Name	WIM Industries P/L, trading as H2O Cleanawater
Project Description	Vehicle Wash Water Recycle Project
Report Number 5D	Final Evaluation Report
Date of Milestone Report	7 April 2005

Background

H2O Cleanawater (formerly Hydramotive Engineering) has been involved in the waste water treatment industry for a number of years. In 2000 H2O Cleanawater designed and installed a totally self-contained recycle wash water plant for vehicles and equipment at A H Plant Hire, Strathfieldsaye, VIC. As this plant site had no town sewer connection it was necessary to eliminate plant discharges to ensure that any (minor) discharge to site would meet the EPA river water specification. This specification requires that the suspended solids and BOD5 levels are below 30 mm/L and 20 mg/L respectively. The stringent EPA requirements were achieved by adding an aerobic bio-reactor system to the solids removal equipment. No external discharge has been necessary since the plant commenced operation. Site town water use has reduced substantially. The success of this and a similar recycle plant at the Holden Lang Lang proving ground led to the receipt of a **savewater award** in 2001.

Utilising the experience gained with these self-contained recycle plants H2O Cleanawater decided to investigate whether a cost reduced, or modified, version of the plant would meet the needs of the commercial vehicle wash industry. At this point an application was made to the Smart Water Fund for assistance with the research. Wim Industries P/L (trading as H2O Cleanawater) was successful in August 2003 in receiving staged funding, to a total of $164,000 to assist with this work. The research to be conducted was to:

- Establish that H2O Cleanawater had discussions with operators of carwashes and the Carwash Association to identify water recycling issues that needed to be addressed.
- Identify and evaluate a range of technical options to address the issues identified by these discussions.
- Recommend preferred options, and
- Implement a program based on establishment of prototype plant(s) to allow evaluation of the options.

The initial stage of the project required direct input from a broad section of the carwash industry, including the Australian Carwash Association. Competitive Edge, a highly experienced specialist market research organisation, was contracted to undertake this work.

A total of thirty seven respondents were interviewed and detailed responses received from a survey of 27 questions/sections. Evaluation of the results enabled the ***Identification of Key Water Quality Requirements for Recycled Water*** to be identified, as over:

Identification of Key Water Quality Requirements for Recycled Water

The responses from the vehicle wash survey by Competitive Edge probing the industry requirements for recycle water quality were carefully considered and resulting target standards proposed for recycle water quality. This target standard was used in the design and development of wash water recycle equipment for the on-going stages of the Smart Water Fund project by WIM Industries P/L.

Although there is strong and varied opinion in the Industry regarding the percentage of recycle water that can be used on individual sites, an equipment development target of 85% recycle water use (minimum on the majority of sites) was considered important. With this volume target the following bench marks for water quality were developed from the survey responses.

1. Percentage recycle:	85% minimum.
2. Suspended solids – density:	50 mg/L maximum.
3. Suspended solids – particle size:	5 micron maximum.
4. Turbidity:	50 NTU maximum.
5. Colour:	Slight colour acceptable.
6. Odour:	Odour free.
7. Soap & Wax:	Majority removed.
8. Chemical use:	Nil, or minimum use.

The limits specified above were set as individual targets. To achieve all may be uneconomic with a 2,000 to 5,000 litre per hour recycle system for general industry use.

The investigation of equipment type/s to satisfy the requirements of each of the items above was considered in later Milestones of this project.

In addition to the Key Water Quality Requirements the survey results highlighted the following **Physical and Economic Targets** that were also included in the program:

a. The maximum plant space requirement – a 3 x 2 metre envelope.
b. Additional above ground storage - limited to 3,000 litres.
c. The target installed price - below $20,000 for a 2,500 L/hour recycle system.
d. The target for consumables - a maximum of $1,500 p.a.
e. The target for bought-in services (eg sludge removal) - $2,000 p.a.
d. The target maximum installed power for the plant - 4kW, preferably supplied at 240V.

Once these limits were set the on-going research and development work conducted was aimed at achieving each of these targets. The research and testing program was carried out over a number of Milestones with specific target outcomes and associated reports. An overview of the scope of this program is noted in the following section.

In considering these target key requirements it was clear that removal of suspended solids was the initial major goal. A number of alternative procedures were considered for solids removal including coagulation / flocculation, hydrocyclone, media filter, and bag or cartridge filter.

Solid Separation and Particle Size

Primary filtration - Hydrocyclone

The removal of suspended solids from wash water is critical to the performance of a recycle system. An extensive hydrocyclone test program was approved to test the superior solids separation performance claimed for cyclones. The aim of this test program was to assess the solids removal performance of a cyclone with varying wash water feed samples and cyclone configurations, with the objective to:

- achieve an overflow volume (clean water discharge) of 2,500 litres per hour.
- minimise the suspended solids discharged through the overflow, with a target cut point of 5 micron mean solids particle size.
- maximise the solids volume in the underflow (dirty water discharge) while minimising the water volume – with a water volume target of less than 10% of the feed to the cyclone.

The photograph above shows the hydrocyclone test rig utilised for the cyclone test program at the H2O Cleanawater works located in Blackburn, Victoria.

Wash water samples were collected from three differing car wash configurations. These were classified as follows:

1. Manual (hand car wash),
2. Self-serve (with pressure pump use), and
3. Automatic wash (with brush or touch-free operation).

Twelve car wash sites provided a total of fourteen wash water samples for the test program. Two additional sites with existing low cost Cleanawater recycle systems were tested to compare the coalescing separator and filter station performance against the cyclone tests.

It was found that the density of solids, and type of detergent/s used, varied from site to site. The density of solids varied due to the car wash configuration and also the design of the solids pre-settling system. The performance of the cyclone for coarse solids removal was very satisfactory. The cyclone could reduce solids in the overflow stream to a ***mean particle size*** of approximately 10 micron. However the target for the cyclone tests was to achieve a solids reduction to a ***maximum particle size*** of 5 micron. To obtain a maximum (or absolute) particle size of 5 micron, the mean particle size at discharge would need to be below 2 micron. Included below are two graphs, one showing a mean particle size of 10 micron and the other, a maximum, or absolute particle size of 10 micron.

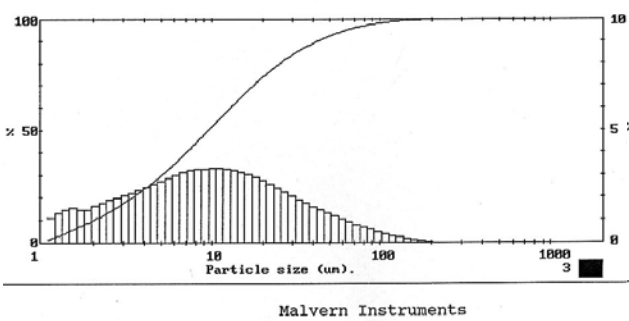

Fig 1 – Shows water containing solids with a mean particle size of 10 micron. Note that the maximum particle size in this case is above 100 micron.

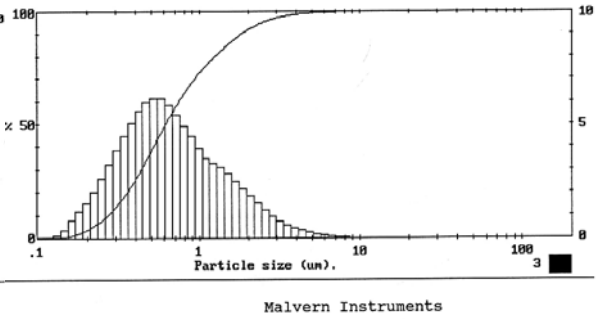

Fig 2- Shows water containing solids with a maximum particle size of 10 micron. Note that the mean particle size in this case is less than 1 micron.

Fig. 1 shows that a mean reading of 10 micron is the centre point of the area under the bell curve. As the graph shows there are particles in the sample that approach and exceed 100 micron. The major international pressure pump manufacturers specify that feed water to the pump inlet should not exceed 10 micron *absolute*. Supply of reclaim water with a *mean* solids particle size of 10 micron is therefore unsuitable.

Fig. 2 shows water with a mean particle size below 1 micron, and with all particles below 10 micron *absolute*. Reclaim water of this quality is acceptable for pressure pump use.

During the program wash water from 15 car wash sites was tested for particle size, suspended solids, BOD5, turbidity, conductivity and total oil and grease. Following a significant number of tests it was concluded that the hydrocyclone could achieve a 20 to 50% reduction in suspended solids and could achieve a *mean particle size* of close to 10 micron in the overflow. The extent of turbidity reduction varied due to the particle size present in the sample. Fine particles were difficult to remove with the hydrocyclone and turbidity reduction was moderate. There were slight shifts in the reduction of BOD5 and total oil and grease.

With the results achieved from the cyclone testing it was concluded that the discharge water from the hydrocyclone was only suitable for inlet to the next stage of solids separation.

Secondary Filtration –Sediment Filtration

A specially designed sediment filter was installed at a commercial Carwash site to investigate filter performance under continued operation. This sediment filter contained media that was formulated for the specific carwash application so it would not clog with waxes, oil and

grease. In normal application sediment filters are not recommended for carwash systems as they can become loaded with these contaminants, causing the bed to ball and channel. The sediment filter chosen by H2O Cleanawater contained multi layers of media to handle the solids load and contaminants found in a car wash environment.

The system was thoroughly tested for solid separation and particle size. It was concluded that the cyclone and sediment filter combination could provide exit water quality close to the 'Target guidelines' mentioned earlier. Research was also conducted by H2O Cleanawater to "fine tune" the filtration at the end of the process. It was felt that a screen type filter would be required as a safety barrier in case of particle leakage past the cyclone and sediment filter system. This filtration barrier would guarantee that solids particles present in the final recycle water stream were below *2 micron mean* and close to *10 micron absolute*. This last stage of filtration is discussed in the next section.

Micro Filtration
H2O Cleanawater conducted a series of tests with cartridge and bag filters as a final solids barrier. It was discovered that most filter manufacturers do not provide accurate test results for their bag or cartridge systems. Several bag and cartridge filter combinations were tested to find an economical and reliable filtration barrier that will polish the recycle water to the required specification.

Project Summary
The range and scope of tests completed during this program highlighted a number of system features that are vital for a vehicle wash water recycle system.

In particular, one specific plant layout will not suit all installations. When proposing an installation for a given site the individual site parameters must first be assessed, and a plant layout developed to suit these. Depending on the condition of the water in the settling pit, and the final water quality requirement for the site equipment, a specific plant layout can be developed.

Equipment offered will generally include one or more of the following items, an oil solids separator, a hydrocyclone, automatic back-wash media filter/s, bag filters, chemical odour removal. The target must be to provide a system with the lowest capital and maintenance cost that will meet the specific site requirements.

Site conditions that will affect the system design include:

Settling Pit: The settling pit design has a very significant influence on the plant performance. A well baffled pit can provide intake water with low level of suspended solids.

Site Water Quality Requirement: Where the reclaim water is to be supplied to the inlet of a pressure pump/s, the suspended solids particle size must be maintained *below a maximum of 10 micron*. This will dictate the extent of fine filtering required. Where the reclaim water is to be supplied to the inlet of a multistage impeller pump, or other, a lower water quality may be allowable. This must be confirmed with the equipment manufacturer, installer and owner.

The **Key Water Quality Requirements for Recycled Water** can be met with the following equipment:

1. Percentage Recycle – 85% Minimum:
It will be possible to reclaim more than 90% of all wash water returned/recovered in the collection pit (the 10% loss is the maximum backwash water volume for a media filter/s). N.B. In calculating this loss percentage the above ground losses such as evaporation, drip-off, etc. are not included.

2. Suspended solids, density - 50 mg/L:
This requirement can readily be achieved with packed media separators, media filters, and/or media and bag filters.

3. Suspended solids, particle size – 5 micron maximum:
Filter systems will be supplied to provide a mean particle size of less than 2 micron. These will guarantee a maximum particle size of around 10 micron, as shown in Fig. 2 previously.

4. Turbidity – 50 NTU maximum:
As the chemical use on site (wax, etc.) can influence the turbidity reading a maximum of 50 NTU will **not** always be achieved. Readings to 150 NTU can occur even when the suspended solids are below 20 mg/L and the particle size is below 10-20 micron. If all other parameters are achieved the turbidity reading is of the least importance.

5. Colour – Slight colour acceptable:
Chemical use on site can affect the colour reading. Platinum Cobalt colour readings of 10 to 100 Pt/Co are achievable with the fine filtering utilised. Reclaim water to 100 Pt/Co units of colour is generally acceptable.

6. Odour – Odour free:
Odour will be controller by the use of Calcium Hypochlorite, or similar chlorinator.

7. Soap and Wax – Majority removed:
Not all of the soap and wax will be removed. Retained soap and wax will not be a problem for vehicle washing provided that fresh/mains water is used for rinsing.

8. Chemical use – Nil, or minimal use:
Odour will be controlled by Calcium Hypochlorite, but only in small quantities.

In addition the following **Physical and Economic Targets** can readily be achieved for a 2,500 L/hour recycle system:

- A maximum plant space of less than 3 x 2 metres.
- Additional above ground storage of less than 1,500 litres.
- An installed price below $20,000 plus GST.
- Annual consumable use of less than $1,400 plus GST.
- Installed plant power requirement of 3.5 kW, at 240V single phase.

H2O Cleanawater will be pleased to work with potential customers to define the most efficient and economic recycle plant layout for the customer application. Contact H2O Cleanawater by phone on 03 9878 3888 or info@cleanawater.com