of these units is the removal of solids. Thus, these units are specifically designed for this purpose and the equalization of temperature or the removal of oil & grease are a secondary benefit.

Catch basins or sediment pits are relatively simple, inexpensive methods of removing sand and grit from wastewater. They are typically constructed below ground and have a hydraulic detention time between 15 and 40 minutes. The effectiveness of the catch basins or pits in removing solids is dependent on particle size, the characteristics of the wastewater (ie. oil and grease content) and the hydraulic detention time. The percent solids removal achievable generally increases (to a maximum) with detention time. Sediment pits or sedimentation basins designed for the removal of floc following coagulation may be equipped with a moving scraper along the bottom of the tank to collect settled floc.

Holding tanks, with detention times of 2 to 4 hours, provide in addition to solids settling, better opportunities for flow equalization and free oil separation. With detention times of this magnitude, the maximum level of solids removal without further treatment is usually achievable. Some physical, chemical and biological reactions may also occur which can lead to other pollutant reductions, particularly if the holding tank is equipped with aerators or mechanical mixers. Another benefit of holding tanks is that flow equalization dampens wastewater quality and quantity fluctuations to the sewer. Holding tanks are typically of steel or concrete construction and are built below ground.

Oil/Water Separators

Free or non-emulsified oil & grease may be gravity separated from water, because of the difference in their respective densities. Separation can be accomplished to a limited extent in the single chambered sediment pits and holding tanks described above, but is better accomplished with chambered separators such as the API (American Petroleum Institute) type separator or the coalescing plate interceptor (CPI). While gravity separation of free oils by either an API separator or CPI will also remove floatable debris and settleable solids, they are specifically sized for oil & grease removal.

The API type separator is generally designed for the removal of oil droplets 150 microns in size or larger, as the removal of smaller droplets would require prohibitively large chambers. CPIs are typically sized to remove droplets 60 - 90 microns and larger. Because the design of separators is based on the rise rate of oil droplets, which is in turn related to water temperature, droplet size and specific gravity, there is a certain amount of variability or uncertainty in separator design and performance.

A number of variations on the standard API separator exist. In general however, they contain flow distribution baffles (vertical or horizontal) at the inlet and baffles for the removal of settleable solids and floating oils throughout, dividing the vault into three or four chambers. Some larger API separators may also have more sophisticated mechanical equipment for the removal of floating oils or settled solids. Three designs of these chambered oil/water separators are depicted in Figure 4.1.

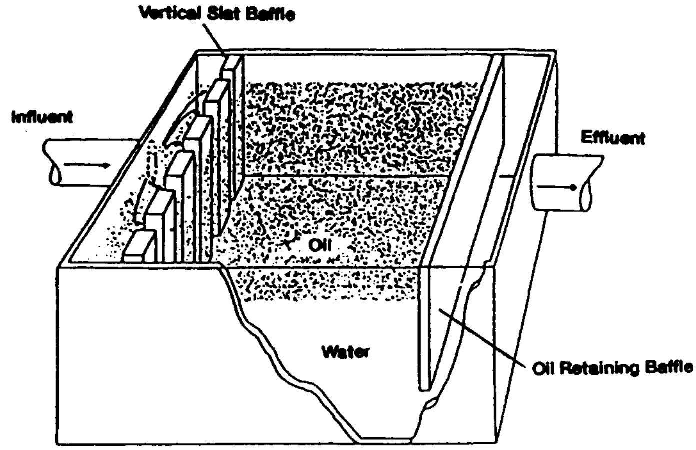
The CPI consists of a series of closely spaced fibreglass or polypropylene plates in the separation chamber, at an angle between 0° and 60° from the horizontal. Because these plates reduce the distance required for solids settling and aid in the coalescing of oil droplets, pollutant removal efficiency is greater and thus, the space requirements less than with an API separator. However, the CPI is generally more costly to operate and install. Both a simplified CPI design and a more complex design are shown in Figure 4.2.

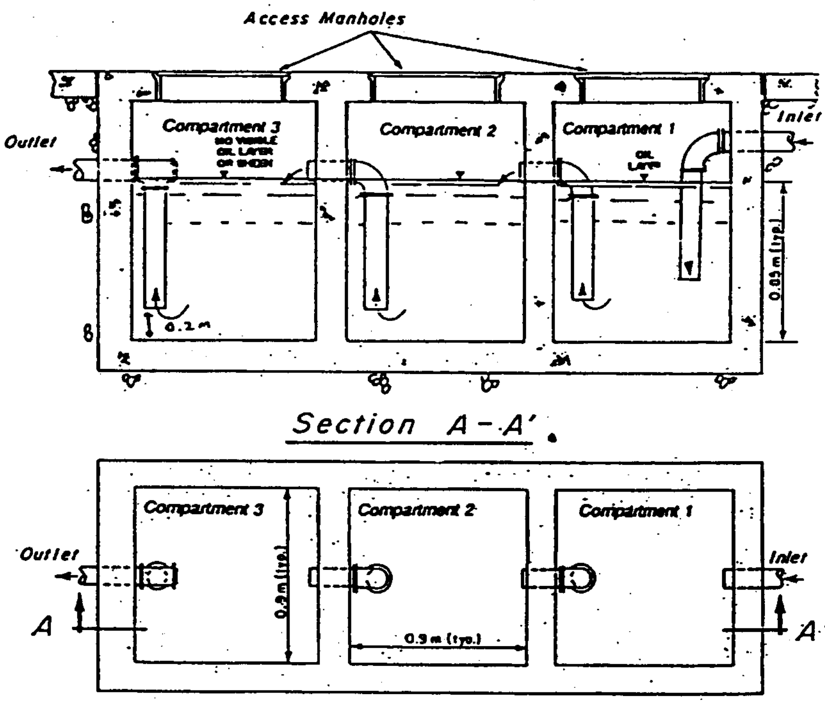
While the API type separator and in particular the CPI can provide improved oil & grease removal over sediment pits and holding tanks, the removal of emulsified oils will generally require additional treatment processes to break the emulsion. (Emulsions may form as a result of the use of detergents, high pH chemicals or high water temperatures.) Such treatment processes may involve acidification, addition of alum or iron salts or the use of emulsion-breaking polymers or "quick-breaking" detergents. The breaking of emulsions can be a difficult task and may necessitate laboratory testing to determine the optimum approach. In addition, the use of alum or iron to destabilize emulsions can generate large quantities of sludge. Once the emulsion is broken, oil & grease can be removed by a gravity separation method.

pH Adjustment

pH adjustment may be required depending on the pH of the wastewater, local sewer use restrictions or downstream (pre)treatment processes. For example, the performance of treatment processes such as coagulation, carbon adsorption or biological treatment are pH dependent.

BASIC OIL/WATER SEPARATOR
(Ont. MOE, 1992)





3-CHAMBERED OIL/WATER SEPARATOR
(Ont. MOE, 1993)

API SEPARATOR WITH OIL SKIMMER
(King County, 1994)

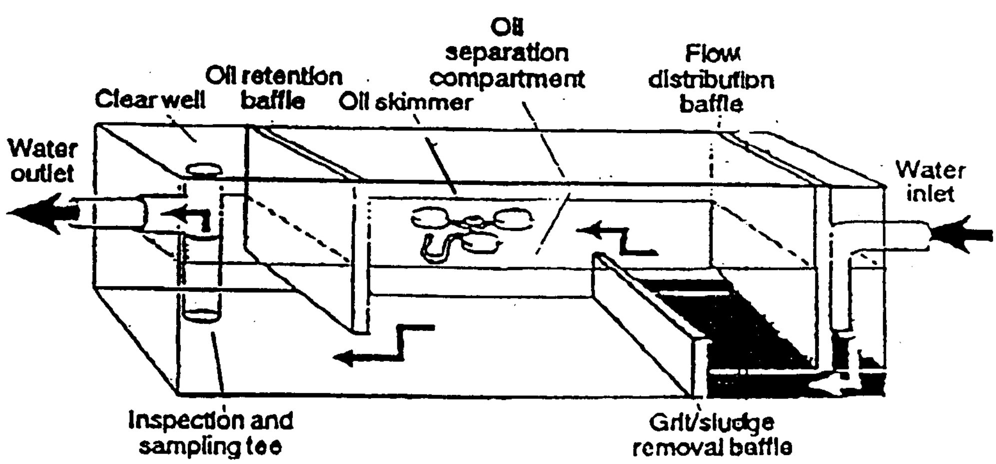
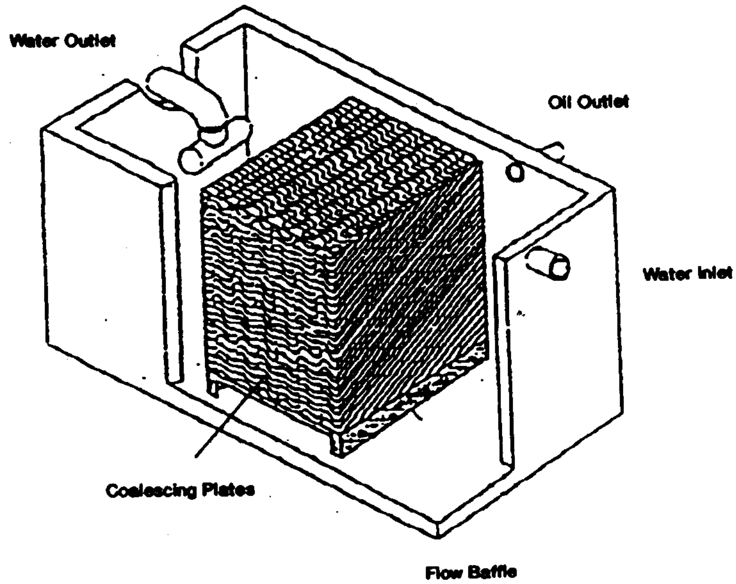
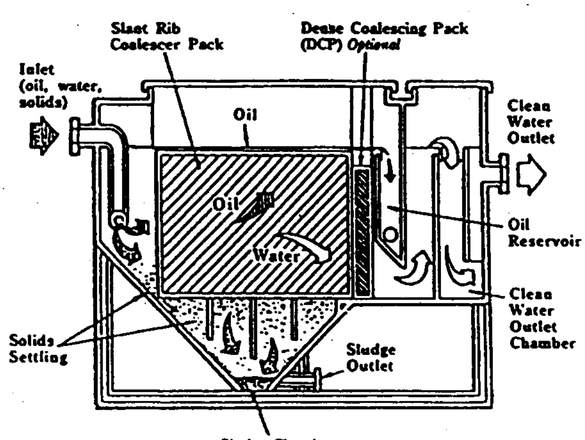


FIGURE 4.1
STANDARD OIL/WATER SEPARATION UNITS



BASIC COALESCING PLATE INTERCEPTOR
(King County, 1994)



SLANT RIB COALESCING SEPARATOR
(Palo Alto, 1992)

FIGURE 4.2
COALESCING PLATE INTERCEPTORS

pH adjustment is usually performed through metering an acid or alkali into the wastewater contained in a well mixed tank. Chemicals commonly used for pH adjustment include sulphuric acid, sodium hydroxide and lime.

Precipitation

The precipitation of dissolved metals, through the addition of hydroxides or sulphides, is a common wastewater treatment process.

At the appropriate pH, generally between 7 and 11, many metals form hydroxide precipitates which can be removed by settling. While the metal hydroxide solubility varies among individual metals, hydroxide precipitation is useful for the reduction of dissolved aluminum, arsenic, cadmium, chromium, copper, iron, lead, nickel and zinc.

Hydroxide precipitation may be combined with the addition of sulphides to produce metal sulphide precipitates. Because metal sulphides have a solubility less than that of the corresponding hydroxides, increased removal of metals such as arsenic, cadmium, mercury, nickel and zinc should be achievable.

Coagulation

Oil & grease and metals (ie. lead, copper, zinc) in wash water are often in the form of colloidal suspensions which can not be effectively removed through solely physical techniques. Chemical addition can destabilize the colloidal material to cause aggregation of the colloids to larger particles. These particles are then removable through sedimentation, floatation or filtration. Because semi-volatile organic pollutants tend to adsorb or partition to wastewater solids, they may also be removed during coagulation, as may dissolved metals through precipitation (depending on the pH).

The destabilization of colloids can be achieved by lowering the pH of the wastewater (acidification) or through the addition of aluminum, ferric or calcium salts. Important design parameters for the development of the larger particles or floc include hydraulic detention time or contact time (generally inversely proportional to solids concentration), mixing (either mechanical or through stream pressurization) and dosage (wastewater dependent). Particle contact, to improve coagulation, can be aided through the use of baffles in the mix tanks.

Dissolved Air Floatation

Dissolved air floatation (DAF) can be used for the removal of suspended solids/floc and emulsified oil & grease from many types of wastewater. It can also result in the removal of some volatile and semi-volatile organic pollutants, as well as BOD and COD. Generally, dissolved air floatation units operate at surface loading rates four times higher than gravity settlers, therefore requiring significantly less detention time and thus, volume. For the optimum performance of DAF units, pH adjustment and coagulation ususally precede floatation.

Floatation is accomplished through pressurizing all or part of the effluent stream with air. The increase in pressure increases the saturation point of air in water, allowing additional air to dissolve in the wastewater. When the pressure is again reduced to atmospheric, the dissolved air is forced out of solution, causing the formation of minute bubbles throughout the liquid. The floc become attached to the bubbles and are carried to the surface of the tank where they can be skimmed off. The principal components of a dissolved air floatation unit are a pressurizing pump, holding tank, pressure-reducing valve, air injector and a floatation tank. Design factors include the feed solids concentration, hydraulic loading rate and the particle rise velocity. For effective operation, testing of the effluent is required prior to full-scale installation of a dissolved air floatation unit.

Filtration

One type of filtration method which has been used for vehicle wash water treatment involves passing the wastewater through cylindrical tanks containing filter media of various specific gravities and particle size. In general, multimedia filtration is only used to achieve further floc removal following sedimentation, when the intention is to recycle the effluent. Because of variability in the efficacy of dissolved air floatation, filtration following floatation is not recommended.

Other Treatment Technologies

Ultrafiltration, electrocoagulation, reverse osmosis, wet air oxidation, biological treatment, carbon adsorption and air and steam stripping have all been laboratory or pilot tested on wash waters. While in theory they are capable of reducing contaminant concentrations, they were found to be typically either practically or economically unsuitable at present.

4.2.2 Treatment Trains

It is generally acknowledged that fixed commercial car washes, discharging to the sanitary sewer and strictly washing only vehicle bodies with mild detergents, should have some form of separation unit for the removal of free oil & grease and settleable solids. The use of chemicals causing wastewater pH to be outside of the local limits or the performance of other cleaning processes resulting in more significant levels of wastewater contaminants (ie. engine cleaning resulting in elevated oil & grease and metals concentrations) may necessitate additional wastewater treatment.

Because truck wash facilities generally use harsher chemicals and there is a much greater potential for a wide variety of pollutants in the wastewater, pretreatment at these facilities requires more individualized attention. In general however, in the U.S., pretreatment at tank truck cleaning facilities discharging to the sanitary sewer consists of flow equalization, pH adjustment and coagulation, followed by either dissolved air floatation or sedimentation.

In the U.S., a treatment train deemed acceptable for the direct discharge of a truck wash facility's wastewater to a watercourse consists of the following elements: gravity separation, equalization, pH adjustment, coagulation, dissolved air floatation, mixed-media filtration, carbon adsorption and biological treatment. This system has been proven successful for facilities using a hot caustic wash and fresh hot water rinse on trucks having carried a variety of products including, oils, detergents, sugars, paints and a spectrum on non-chlorinated and chlorinated aliphatic and aromatic solvents.

In brief, the treatment process is as follows:

- The gravity separation of free oils and settleable solids is accomplished in an API separator with detention times of 1 to 2 hours. The floating oils are drained from the separator and sold for re-refining. The settled solids are collected and shipped to a licenced landfill.

- The effluent from the separator then enters concrete storage basins for flow equalization, to provide a constant, equalized feed to the remainder of the process.

- From the equalization tank, the wastewater is pumped to a mixing tank for pH adjustment. Sulphuric acid is used to achieve a pH between 6.5 and 8.0. At this stage a cationic polymer is also added to aid in the agglomeration of suspended solids.

- The wastewater is then pumped to a high pressure retention tank to saturate the wastewater with dissolved air. An anionic polymer (also to aid in the agglomeration of suspended solids) is added to the wastewater as it passes the control valve from the pressure retention tank to the dissolved air floatation unit. The froth on the water surface in the dissolved air floatation unit is skimmed off for subsequent disposal. The heavier flocculated materials which settle to the bottom of the tank are recycled to the equalization tanks.

- The suspended solids carried over from the dissolved air floatation unit are removed in a mixed-media (sand and anthrafill) filter.

- High molecular weight or refractory organics are adsorbed by granular activated carbon filters. This step, while costly, serves as a vital detoxifying step for subsequent biological treatment of the wastewater.

- Effluent from the carbon adsorption system is biologically treated in a rotating biological contactor. The effluent passes into a tank, where the biomass degrading the organic materials in the wastewater has formed on a series of circular discs which rotate through the wastewater in the tank.

4.2.3 Implementation of Treatment Technologies at New or Existing Facilities

As discussed in Section 4.2.2, wastewater pretreatment trains at a typical vehicle wash facility should have, at a minimum, units suitable for the removal of settleable solids and free oil & grease.

Gravity oil/water separators, to a certain extent capable of achieving both these tasks, are relatively simple and inexpensive structures. Their installation at new car and truck washes is therefore not considered prohibitive, from an economic or operational standpoint, and should be considered an integral part of doing business.

The installation of an oil/water separation unit at an existing facility will clearly incur a number of additional costs in comparison to a new facility. These may include the cost of raising the existing asphalt or concrete and resurfacing when construction is complete, disconnecting and reconnecting piping and lost business during construction. Some existing facilities may have sumps or sediment pits already in place. If they are of adequate volume, they may be relatively inexpensively modified for improved performance if necessary. Modifications may include the installation of baffles or skimmers. If these existing units are of insufficient capacity, these modifications will likely not be enough to provide the required level of treatment. In addition to the installation of a new pretreatment unit at such sites, costs will be incurred for the removal of the existing unit.

4.3 BEST MANAGEMENT PRACTICES

Best Management Practices (BMPs) are "state of the art" practices, intended to provide benefits to the operations at which they are implemented and to the physical environment and thus, the community. Through the implementation of good management practices, reductions in the following may be directly or indirectly evidenced:

- water use;
- wastewater pollutants (ie. BOD/COD, oil & grease, metals);
- undetected, accidental or uncontrolled discharges;
- health and safety claims; and
- sewage treatment plant upsets.

BMPs generally focus on the following areas:

- maintenance;
- material selection;
- material handling and storage;
- spill control measures;
- good housekeeping;
- employee training; and
- record keeping.

BMPs are usually only *suggested* practices, aimed at helping facilities comply with local environmental regulations. They are consequently, closely linked to water quality, solid waste disposal and sewer use legislation and are indirectly enforced through the enforcement of this legislation.

The success of BMPs (their acceptance and correct implementation) relies on supporting initiatives such as publicity, workshops, incentive programs and bylaw enforcement.

The supporting initiatives and the BMPs themselves from a number of regulatory agencies interviewed in the U.S. and Canada are discussed in Section 5.

Part II of this report presents a BMP developed for vehicle wash facilities in B.C. It incorporates basic principles from the literature and the experience of the regulatory agencies interviewed.

5.0 REVIEW OF REGULATORY AGENCY INITIATIVES

Interviews were conducted with select regulatory agencies in the U.S. and Canada to obtain information regarding the development, implementation and success of vehicle wash water control initiatives in their jurisdictions. The interviews with the Ontario Ministry of Environment, Metro Toronto, the Alberta Ministry of Environment, Metro Seattle, King County and Palo Alto were conducted in the Fall of 1994.

5.1 ONTARIO

Mr. S. Neville and Ms J. DiCaro, respectively of the Ontario Ministry of Environment's Municipal Programs Section and Pollution Prevention Office, were contacted regarding Ontario's initiatives in the investigation and regulation of wastewater discharges from car and truck washes.

The regulations to legislate the enforcement of Ontario's 1988 Model Sewer Use Bylaw are in the process of being finalized. For the most part, the Bylaw will remain in its current form, however one amendment still under consideration is the manner in which commercial sector Best Management Practices will be implemented. Basically, certain commercial sector dischargers will have to comply with all of the requirements of the Sewer Use regulation unless the discharger has i) implemented a BMP plan, prepared in accordance with the applicable sector BMP manual; ii) the discharger has notified the municipality that it has done so; and iii) the discharger is in compliance with all the requirements of the BMP plan.

The two documents, *Background Information for the Development of BMP Plans* and *Guidance Manual for the Administration and Development of BMP Plans,* were precursors to the development of two BMP plans in Ontario to-date -- one for the motor vehicle servicing industry and the other for photo-finishing "mini-labs". Neither has however been implemented. As discussed above, the supporting regulations are not yet in place and in the case of the Motor Vehicle BMP requirements, there is some debate whether upper discharge limits should be stipulated. The motor vehicle BMP document was prepared in conjunction with Metro Toronto, which had already conducted some investigation into this industry, and the Canadian Petroleum Partners Institute.

Currently, the only wastewater control requirements for car and truck washes in Ontario come from the provincial plumbing or building codes, which have the provision that no oily wastewater be discharged to the sanitary sewer. Therefore, the majority of wash facilities in the Province have either an oil/water separator or sediment pit. However, no guidelines for the design of separators or sediment pits are stipulated in the Codes. The municipalities are responsible for ensuring that the Codes are enforced and may also have some additional wastewater discharge restrictions of their own.

5.2 METRO TORONTO

Metro Toronto's initiatives towards pollution prevention in the car and truck wash industry were discussed with Mr. M. Shaw, a Senior Engineer with the Water Pollution Control Department.

Currently, Metro does not issue wastewater discharge permits to fixed wash facilities. Apparently, for the most part, these facilities do not exceed local sewer use bylaw limits. The majority of fixed car and truck washes in Metro have sediment traps and they all discharge to the sanitary sewer.

On Metro's part, there is more concern with the mobile car wash operations, as their wastewater typically ends up in storm sewers. Metro requires that mobile washers hired for the servicing of their municipal fleets adhere to their Sewer Use Bylaw and thus, not discharge contaminated wastewater to the storm sewer. It is only a recent development that some mobile washers are operating trucks with double tanks -- one for clean water and one for wastewater. The wastewater is captured by a number of means:

- wastewater is routed to a depression;
- portable plastic berms;
- rubber gaskets over catch basins; or
- sump pumps to retrieve water from a catch basin.

In 1990, Metro Toronto conducted wastewater sampling at five service stations with car washes. The results were presented in Section 4.1. Unfortunately, the supporting documentation for this data is currently unavailable.

5.3 ALBERTA MINISTRY OF ENVIRONMENT

The investigation and regulation of wastewater discharges from car and truck washes in Alberta was discussed with Messrs. A. Cummins and T. Trimble, Engineer and Senior Technologist respectively, with the Ministry of Environment's Industrial Waste Branch.

In general, the wastewater from car and truck washes in Alberta is not currently of great concern. Alberta is not planning the development of BMPs for this service industry nor are they planning any investigations into their operations. However, a survey of truck washes was conducted in the early 1980's (the report is currently unavailable). The primary concerns identified at the time were apparently the frequent cleaning of trucks switch loading commodities and the use of solvents to remove persistent residues.

A current concern the Alberta Ministry staff did raise is the failure of some car wash sump residues to meet the BTEX limits at some landfills. However, not all landfills in the Province have enforced BTEX limits.

5.4 METRO SEATTLE

At Metro Seattle, Ms C. True, Senior Industrial Waste Investigator in the Water Pollution Control Department, was contacted regarding Metro's approach to regulating wastewater discharges from car and truck washes.

According to Ms True, Metro Seattle has not conducted any comprehensive sampling programs for either fixed or mobile car washes, nor are they planning the development of regulations or BMPs. However, fixed car washes are required to have an oil/water separator with a minimum 600 U.S. gal capacity or 45 minute retention time and guidelines have been developed to aid facilities with the selection and operation of separators. For mobile washing, some general guidelines have been published in a newsletter directed towards industry.

Under Metro Seattle's industrial waste pretreatment program, the wash sites of some industries have been included in permits, particularly those of waste disposal companies and tank cleaning facilities. Such facilities would be required to develop a pretreatment system which would enable them to comply with Seattle's local discharge limits.

Ultimately, the primary concerns of the Metro Seattle Water Pollution Control Department are that i) wash water not be released to the storm sewer, but rather the sanitary sewer; and ii) harsh alkaline or acidic cleaning (often referred to as the "two-step" process and used for maintaining the shiny metal exteriors of trucks) not be performed unless pretreatment of the wash water occurs.

In 1989, the City of Seattle developed a manual of water quality BMPs for a variety of commercial and industrial businesses. Among the businesses addressed were: fleet vehicle owners; commercial car and truck washes; and vehicle or equipment washing and steam cleaning operations. The manual provides a brief description of the typical activities conducted within each business category and the materials used and wastes generated. It also provides guidelines for source control, stormwater management and the installation of certain types of pretreatment units. A revision of this document is expected to be completed in early 1995.

5.5 KING COUNTY

Mr. L. Holyoke of the King County Department of Metropolitan Services was interviewed regarding King County's efforts to regulate car and truck wash wastewater. While King County is currently in the process of amalgamating with Metro Seattle, King County and its member local governments have already worked towards establishing BMPs for car and truck washing.

An amendment to the U.S. Clean Water Act in the mid-eighties stated that only stormwater was to be discharged into storm drains, with the exception of wastewater from residential activities. This amendment spearheaded new initiatives to control water quality in King County.

King County has produced a draft *Water Quality Best Management Practices Manual.* Vehicle washing and steam cleaning are some of the commercial (non-residential) activities addressed. The manual briefly describes the pollutant contributions from this activity and stipulates the minimum BMP requirements and a few supplementary BMPs which can provide improved pollution control. It also provides information on the implementation of several pretreatment methods.

While charity car washes are not considered a regular residential activity, governments have been reluctant to enforce the Clean Water Act amendment with charity washes. As a result, the Interagency Regulatory Analysis Committee working with local governments in King County has produced a brochure with tips for conducting car wash fund-raisers in an environmentally responsible manner.

The City of Bellevue, part of King County, has developed their own water quality protection guidelines for automotive businesses. While they address a broad range of activities in the automobile service industry, they also specifically address vehicle wash areas. The BMP stipulates the required features of designated wash areas and associated permit requirements. It also provides direction for the education of employees and customers.

5.6 PALO ALTO

Ms M. Zittle, Program Assistant for the City of Palo Alto's Environmental Compliance Division, provided information regarding Palo Alto's efforts towards reducing water pollution from car and truck washes.

The Palo Alto Sewer Use Ordinance requires that all vehicle service facilities become either a zero discharger (no discharge to the sanitary sewer) or obtain a permit to discharge treated wastewater to the sanitary sewer system. Specifically addressing to vehicle wash practices, the ordinance states that vehicle wash water may not be discharged to a storm drain if it contains soap or if it comes from the routine washing of dirty vehicles in a commercial or fleet washing operation. These requirements apply to vehicle washing conducted by both fixed and mobile operations.

In 1992, the City of Palo Alto developed the Clean Bay Business Program to further efforts to reduce water pollution from vehicle service facilities. The premise of the Program is to provide incentive to, and recognize facilities that, proactively comply with the relevant requirements of the sewer use ordinance. Incentive and recognition is achieved by providing free publicity through a variety of advertising aides (ie. brochures for customers, window stickers, newspaper ads, etc.). The Program began with an informational letter sent to vehicle service facilities, educating them on the sewer use ordinance requirements and on available BMPs. Site visits and workshops were also conducted to assist facilities in reaching compliance.

Zero dischargers are now inspected annually; permitted facilities are inspected semi-annually. Permitted dischargers must monitor their discharges quarterly or monthly, depending on the volume of discharge, and must a submit sampling analyses on a quarterly basis. Since the inception of the Program, 83% of facilities have chosen to be zero dischargers and approximately 50% of all eligible facilities have qualified as Clean Bay Businesses -- a substantial increase from the 4% in full compliance following the initial site visit at the beginning of the Program.

Another Palo Alto initiative was the sponsorship of a car wash discount program to educate the public about the pollution caused by washing cars at home. As a positive incentive to area residents and employees to use the commercial car washes, 8500 $2-off coupons for participating "Clean Bay Business" car washes were distributed in various areas. The City reimbursed the car wash facilities for each coupon turned in. Coupons were used at two of the four participating car washes. One car wash received over 600 coupons and another approximately 50 -- overall, an 8% return rate.

A fleet outreach program has also been implemented in Palo Alto to reduce the inappropriate discharge of wastewater. A survey was conducted to identify businesses maintaining vehicle fleets within the study area. Companies performing at least one vehicle maintenance activity, on-site, for more than five vehicles were visited to provide them with information on water quality protection and to determine the status of the facility's compliance with the sewer use ordinance. The survey and visits found that vehicle washing was the primary activity conducted with the potential for surface water quality damage. Over one-half of the 41 fleets visited were washing vehicles in areas draining to storm drains.

With respect to mobile cleaners, a region-wide effort is currently being planned to control the wastewater produced by these operations. The efforts will include investigating alternative products and methods of operation to affect a reduction in the pollutants generated.

The City of Palo Alto has published a booklet which documents BMPs for automotive-related industries and provides relevant excerpts from the Sewer Use Ordinance. The booklet covers a number of vehicle related maintenance activities including vehicle washing, engine cleaning and automotive steam cleaning. It is specifically noted that these BMPs are only *suggested* methods for complying with the Ordinance.

6.0 CONCLUSIONS & RECOMMENDATIONS

The strength and composition of contaminants found in vehicle wash water can vary significantly both within and between wash facilities, in particular between car and truck wash facilities. Factors affecting wash water quality may include:

- the type of clients served (ie. personal vehicles, tanker trucks and the types of goods hauled);
- services offered (ie. engine cleaning, exterior wash, interior wash);
- wash process (ie. tunnel, roll-over, wand wash)
- chemicals used (ie. engine degreasers, acids, caustics, waxes)
- geographic location (ie. snow, unpaved roads)

Typically when washing vehicle bodies with mild detergents, suspended solids are the contaminant of primary concern. If however undercarriages and engines are being washed, there are generally also concerns with oil & grease, metals, pH and BOD levels. Overall, the wastewater from tunnel, roll-over and wand type car washes has been found to be comparable to domestic wastewaters in terms of total suspended solids, oil & grease, total organic carbon, BOD, COD and phosphorous. Lead, zinc, copper and nickel have been the only metals of relative significance found. Clearly, the pollutants found in truck wash water when cargo areas are being cleaned are closely linked to the previous cargoes. Thus, innumerable pollutants may be found in truck wash wastewater.

Some of the chemicals being used at facilities in the Fraser River Basin include soaps, synthetic detergents, heavier degreasers and engine cleaners, acids, caustics, rust inhibitors, aluminum brighteners and mag cleaners. At the six vehicle washes investigated in the Fraser River Basin, the wash water discharged to the sewer was for the most part found to be comparable to a moderately strengthed domestic wastewater and was below the GVRD Sewer Use Bylaw limits. Generally, the exceptions were truck wash facilities and facilities where, in addition to the washing of vehicle bodies, engine cleaning and other activities were performed. These findings are similar to those of other jurisdictions.

Because truck wash wastewaters can differ significantly from typical car wash wastewaters, they should ideally be addressed separately in BMPs and regulations. Truck wash wastewaters generally have more in common with the wash waters from other operations in the transportation equipment cleaning industry, such as rail tank car and tank barge cleaning.

Concern regarding vehicle wash waters should not be limited to fixed facilities whose primary business is vehicle washing. Studies have found that it is not necessarily always these commercial washes that are exceeding local limits, but also facilities performing wash services as part of their operations, ie. vehicle repair shops. Mobile washers are perhaps the worst offenders in the industry, as they typically wash large fleets with no form of wastewater control. Wash water is therefore discharged directly to storm sewers and in turn watercourses. Fleet operators may also fall into this latter category, as their primary on-site maintenance activity is usually vehicle washing, for which they are generally not appropriately equipped. Ideally, fleet operators unable to comply with minimum wastewater discharge requirements should have their vehicles washed at approved fixed commercial establishments or by a mobile washer able to conform with discharge requirements.

While a 1982 U.S. EPA report concluded that the amount and toxicity of pollutants found in car wash water did not justify developing national regulations and that the toxicity and amount of incompatible pollutants discharged by car washes to treatment plants was not significant enough to justify developing a national pretreatment regulation, numerous municipalities in the U.S. do have some form of legislation regulating the discharge of vehicle wash wastewater. In the U.S. municipalities interviewed in this study, control of wastewater discharges was generally being achieved through Sewer Use Ordinances (Bylaws), supported by suggested Best Management Practices.

In Canada, Sewer Use Bylaws are also common, but their enforcement appears to be less rigorous. In addition, with the exception of Ontario, it does not appear that any BMPs applicable to vehicle washes have been developed. In Ontario, vehicle washes have been addressed as part of the motor vehicle services BMP. However, this BMP will not be implemented until the supporting Sewer Use Bylaw becomes regulation. In B.C.'s Fraser River Basin, for the most part, there do not appear to be enforced standards for the pretreatment or discharge of vehicle wash water. While most vehicle wash facilities have some form of sediment pit, their operation and maintenance appears to be haphazard. In addition, some vehicle washes may be discharging directly to the storm sewer. The exceptions to this scenario appear to be the larger industrial facilities for which the sewer use regulations are generally actively enforced, particularly in the GVRD. Improved operator guidance with management practices, treatment methods and acceptable discharge locations is thus considered warranted.

Suggested improvements at vehicle wash facilities in the Fraser River Basin include:

- planning for the implementation of appropriate pollution prevention and treatment techniques at the design stage of new vehicle washes;
- ensuring that pollution prevention and treatment techniques are installed and operating correctly at new vehicle washes;
- implementing good management practices at existing facilities to improve performance of existing pretreatment units and minimize contaminated wastewater discharges, accidental or otherwise;
- ensuring sanitary sewer discharge of vehicle wash water;
- upgrading pretreatment operations at some existing facilities;
- limiting on-site activities to those suitable for the type of pretreatment available; and
- providing closer review of truck wash operations and the necessary pretreatment facilities, preferably on an individual basis.

Finally, if this BMP plan or any BMP plan is to have success, it is important that it be supported by publicity, workshops, incentive programs, legislation and/or active enforcement.

PART II

BEST MANAGEMENT PRACTICES
for
FIXED COMMERCIAL VEHICLE WASH FACILITIES

BACKGROUND

Numerous organizations are working together to advance the environmental, economic and social sustainability of the Fraser River Basin. The Basin is a valuable resource -- while covering only 25% of B.C.'s land area, it contributes 80% towards the gross provincial product and over 60% towards total household income. The health of the Basin however, is being strained due to population increases, resource extraction and rapid economic growth.

The Fraser River Action Plan is a federal government initiative addressing the pressures facing the Basin's health and sustainability. Pollution abatement is a component of this Plan and thus, effort is being made to identify and control contaminants entering the Basin.

As vehicle washes may be a potential source of pollution, particularly if not well managed, an inventory of the vehicle wash facilities in the Fraser River Basin and Burrard Inlet Drainage Basin was conducted in late 1994 and early 1995 to obtain current information on wash practices and potential contaminants in wash water. This has culminated in the development of this Best Management Practice manual for non-mobile commercial car and truck washes in B.C.

INTRODUCTION

Storm sewers and sanitary sewers are the two main routes by which pollutants may reach our watercourses. Because storm drains discharge directly to local rivers, creeks, lakes and the ocean, they are intended to transport primarily rainfall runoff from streets, buildings, parking lots and other open spaces. The sanitary sewer carries wastewater to the local sewage treatment plant, which in turn discharges to local watercourses.

Most municipalities in the Fraser River Basin have prescribed restrictions on the use of local sewers in a Sewer Use Bylaw. The Bylaw's purpose is to protect the operation of both the sewers and sewage treatment plant, the water quality in our watercourses and the health and safety of sewer workers. The restrictions typically limit the use of storm sewers to storm water, but make exceptions for uncontaminated cooling water, water resulting from municipal services (ie. street flushing and fire extinguishing) and water from *personal domestic* activities such as lawn irrigation and car washing. Discharges to the sanitary sewer are usually limited on quantity and on quality. Pollutants which may be restricted include, oil & grease, metals, organic material and solids. Thus, some discharges to the sanitary sewer may require pretreatment in order to be acceptable.

This Best Management Practices manual contains suggested methods for helping you comply with such environmental regulations and protect your local watercourses.

CAR & TRUCK WASH POLLUTANTS AND DISCHARGE LOCATIONS

The composition and strength of the wastewater generated at a vehicle wash facility will vary depending on factors such as:

- the types of clients served;
- services offered;
- wash process used;
- chemicals used; and
- geographic location.

Pollutants in wash water generally include elevated levels of mineral oil & grease, suspended solids and detergents. Other contaminants may include metals, organic material and unacceptable levels of acidity or alkalinity. These latter contaminants are typically found at truck wash facilities and at do-it-yourself facilities, where customers may be using a variety of cleaning agents, cleaning engines or changing and dumping used oil. Often, the chemical agents used in vehicle washing, including detergents, can be a greater pollution threat than the substances washed off of vehicles.

While most municipalities require that wash water be discharged to the sanitary sewer, some water may still find its way to the storm sewer if the facility is not carefully designed.

The sediment found in vehicle wash water is generally not considered a contaminated waste. However, when undercarriages or engines are cleaned, the levels of oil & grease and metals in the sediment may be raised to hazardous concentrations.

THE MANUAL

Best Management Practices (BMPs) refer to suggested "state of the art" practices which should be implemented on a daily basis to help you comply with local sewer use restrictions and protect the environment. More specifically, following these BMPs can help you to reduce water use and wastewater discharges; wastewater pollutants; undetected, accidental or uncontrolled discharges; health and safety claims; and upsets at privately or publicly owned wastewater treatment plants. Because local requirements may vary, you should also check with your municipality regarding their specific policies. Not all of the BMPs recommended in this manual may be applicable or economically feasible at your facility or they may only be suitable to a limited extent. Some judgement is therefore required in their implementation.

This Manual addresses 7 areas in which BMPs may be applied:

- materials management;
- good housekeeping;
- spill control measures;
- maintenance;
- education;
- record keeping; and
- solid waste disposal.

It also provides some BMPs directed specifically to truck wash facilities and BMPs which are potentially only economically feasible at new wash facilities.

Finally, this manual discusses pretreatment technologies applicable to vehicle wash wastewater.

Further information is available through your local municipality or Regional District, B.C.'s Ministry of Environment or Environment Canada.

Materials Management

Materials management includes product selection, handling, storage and disposal. Careful materials management can result in cost savings and a reduction in waste handling and pollutant discharges.

Wherever possible, materials should be chosen that are:

- *reusable or recyclable*
  The use of reusable or recyclable materials can lead to material cost savings, a reduction in the waste requiring disposal and disposal cost savings.

- *non-toxic*
  Halogenated compounds, petroleum-based cleaners or cleaners with phenol are all highly toxic, costly to recycle or dispose and can create difficulties in the sewerage system if discharged. Water-based cleaners can be acceptable alternatives.

- *biodegradable and phosphate free*
  Detergents resisting biological treatment (ie. non-biodegradable) have caused the contamination of both surface and ground waters. High phosphorous levels in detergents have led to excessive plant growth in watercourses, depleting them of the oxygen necessary for aquatic life.

- *compatible with equipment, containers, other materials on-site and on-site wastewater pretreatment systems*
  The use of incompatible materials can lead to inadequate wastewater pretreatment, equipment failure and leakages. For example, the use of soaps and non-foaming detergents for

vehicle washing and engine cleaning should be kept to a minimum, because they can reduce the efficiency of oil/water separators.

- *suitable to a number of applications*
  Rather than having a number of different types, brands or grades of materials on hand, the selection of agents suitable to a number of different applications can reduce the number of containers to be handled and disposed.

Inventory controls which can reduce the amount of waste generated include:

- *purchasing supplies in bulk and keeping them in bulk dispensers*
  This eliminates the number of empty waste containers requiring disposal.

- *choosing suppliers who accept used materials and containers for recycling*
  This minimizes disposal requirements.

- *purchasing only quantities of materials which can be used within the recommended shelf life and using these materials on a "first in, first out" basis*
  This helps avoid the need to discard expired, unused material.

The storage of chemical agents requires attention to the following:

- Storage containers such as pails, drums and tanks should be tightly capped to avoid contamination and spillage.

- Storage containers should be securely placed to prevent vandalism and to prevent them from falling over and spilling.

- Container labels should be clearly visible.

- Used oil should be stored in a securely capped tank specifically designed for oil storage and protection against vandalism.

- Floor drains in the storage area should at a minimum be connected to the sanitary system; ideally, they should be sealed off and the storage area maintained as a "dry" area.

- Secondary containment measures such as curbs or berms should be in place in the event of spills or leaks.

- Drip pans should be located under dispensers to collect any spilled product for reuse.

In order to minimize the impact of used or excess material disposal and empty container disposal, the following guidelines should be followed:

- Chemicals should not be poured into sanitary or storm sewers, pretreatment facilities or into the environment.

- Liquid chemicals should not be disposed of in solid waste disposal bins, as they may leach out at landfills.

- Empty containers stored outside for disposal should either be tightly capped or covered to prevent the collection of rain water.

Note:

Suppliers may accept excess chemicals and empty containers. Alternatively, your local municipality may have a program in place for the collection/recycling of such materials and should be contacted regarding local policies and programs.

Good Housekeeping

Good housekeeping helps to maintain a smoothly running operation. As part of good housekeeping, the following practices should be considered:

- floors (outside of the wash area) should be kept dry and clean;
- pathways should be kept clear of obstacles;
- chemicals should be stored in an orderly manner;
- only empty chemical containers should be placed in waste disposal bins;
- chemicals should be stored in containers which are difficult to overturn and will not leak or corrode;
- spare containers for storing leaking containers should be kept on hand;
- all leaks, drips and spills should be promptly cleaned up;
- leaks, drips and other spills should be cleaned up without water whenever possible;
- absorbents should be on hand for spill clean up; and
- wet-mopping should only be done when absolutely necessary.

Because good housekeeping relies on employee understanding, interest and effort, education is important. Housekeeping practices should be documented and covered in employee training sessions. As a reminder, they can be discussed at meetings or publicized through posters, bulletin boards and employee publications.

Spill Control Measures

A well managed chemical storage area and good housekeeping practices will help minimize the occurrence of spills. Spill control measures however should still be in place, so that in the event of a spill potential harmful consequences may be minimized.

If a spill does occur, immediate efforts should be taken to contain the spilled material and prevent it from entering the sewer system or outside areas where it can enter soils or surface water.

In general, the use of water for the clean up of spills should be avoided whenever possible.

Small spills can be cleaned up with rags which can be laundered and reused. Rags however, should not be saturated with gasoline, solvents or other hazardous liquids.

Larger spills should be soaked up with dry absorbent. Dry absorbent "snakes" can be used as temporary booms to contain the liquid while it is soaked up with absorbents such as cat litter or specially manufactured absorbent pads. Dry absorbents can be swept up and saved for reuse until their absorbing ability is gone. Guidelines for the disposal of dry absorbents are given in this Manual's section on solid waste disposal.

A wet/dry shop vacuum can also be used to collect spills. However, they should not be used for volatile fluids such as gasoline and solvents because of explosive hazards.

For more information on what to do in the event of a chemical spill, manufacturers' Material Safety Data Sheets (MSDSs), your local municipality or Regional District, B.C.'s Ministry of Environment or Environment Canada can be consulted.

Maintenance

A good maintenance program requires not only the regular repair and maintenance of equipment and treatment units, but also regular inspections. Regular inspections will help to identify potential trouble spots, keeping equipment in peak operating condition and thus helping to avoid equipment failure and chemical spills. Generally, inspection activities should include:

- ensuring all storage containers are properly capped;
- checking for the deterioration of containers, container holders/supports and material transfer equipment;
- checking that equipment is functioning correctly;
- checking for parts requiring repair or replacement;
- checking for leaks; and
- checking for an oily sheen or foam in on-site catch basins or ditches.

Of particular importance is the regular inspection and maintenance of pretreatment units. For details regarding their correct maintenance, you should check with the supplier. In general however, regular inspection and maintenance of a gravity oil/water separator or sediment pit should consist of the following:

- The level of floating oil and bottom sludge in each compartment should be checked and recorded weekly.
- The water directed to the sanitary sewer should be checked for oil and solids.
- Separators should be cleaned at least once per year, after a major spill or, as a general rule, when the floating oil exceeds 5 cm or when the bottom solids exceed 1/3 of the depth between the bottom of the chamber and the bottom of the lowest inflow or outflow pipe in that chamber. The ultimate goal is that clean-out occur prior to the flushing of oil or sediment into the sewer connection or back-up of water into the facility.
- Clean-out entails emptying each compartment and all drains and rinsing with fresh water. Rinse water should be pumped out.

  Note:

  Waste from separators should be disposed of by approved, environmentally safe methods, such as those used by commercial tank-cleaning companies.

  If absorbents are used to remove floating oils, the absorbents should be disposed of according to the waste disposal guidelines in this Manual.

  If oil is skimmed from the water surface, it should be kept in a tightly capped used oil tank for re-refining or appropriate disposal

- The separator should be inspected for cracks or damage after clean-out.
- Separator defects should be repaired prior to reuse.

Education

Education of both employees and customers is important if practices or accidents causing the release of pollutants or resulting in product loss or clean up costs are going to be reduced.

Employees require training on the objectives and use of BMPs and their personal responsibilities with respect to their implementation. New employees should be trained by experienced staff when they begin work and all employees should review the BMPs at least once per year. Posters, bulletin boards and newsletters may also serve as reminders throughout the year. BMPs should be incorporated into the facility's written procedures for easy reference.

Specific areas which should be addressed in the training of employees include:

- site layout and drainage;
- potential sources of contamination;
- products used and stored on-site and any necessary precautions associated with their handling and use;
- use, maintenance and inspection of pretreatment units;
- spill control procedures;
- good housekeeping practices; and
- reporting requirements.

Owners, managers and staff can keep informed of new developments in management practices and pollution prevention through trade association meetings, publications or government workshops.

Customer education is not only good for the environment, but can also be good for business. With current concern regarding the environment, it is good public relations to let customers know what is being done to protect it. Their knowledge of what you are doing sets a good example, shows you as a good neighbour and, perhaps, makes you a facility of choice.

It is also important, to increase the customers' awareness regarding their polluting habits. Not only does this help us all in the end, but *you* are ultimately responsible for any materials improperly disposed of on your site and preventing pollution is much less expensive than cleaning it up. Customer education is particularly important at do-it-yourself operations.

You can make your customers more waste-conscious by posting reminders at your facility. These may include:

- no oil changing;
- no oil dumping;
- fix oil leaks;
- no engine cleaning;
- no dumping of liquids into waste disposal bins or storm drains; and
- no dumping of solids into any drains.

If you have persistent problems with customers inappropriately discarding waste, you may need to monitor their activities more closely.

Record Keeping

The effective management of a vehicle wash facility is aided by appropriate record keeping. It is recommended that records be kept on the following:

- materials inventory;
- maintenance;
- waste disposal; and
- employee training.

The materials on-site and their respective quantities and purchase dates should be kept on file.

The equipment maintenance record should contain information regarding the dates and findings of inspections and the dates and details of repairs or parts replacement. Inspection data may include (if applicable):

- wastewater appearance in each separator chamber (ie. presence of oily sheen, oil layer, colour, turbidity);
- oil depth in each separator chamber;
- sludge depth;
- presence of oily sheen or foam in on-site catch basins and ditches;
- observed leaks;
- date of inspection; and
- name of inspector.

Information which should be kept on file with respect to waste disposal (ie. oil/water separator or sediment pit clean-out) includes date of disposal, name of waste carrier and type and volume of waste disposed.

Finally, the names and positions of employees having undergone training, the instructor's name and position, the dates of training and the subjects covered should also be recorded.

Solid Waste Disposal

Waste disposal requirements may vary from municipality to municipality, but in general the following guidelines apply:

- Absorbents used to soak up non-chlorinated spills and absorbents containing less than 3% by weight of petroleum product can be disposed of in regular waste disposal bins.
- Absorbents used to soak up chlorinated solvents or absorbents containing greater than 3% by weight petroleum product are considered a special waste under the provincial Special Waste Regulations; it is recommended that an approved waste management company be contacted for their disposal.
- Reusable absorbents may be considered for petroleum products to avoid the need for disposal.
- Bottom sludge from oil/water separators may be contaminated and should be removed and disposed of by an approved commercial tank cleaning company.

Additional BMPs for Truck Washing Facilities

Because truck wash facilities generally wash interior cargo areas in addition to vehicle bodies and use harsher cleaning agents, some additional BMPs are applicable (pariticularly for faclilities washing tank interiors). These include:

- Cargo areas which last carried materials incompatible with the wastewater treatment system (private or public) should not be cleaned.

- Heels should be drained and contained in capped drums for either use, disposal at appropriate off-site facilities or for return to carriers/shippers.

- Concentrated rinses should be captured for separate treatment or disposal.

- Less contaminated rinses may be captured for reuse during the pre-rinse cycle.

- Cleaning solutions should be recycled, if possible.

- High-pressure, low-volume spray nozzles with flow control devices should be used.

Additional BMPs for New Vehicle Wash Facilities

The design of a vehicle wash facility can affect the quantity and quality of contaminated wastewater generated and its discharge location.

The strategic grading of outdoor spaces can prevent the run-on of stormwater from adjacent sites, thus preventing it from contacting potentially contaminated areas or water on the wash site. It can also direct the wastewater generated to the appropriate discharge location, ie. the pretreatment system and sanitary drains rather than storm drains. Sites should be examined for the identification of areas which should be "mounded", curbed or perhaps surrounded by speed-bump sized berms.

At facilities using pressure wands, wastewater can quite readily be directed over a large area. As a result, it may not find its way to the appropriate discharge location. Here again, grading may help in the appropriate collection and direction of wastewater. Construction of wash bays of sufficient length to prevent the escape of wash water can also help (some studies recommend a minimum wash bay length of 10m for cars).

Constructing a cover over the designated wash area will prevent rainfall from coming into contact with contaminated wastewater. This will in turn help prevent increases in the quantity of wastewater generated during rain events.

Depending on the activities to be performed at the site, the use of concrete rather than asphalt should be considered. Asphalt absorbs organic contaminants and can be dissolved by some fluids. Over time, the asphalt may then also become a source of stormwater contamination.

Treatment Technologies

As described earlier, the quantity and quality of wastewater generated at a vehicle wash will vary depending on a number of factors. Those factors, in addition to the following, will affect the type of wastewater treatment required:

- distance to sanitary sewer connection;

- local sewer use regulations; and

- sewage treatment plant limitations.

Because of the variability of wash water between facilities and also within one facility, it is difficult to make a generalization as to the type or level of treatment required. Some general guidelines are presented in this Manual, however, your municipal government should be contacted regarding specific local requirements. This Manual has assumed that wherever possible, wastewater will be discharged to the sanitary system, as direct discharge to the environment would in most cases require costly treatment.

In general, car washes using mild detergents and only washing car bodies (ie. not engines or undercarriages) should have wastewater pretreatment units for the removal of large objects (particularly at automated or unsupervised washes), suspended solids and free oil.

There are a number of treatment units which may accomplish this. A suggested basic pretreatment process consists of a bar screen and some form of gravity separation.

Bar screens consist of flat steel bars welded in a grid pattern to form rectangular spaces, typically 6 mm by 20 mm in area. Bar screens allow free flow of the wastewater, while removing the larger objects. Bar screens can be hand cleaned.

Free oil & grease and suspended solids can be gravity separated from water. Free oil & grease separation can be accomplished to a limited extent in single-chambered sediment pits and holding tanks, but is better accomplished with chambered separators such as the API (American Petroleum Institute) separator or the coalescing plate interceptor (CPI). While such separators are specifically sized for oil & grease removal, they will also remove floatable debris and settleable solids.

A number of variations on the API type separator exist. In general however they contain flow distribution baffles (vertical or horizontal) at the inlet and baffles for the removal of settleable solids and floating oils throughout, dividing the vault into three or four chambers. Some larger API separators may also have mechanical equipment for the removal of floating oils or settled solids.

The CPI consists of a series of closely spaced fibreglass or polypropylene plates in the separation chamber, at an angle between 0° and 60° from the horizontal. These plates reduce the distance required for solids settling and aid in the coalescing of oil droplets, resulting in greater pollutant removal efficiencies. Space requirements for CPIs are thus less than for API separators. However, the CPI is generally more costly to operate and install.

Figures 1 and 2 depict some basic oil/water separator designs. Whether constructing a sediment pit or oil/water separator, one of the most important design factors affecting suitable operation will be the hydraulic retention time (essentially the volume). Local suppliers can provide you with the appropriate sizing of a separator for your facility.

It should be noted that the use of detergents, high pH chemicals or hot water can cause the emulsification of oil, potentially rendering gravity oil/water separators ineffective. If significant quantities of emulsified oil & grease are present in your wastewater, alternative or additional wastewater pretreatment processes may need to be considered.

In addition to the presence of emulsified oils in your wastewater, the use of harsher chemicals (such as acids, caustics, degreasers, etc.), the cleaning of engines or the cleaning of trucks (indcluding cabs, trailers and tankers) will also likely require that you consider additional or alternative pretreatment. This may include consideration of processes such as pH adjustment, precipitation, coagulation and dissolved air floatation. Table 1 presents a matrix of applicable treatment technologies for various pollutants. If you think additional treatments may be required at your facility, your local municipality/Regional District can be contacted for more information.

TABLE 1: Matrix of Applicable Treatment Technologies for Various Pollutants

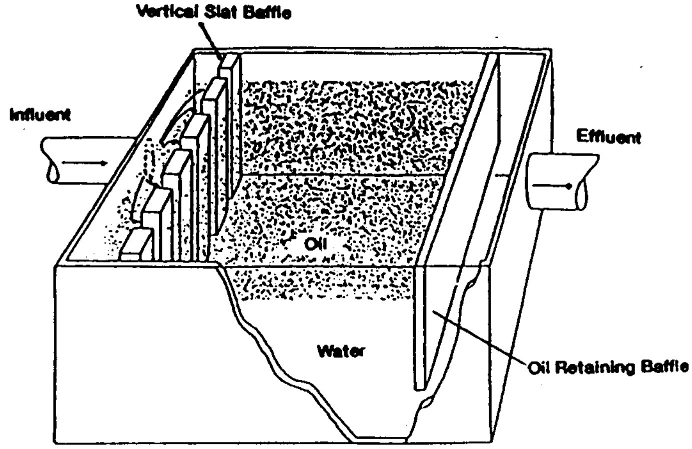
Treatment Technology / ***Pollutant Category***	Large Objects	Suspended Solids	Free Oil & Grease	Emulsified Oil & Grease	Acidity/Alkalinity	Metals	BOD/COD	Volatile Organics	Semi-Volatile Organics
Bar Screen	x								
Catch Basin/Sediment Pit/Holding Tank		x	(x)						
Gravity Oil/Water Separation		(x)	x						
Coalescing Plate Separator		(x)	x	(x)					
pH Adjustment					x				
Precipitation						x			
Coagulation		x		x		(x)	(x)		(x)
Dissolved Air Floatation		x		x			(x)	(x)	(x)
Filtration		x							

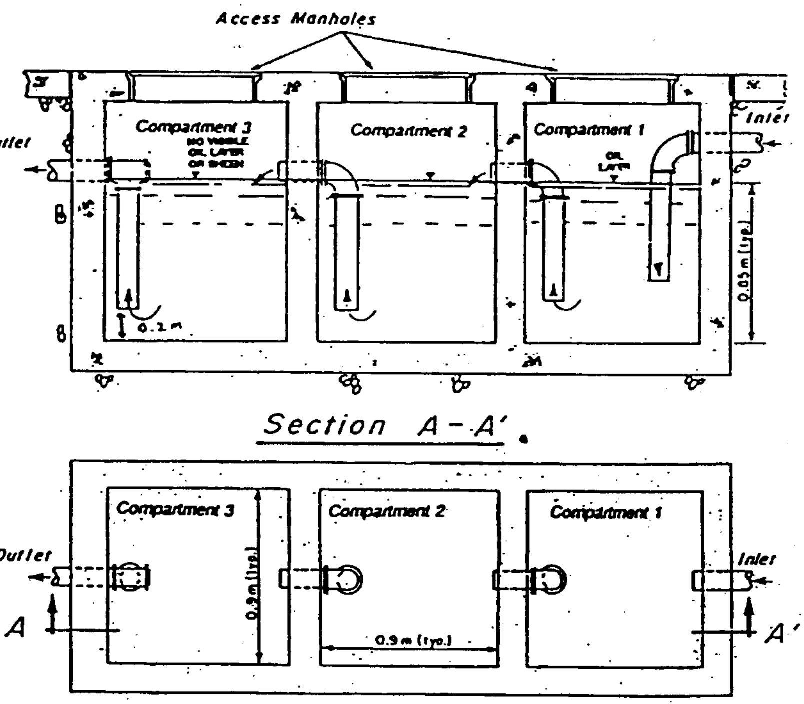
Note: **BOD/COD, metals and semi-volatile organics may be associated with suspended solids, therefore their levels may also be reduced by suspended solids removal methods**

x = technology is applicable to pollutant category
(x) = technology is applicable to a limited exent; additional treatment is most likely required

based on: Preliminary Data Summary for the Transporation Equipment Cleaning Industry

BASIC OIL/WATER SEPARATOR
(Ont. MOE, 1992)





3-CHAMBERED OIL/WATER SEPARATOR
(Ont. MOE, 1993)

API SEPARATOR WITH OIL SKIMMER
(King County, 1994)

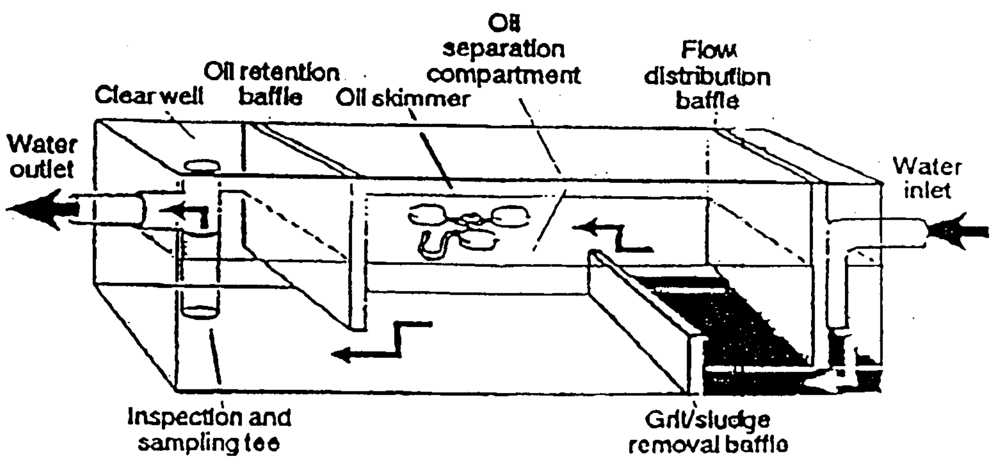
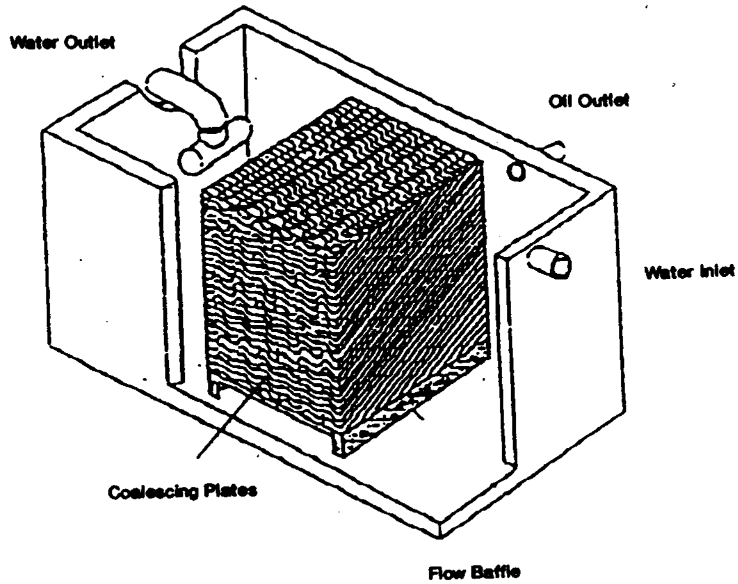
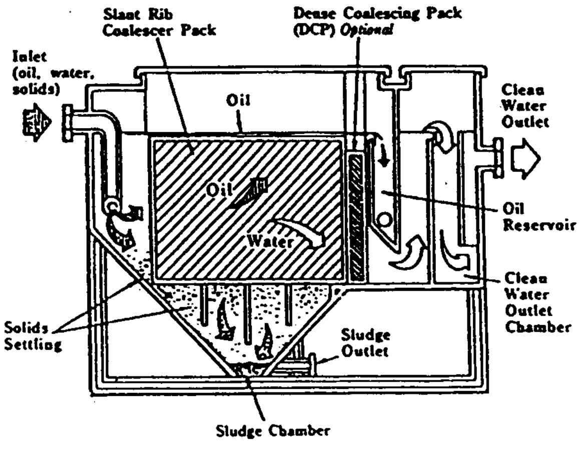


FIGURE 1
STANDARD OIL/WATER SEPARATION UNITS



BASIC COALESCING PLATE INTERCEPTOR
(King County, 1994)



SLANT RIB COALESCING SEPARATOR
(Palo Alto, 1992)

FIGURE 2
COALESCING PLATE INTERCEPTORS

GUIDELINES FOR MOBILE VEHICLE WASHES

BACKGROUND

Numerous organizations are working together to advance the environmental, economic and social sustainability of the Fraser River Basin. The Basin is a valuable resource -- while covering only 25% of B.C.'s land area, it contributes 80% towards the gross provincial product and over 60% towards total household income. The health of the Basin however is being strained due to population increases, resource extraction and rapid economic growth.

The Fraser River Action Plan is a federal government initiative addressing the pressures facing the Basin's health and sustainability. Pollution abatement is a component of this Plan and thus, effort is being made to identify and control contaminants entering the Basin. It is evident that mobile vehicle washes, including charity washes, if not correctly managed may be contributors to the pollution of the Basin.

THE PROBLEM

Many have argued that the release of pollutants from wash vehicles is similar in result as the action of rainfall. There are however a number of shortfalls with this reasoning. While many pollutants may be washed off of vehicles by rainfall, there is no specific point of discharge associated with rainfall and therefore also, no means of controlling the discharge. With mobile or charity washes however, a number of vehicles are generally washed at one site at one time, resulting in a substantial contaminant load to the storm or sanitary sewers or the ground. In addition, the actions of detergents and other cleaning agents add to the harmfulness of the wastewater generated.

Storm sewers and sanitary sewers are the two main routes by which pollutants may reach our watercourses; thus, most municipalities in B.C. have placed restrictions on their use in the form of a Sewer Use Bylaw. Storm drains, because they discharge directly to local rivers, creeks, lakes and the ocean, are intended to transport primarily rainfall runoff from streets, buildings, parking lots and other open spaces. Allowances have been made for wastewater resulting from *personal domestic* activities such as car washing. The sanitary sewer carries wastewater to the local sewage treatment plant, which also eventually discharges to watercourses. Therefore untreatable pollutants may still reach watercourses through this route. In order to protect the environment, the operation of the sewerage system and sewer workers, the Bylaws place limits on the quantity and quality of wastewater discharged to the sanitary system.

Groundwater can also become contaminated if vehicles are washed on soils with insufficient capacity to "treat" the wastewater. Some wastewater components may even be untreatable and will pass directly through to the groundwater.

THE POLLUTANTS

The wastewater generated from washing vehicles may contain high levels of suspended solids, oil & grease, metals, chloride, nitrogen, phosphorous and organic matter. Detergents, while advertised as environmentally friendly, biodegradable and phosphate free, may also be considered pollutants. For example, biodegradable simply means that the product will eventually breakdown through the action of microorganisms. It does not necessarily mean that it is non-toxic and safe to discharge to the environment. Detergents contain surfactants which even at low concentrations can be toxic to sensitive stream organisms and may lower dissolved oxygen levels to below those necessary for aquatic life. The foaming action of detergents can also cause unsightly foaming in local surface waters and operational difficulties in sewage treatment plants. Engine cleaning can be particularly harmful, because of the often toxic components of the cleaning agents used and the high levels of oil & grease and metals released.

RECOMMENDED PRACTICES FOR CHARITY WASHES

To avoid the discharge of untreated wash water to the environment or the sewer system, the first approach towards organizing a charity wash should be to find a means of working with a fixed commercial car wash equipped with approved pretreatment facilities. For example, coupons could be sold for customers to get their cars washed by the commercial facility or alternatively, arrangements could be made for charity volunteers to wash cars at a commercial wash with self-service bays.

If such arrangements are not feasible, effort should be made to ensure that the wastewater generated is directed towards the sanitary sewer system; in this way, it will at least receive treatment at the sewage treatment plant prior to discharge to the environment. To accomplish this, vehicles could be washed in an enclosed area where the floor drain is connected to the sanitary system (a city parking garage may be a possibility). Alternatively, the municipality may be able to assist in diverting the wastewater from the storm sewer to the sanitary sewer (ie. by placing a temporary plug in the storm drain and pumping the water to a sanitary drain or manhole).

If discharge to the sanitary system is an impossibility, the following guidelines should be followed:

- only wash vehicle bodies -- do not wash undercarriages or engines;
- use water only -- do not use detergents, solvents, heavy degreasers or highly alkaline or acidic agents;
- do not wash heavily soiled, greasy or oily surfaces;
- use a flow control device on water hoses, such as a hand spray with an on/off trigger;
- wash on grassy or gravelled areas with sufficient soaking capacity; and
- if washing on a paved surface, wash cars next to the storm drain.

RECOMMENDED PRACTICES FOR MOBILE WASHES

Due to the number of vehicles mobile washers clean on a regular basis, the wastewater discharges from such operations are an even greater concern than charity washes.

It is recommended that mobile washers abide by the local Sewer Use Bylaws. This entails collecting all wastewater generated, for transportation to a site where it can undergo pretreatment. Depending on the municipality, it may also be allowable to collect the wash water for discharge directly to the sanitary system at an approved location. The wastewater can be captured by a number of means:

- routing it to a depression;
- containing it with portable plastic berms;
- sealing catch basins with rubber gaskets; or
- using a portable containment device under vehicles (or at the rear of a truck trailer when cleaning the interior).

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