4.0 TREATMENT & PROCESS DESCRIPTIONS

4.1 The Chlorination Process & Control Instruments

The aim of chemical disinfection is to destroy existing micro-organisms (or to at least interfere with their replication process) so that they cannot multiply. Historically chlorine is the most common disinfectant for swimming pools. Chlorine has achieved its "most commonly used" status because of its low cost, the convenience of on-site storage, and because its excess residual can persist for some time.

Refer to **Section 6.3** for a detailed description of Darwin City Waterfront chemical dosing plant. Chlorine is introduced into each pool via electrolytic salt chlorinators. The pH level, which has a very direct bearing on chlorine efficiency is automatically maintained using Dry Acid (Sodium Bi-Sulphate). Acid is injected downstream of the filtration plant (for maximum mixing and contact time) whilst Hypochlorous Acid (a result of the electrolytic reaction) is also downstream of the filters.

The water chemistry in each pool is automatically controlled via Instruments that operate with closed loop control. In this arrangement, a sample of pool water is analysed and the dosing system is regulated to maintain a particular set point. If the Instrument detects a chemical deficiency, a dosing correction is applied. The instruments provided at Darwin City Waterfront require proper calibration and regular maintenance thereafter. The instruments are not designed to replace the Operator, nor the need for regular (manual) water testing and strict management. Whilst the readings taken from the pool will not necessarily be the same as those indicated on the water chemistry Instrument, it is more relevant that there be a consistent and understood relationship between the two.

The chlorination systems at Darwin City Waterfront are controlled by Free Chlorine measurement of the pool water. The rate at which the salt chlorinators produce chlorine governed by the deviation of the sample value from the set point. With pH control the Instrument produces a current output which, activates a dosing pump that permits an acid solution to flow into the system.

The nature of closed loop control is greatly dependent upon many factors such as the representative nature of the sample water, the flow through time of the system, and the condition of the measuring electrode that is immersed in pool water. It is important to let the Instruments do their work. During the first three months of operation, changes to the set point can only be made by authorised persons. It is not uncommon for the pH of a new swimming pool to take several weeks or even months to properly settle.

4.2 Precoat Filtration

Compared to traditional sand filters, precoat filtration can provide many technical benefits by virtue of its unique “single pass” efficiency. Precoat filters provide a particle selectivity of about one to two microns and are able to remove significant amounts of small micro-organisms and bacteria. This commonly results in reduced chlorine consumption and vastly simpler pool chemistry. Unlike sand filters or other process (including ozonation with the normal 2 minute contact time) media filtration has the ability to “filter-out” modern chlorine resistant pathogens like Guardia and Cryptosporidium.

Whilst precoat filters may require slightly more operator involvement than a conventional sand filters, they are able to provide a unique and very simple process efficiency. Whilst it is necessary to replace the filter media after each an every backwash, this results in far cleaner filtration with infinitely less chance of any biological fouling within the filter vessel.

The replaceable filter media that is recommended for Atlas filters is Perlite in the form as Dicalite Grade 4156 or alternatively diatomaceous earth (Celite Grade 545) may be used. The choice of media is ultimately an Operator decision. The deployment of precoat filters can be noted by reference to the Data Sheets provided in **Section 5**. Specific product information can also be found in **Section 6.**

When handling dry filter media a disposable face mask is required. Waste filter media and collected dirt is detained within a bag filter in the plantroom, with the residual Grey water being pumped to the backwash tank for removal to sewer.

The Filter Cycle

The filter plant should be normally run 24 hours a day. The filter plant provided has been selected on the basis of the design criteria as outlined in **Section 5** of this manual. For filtration efficiency, the filter plants operate at a design flow rate of <5m3/hr/m2. This rating results in the provision of 240m2 of filter area for the Wave pool and 60m2 of filter area for the Wading pool.

For normal filtration, valves should be set as follows for UFF filters;

(1)	All filter inlet valves on the filter face plumbing are	OPEN
(2)	All filter outlet valves on the filter face plumbing are	OPEN
(3)	All backwash valves on the backwash header are	CLOSED
(4)	All filter diversion valves on the filter face plumbing are	CLOSED

If a particular filter is to be isolated, flow through the system should be decreased to suit the number of filters actually on-line. Failure to observe this instruction could adversely affect the efficiency of the filter system.

4.3 Filter Backwashing

Optimum filter performance is totally dependent upon regular backwashing at the prescribed rates. Refer to **Section 3** for the required backwash flow for each filter. Details on normal operating pressures, wash water rates, valve settings etc., are provided in the commissioning documentation in part B of this manual.

Although the frequency of backwash is load related, the Pool Operator is required to backwash the installed filters (AS A MINIMUM) at least every 4 weeks.

Note that the backwash duration on UFF filters is approximately two minutes and a one minute rinse. With experience, backwashing of the Ultra Fine Filters can be done at times that are convenient to the Plant Operator. Each backwash must be faithfully recorded in the Plant Log Book and on the blackboard on the side of the filters. Backwashing of the filters is preferably carried out at or near the end of the day's activities. Given the amount of make-up water that is inevitably required after backwashing, this gives the pool a greater recovery time to process the raw mains water.

4.4 Disposal of Wash Water

All wastewater eventually ends up in the backwash tank located adjacent to the plantroom. An automatic pump out system sends this water to sewer at a rate of 2 lt/sec. At regular intervals (say every 6 months) the backwash tank will need to be emptied of built up solid matter. A vacuum tanker contractor should be engaged for this process.

4.5 Pumping Equipment

Given that recirculating pumps are responsible for maintaining the flow through the treatment plant they are often considered to be the "heart" of the system. Whilst pumps create the flow, all other items in the recirculation system provide resistance to this flow. For this reason, pumps must not only furnish the required flow, they must do so with enough force to overcome the resistance of items like pipework, valves, and filters etc., that are an inherent part of the system.

The recirculating pumps at Darwin City Waterfront are centrifugal pumps, where typically the flow varies according to the resistance that they are required to operate against. In the case of the pools, pumping capacity is provided by full-duty pumps. This provides greater flexibility and provides the Operator with a simple mechanism to manage the pool's energy requirements according to actual loads and conditions.

Since the performance of any centrifugal pump has two dimensions - "flow" (normally expressed as litres per second) and "pressure" (normally expressed metres head), a correct definition should always provide reference to both parameters eg., x flow at y metres head.

Operators should remember:

the higher the pressure; the lower the flow, and conversely,

the lower the pressure; the higher the flow.

In operational terms, when the filter is dirty the resistance to the flow will be at it highest and the resulting flow will be at its lowest. Cleaning the filter lowers the filter pressure and increases the system's flow. It should be noted that a pump's power consumption increases as the flow increases. When a filter is clean, it is producing a high flow and therefore consuming maximum power. As the filter becomes dirty, the flow rate decreases and the power consumption decreases proportionally. Contrary to popular belief the least amount of power is consumed when the pump discharge valve is completely closed with zero flow and maximum pressure upstream of the closed valve.

Each pool's turnover has been commissioned on the basis that the system flow occurs at a point half way between a clean and dirty filter. To provide the required flow, the manual flow control valve provided on each pump discharge has been set and marked during the commissioning process. This simple valve (on the pump's discharge) plays a very important part in managing the system's flow and should not be adjusted or changed without reference to Trisley's Hydraulic Services.

Pump flows can be diagnosed by consulting the vacuum and pressure gauge readings against a certified pump curves. A vacuum gauge reading higher than - 25 kPa should be immediately investigated on the basis that it implies a resistance on the suction side of the pump, eg., a line blockage, a dirty pre-pump strainer, an inadvertently closed or restricted suction valve.
To protect the internal workings of the pump, all recirculating pumps are arranged with Pre-Pump Lint Filters that feature quick action toggle bolts for easy access to perforated strainer baskets. Refer to **Procedure 7.7** for details on cleaning the pre-pump strainer.

4.6 Pool Heating Systems

The pools at the Darwin City Waterfront project operate at ambient temperatures.

4.7 Control Systems

The Pool Control Board within the plant room connects the incoming supply and distributes the required power to all electrical equipment provided under the Contract.

Whilst the Pool Control Boards provide power to ancillary equipment, flow switches have been installed which will prevent power being supplied to the Chemical Dosing plants.

The operation of all main recirculating pumps is electrically interconnected with the chemical dosing plant such that chemical dosing can only operate when water flows through the system. If a recirculating pump fails to produce sufficient water flow, or fails to adequately "make and hold" the associated plant will automatically shut down and display a fault.

Indicating lamps are provided on the Pool Control Board to demonstrate operating status of all main pumps. The flow through each pool system has been determined by volumetric analysis and gauge readings against a certified pump curve.