The Meulwater WTW on Paarl Mountain

Meulwater Treatment Works

FINALIST – Technical Excellence Category

KEY PLAYERS

Client
Drakenstein Municipality

Main consultant
Aurecon

Main contractors
Superway Construction, Bateman Africa

SUMMARY

Paarl, the largest town within the Drakenstein Municipality area, purchases approximately 95% of its water supply from the City of Cape Town, which is relatively expensive.

An existing water supply scheme included the Nantes and Bethel bulk storage dams on Paarl Mountain, as well as the infrastructure to supplement the natural run-off to the dams with the municipality's allocation of water from the Berg River.

In addition, reservoirs and pipelines existed to feed the water into the town's distribution network. This scheme could provide up to 25% of the town's annual water requirements, substantially reducing water supply costs. However, apart from basic disinfection, no treatment facilities existed and the infrastructure was largely wasted.

The need for a treatment works was identified in a 2001 feasibility investigation by Ninham Shand (now part of Aurecon). The Drakenstein Municipality subsequently commissioned the construction of an 8 Mℓ/d water treatment works (WTW) on Paarl Mountain.

The new WTW treats water from the two dams on the mountain, and is located on the boundary of the beautiful Paarl Mountain Nature Reserve. Due to its location, the plant was designed with careful attention to environmental considerations.

An innovative treatment process was designed to use direct filtration and minimise the plant footprint. The filters are equipped with a dual-parallel lateral under-drainage system, the first plant in South Africa to incorporate this design. This system is part of an overall design to enhance the filter performance through the incorporation of optimised collapse-pulsing backwashing.

Other special design features include the architectural style of the WTW to minimise its visual impact. Granite sourced from excavations for the plant was used to clad structures, giving them a texture closely approximating that of their surroundings. Buildings incorporate 'green' roofs and the site was re-vegetated with indigenous seeds and plants from the mountain reserve.

Exceptional attention to plant design, construction and finishing, together with innovative solutions to environmental protection needs, has resulted in a unique and aesthetically pleasing plant.

Construction of the Meulwater WTW in progress on Paarl Mountain

DESIGN APPROACH AND AESTHETICS

Plant design

The design team included professional staff specialising in process design; civil, geotechnical, structural, mechanical, electrical and electronic engineering; as well as an architect, a landscape architect and botanists.

This diverse team incorporated the advice of heritage specialists and various environmental specialists, to produce an integrated design that paid careful attention to the various constraints and design objectives.

From the basic engineering and the innovative treatment process design, through to the architecture and the landscaping, careful attention was given to ensuring that the plant was well-constructed in accordance with appropriate specifications. Finishing details such as screeding, tiling and painting received particular attention, so that with minimal cost, substantial value could be added.

Treatment process design

The water treatment process consists of coagulation and flocculation, direct filtration through four deep sand-bed rapid gravity filters, equipped with a dual parallel lateral under-drainage system, disinfection with chlorine, and stabilisation with lime.

Flexibility was built into the plant design to accommodate the future possibility of the municipality increasing the annual volume of Berg River water that is pumped into the Nantes Dam to supplement the natural inflow.

Aesthetics

As opposed to a more conventional single large structure, the plant is made up of several smaller structures and designed to mimic the large granite boulder outcrops that characterise Paarl Mountain. Other features are:

- The height of the WTW above natural ground level was minimised.

- Sitting the plant up to 5.5 m deep into the ground displaced approximately 1 500 tons of granite, almost half of which was used as granite cladding, or as stone pitching around the site.
- Flora species sourced from the Paarl Mountain Reserve were planted on the roofs of the buildings and in the general vicinity of the WTW.
- The site was landscaped to effectively reduce its visibility.
- Lighting was designed to prevent 'light pollution'.

INNOVATIVE TREATMENT PROCESSES

Innovative treatment processes were implemented in the construction of this plant. For example, direct filtration, which is not common in South Africa, was selected to reduce the plant's footprint. This achieved a compact and effective treatment process which is also environmentally sustainable. A substantial capital cost saving over conventional treatment options was achieved – in the order of 15% of the construction costs.

Process design

The design of the water treatment works is unusual: the filter media bed in a rapid gravity sand filter system must be supported by an under-drainage system, which is important to achieve uniform filtration and backwash.

When a combined air scour and backwash process is used to create the collapse-pulsing mechanism, a false floor is often used. However, in view of the risk of false floor failures, the project team installed a dual-parallel lateral system, the first plant in South Africa to incorporate this design.

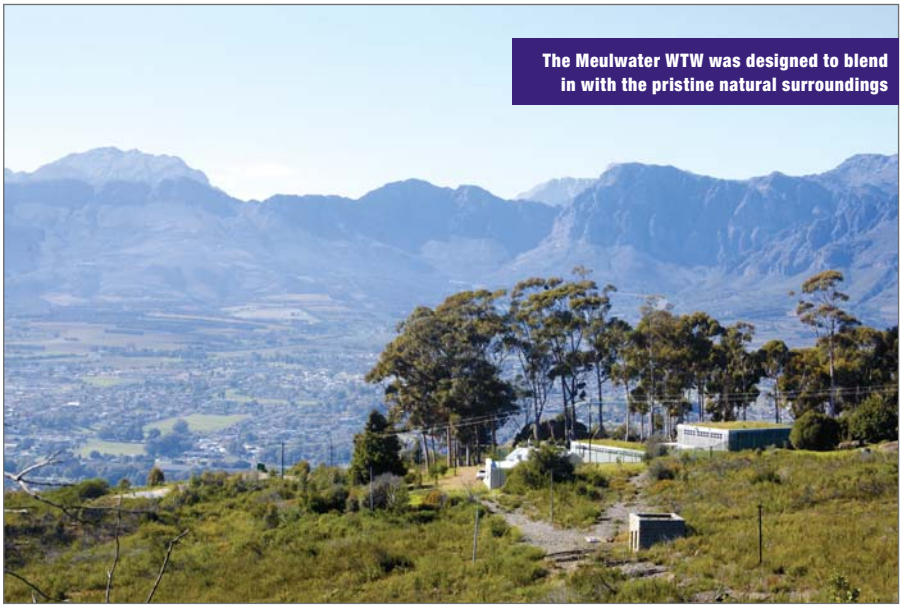
In line with the international trend, Meulwater has coarse filter beds designed to achieve longer filter cycles. Also, the coarser beds allow a higher nominal design filtration rate of 8.5 m/hour, with concomitant savings in construction costs.

Another novel aspect is the design of the filters with declining rate hydraulic control. This is again an uncommon feature in South African plants, but is able to produce a better filtered water quality and capital cost savings. This system is part of an overall design to enhance the filter performance through the incorporation of optimised collapse-pulsing backwashing.

CONCLUSION

The optimised design, with a smaller footprint than for conventional treatment processes, allowed for a cost-effective construction cost (excluding professional services) of approximately R34.7 million, translating into R4.34 million per megalitre of water treatment capacity. This cost is considered reasonable for a relatively small plant, particularly in view of the onerous environmental sensitivity constraints.

The project team worked closely with the client to match the funding requirements of the Meulwater project with the municipality's annual budget allocation derived from external and internal sources. This procedure worked well and accommodated the delays in obtaining approvals from the Department of Environmental Affairs and Tourism. □



The Meulwater WTW was designed to blend in with the pristine natural surroundings