

# VICTORIAN DESALINATION PROJECT

CONSTRUCTION COMPANY : Thiess Degrémont Joint Venture

ARCHITECTS : AAE, ARM, peckvonhartel

DESIGN : PB Beca Joint Venture

PROJECT END VALUE : \$3.5 Billion

## ENSURING VICTORIA'S WATER FUTURE

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Where the Bass Strait meets Victoria near Wonthaggi, construction of the biggest desalination plant in Australia is well underway.

AquaSure, who won the 30-year contract with the Victorian Government to deliver the Victorian Desalination Project, appointed the Thiess Degrémont Joint Venture as its design and construction contractor.

The joint venture partners combine the strength of one of Australia's largest and most trusted construction, mining and services companies, Thiess, with the global knowledge of Degrémont, a Suez Environnement company, water treatment specialist and a world leader in reverse-osmosis (RO) technology. Degrémont currently has 260 projects all around the world.

The \$3.5 billion Victorian Desalination Project will have an initial production capacity of up to 150 billion litres of water a year (444 million litres per day). The project is effectively five major projects in one: the desalination plant comprising 29 buildings; the marine intake and outtake structures; the intake and outtake tunnels; an 84km transfer pipeline to transport drinking water from the desalination plant to Melbourne and regional water network; and 87km of underground 220 kV HVAC power cable to supply power to the desalination plant. This is the longest underground HVAC power cable in the world.

This project's complexity and detailed scope included 45 road crossings, 21 waterway and one railway crossing for the pipeline and power construction, one of the biggest green roof installations in the world and one of the largest ecological restoration projects ever undertaken in Victoria.

The driver for constructing the greenest plant possible was the location, which is within one of Victoria's prime nature tourism locations. The local economy is highly reliant on its tourist trade, and Thiess Degrémont has proactively addressed concerns about visual impact of the plant on the surrounding landscape with an innovative architectural solution.

The desalination plant has been designed to be totally integrated into the landscape. Despite being one of the biggest facilities of its kind in the world, it will be barely visible from all public viewing points. The roof of the biggest building on site, the 28,900 square metre RO building, is a key aspect of the design. Its roof is made up of 438 individual panels installed at 23 different angles to mimic the undulating sand dunes in the surrounding environment. The panels support a green roof, one of the biggest in the southern hemisphere, which will help blend the plant into the landscape. The green roof will feature around 100,000 plants of 25 different species of indigenous ground covers, tussocks and low lying shrubs.

The buildings are also surrounded by constructed dunes, designed to provide visual and acoustic protection to neighbours nearby. The plant's actual footprint is quite small, taking up just 38 hectares of the 263 hectare site.

The remaining 225 hectares will become the focus of one of the largest ecological restoration projects in Victoria's history, complete with wetlands, coastal and swampy woodlands, and new habitat for local fauna.

Other environmentally sustainable aspects to the project are its energy efficiency and power offset. The desalination plant and transfer pipeline's operating power requirements will be 100% offset by renewable energy, ensuring the same amount of renewable energy is fed back into the grid.

A number of innovative systems have been introduced to minimize power consumption within the plant including world-leading energy recovery and re-use devices that significantly reduce power consumption in the RO process. The plant's compact, modular design reduces pipe work and eliminates inefficient energy use, and further energy is saved by constructing the plant a low level relative to sea level, reducing the amount of energy needed to lift seawater into the plant. The use of variable speed drives, high efficiency motors and low energy use membranes have also all been adopted.

The plant is being built in three parallel 50GL modules, all with identical and replicated technology and equipment. Each module has its own dual media pre-treatment, pumps, motors, instrumentation, sub power supply, cartridge filters, dual pass reverse osmosis membrane racks and energy recovery. Online, real time instrumentation monitors water quality at seven delivery points along the 84km transfer pipeline to ensure water quality standards are met.

Construction on the Victorian Desalination Project began in September 2009. In just over two years on site, the marine and tunnelling works have been completed; construction on the desalination plant is well advanced and commissioning now in progress; laying and hydrotesting of the 84 km transfer pipeline is complete and laying and energisation of the 87km underground power is complete.

Almost 6,000 people have worked on the desalination plant site to date, with thousands more indirectly employed by companies supplying to the project. The project has also generated opportunities for almost 90 apprentices and trainees to date.

Weather has presented the most significant challenge for the construction team. While the project was conceived as an emergency response to the worst drought in Victoria's history, what no-one could have predicted is that it would end up being constructed through the wettest summer in Victoria's history. Despite this, more than 14.5 million man hours have been worked to date to bring construction of the project to 87% completion.

First water for commissioning is expected to be produced from the plant around the middle of 2012. Once the design and construction of the project is complete, the plant will be operated and maintained by Degrémont Thiess Services for the next 27 years.



A worker at the Victorian Desalination Project.







# THE CONCEPT(ION) OF INVISIBLE INFRASTRUCTURE

The architectural team for the Victorian Desalination Project had a challenging brief indeed – how to address community concerns about visual impact, by integrating Australia’s biggest desalination plant into the Bass Coast landscape.

To succeed, architects peckvonhartel and ARM Architecture, together with landscape architects ASPECT Studios, developed a design which works with the environment, rather than against it, and which incorporates a large ecological reserve, complete with engineered dunes to provide visual and acoustic camouflage.

First, the team undertook extensive research into the international and Australian history of large infrastructure projects in sensitive environments. They also investigated the history of large scale land art, to see if this could inform a conceptual strategy for marking out a piece of land in other than an utterly pragmatic way. Finally, an extensive site analysis was undertaken. There was also important early collaboration with Architects AAE of Paris, who had specific experience with desalination and wastewater projects.

From the State Government’s design brief, a key design element for the architectural team was contextual harmony. The concept delivers a vehicle whereby all aspects of the project will meet the highest practicable environmental, architectural and landscape design standards, and that the project will make a positive contribution to the site and to the State’s reputation for high quality design outcomes.

The plans for the plant needed to address essential functional requirements, while achieving high quality design outcomes which integrate landscape and built components. This design also needed to facilitate an awareness and understanding of the unique coastal site, and promote pride among visitors to, and users of, the facility.

The final design concept integrated the team’s research and the functional requirements of the plant in a way which proved a key factor in AquaSure winning the bid.

“The overall marking of the land and the shapes of the dune system and building roofs were inspired by the land art of Michael Heizer and also the symbol of water, Aquarius the water carrier. The reinterpretation of the coastal dune system that was part of the pre-settlement landscape was a critical tool in giving effect to part of this concept” says Steve Ashton, Director of ARM Architecture.

The other, equally important part was the adoption of a ‘green roof’ system on some of the plant buildings. This system allowed for the clear and strong expression of the integration of the plant into the landscape, as called for by the brief, and became known as the ‘Green Line,” explained peckvonhartel Principal, Yvonne von Hartel.

“We arranged the dune system so that the entire plant would be substantially screened from all of the mandatory view points nominated by the State and required in the contract. In concert with this, the green

roof portions of the plant were shaped to create sloping and angular skylines, which will read as part of the dune system when viewed from a distance, rather than obvious built structures.”

The dune system and the Green Line were arranged to provide a carefully orchestrated entry sequence to the plant. The plant remains substantially concealed from the main entry on Lower Powlett Road, and is then gradually revealed as one traverses the entry road.

The design for the dune system was robust enough to allow for variation as work progressed, with no need to import fill, as all soil and sand was obtained from the project site. A massive 1.3 million m<sup>3</sup> of soil was used in engineering the dunes – enough to fill the MCG.

“The dune concept also provides acoustic attenuation, reducing noise to around ambient night time levels,” said ARM Architecture Project Architect, Wayne Sanderson.

Another key element of the design is the incorporation of one of Victoria’s largest ever ecological restoration projects, which had been previously cleared for farming and other uses – millions of trees, shrubs, grasses and other endemic coastal scrubland species are being replanted across the site’s open spaces. The combined architectural and landscape team has added features including timber walkways, bird hides, picnic areas, horse riding paths and walking trails, and also interpretive signage which explains to visitors how the dunes were engineered and other aspects of the history and environment of this area.

Design research and drafting commenced in October 2008, and the team has maintained a constant involvement since the award of the project in July 2009.

“We have contributed to or specified the products and materials for all built forms externally and for the interior fitout,” said Wayne.

“The forgotten children of these type of projects are often the ancillary structures. For this project, the booster pump station, the power compensation station, surge tank and water delivery points have all had the same approach taken of integration into the landscape. The compensation station for example, has stylized camouflage painted graphics and dunes around it, so there is a filtered view through the vegetation. Half of the water quality monitoring stations along the pipeline have timber shrouds and integrated earth mounds.”

Being appointed early in the bid phase allowed the design vision to become truly shared between the construction and consultant team. The architectural team and the landscape team literally worked side by side, both in the design phase and through the delivery of the project.

“This was a truly integrated design process that has maintained its clarity from start to finish, and the result is a testament to everyone who has been involved,” said Wayne.

“This is a redefinition of what it means to do an infrastructure project.”

“At the end of the day, we will have made a big environmental gesture. We will leave behind an improved landscape outcome, and return as much land to the community as possible,” said Yvonne.

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## ENGINEERING A CENTRAL NERVOUS SYSTEM FOR THE VDP

*LogiCamms deliver engineering and asset management solutions to a range of water operations.*

As the largest desalination plant in Australia, the Victorian Desalination Plant (VDP) requires innovative, leading-edge engineering solutions when it comes to its process control. LogiCamms, one of Australia's leading automation and control system providers, is delivering a Siemens PCS7 based Process Control System (PCS) for the VDP that will be the largest application of this technology in the southern hemisphere.

The PCS will control over 30,000 devices and all process areas in the plant utilising over 20 PCS SCADA servers, 30 work stations and 40 automation stations.

Innovative, customised solutions were developed to ensure quality outcomes, and the project's scale required comprehensive risk mitigation activities. The PCS engages the largest test system for Factory Acceptance Testing (FAT) activities, including all PLCs and servers fully integrated within the dedicated office environment. This aims to optimise time spent commissioning onsite, minimise potential risks of implementing the system on site, identify and deal with potential issues prior to implementation on site.

The PCS has also been designed to be fully redundant. A specialised document library for the plant was customised to client-specific process requirements. This ensures the system delivered has a high level of repeatability and value for the client's future projects.

LogiCamms undertook all design, supply and manufacture of all PCS panels, consultancy, automation stations (PLCs), SCADA servers and workstations. Up to 200 control panels will be commissioned at the site.

In delivering the VDP PCS, a team of approximately 25 engineers are working closely with the client from LogiCamms' dedicated Melbourne office. The panel manufacturing was done in-house by panel technicians at the company's control panel workshop.

LogiCamms is an ASX-listed engineering, project delivery and asset management provider. Core capabilities include multidiscipline engineering design from Front End to Detailed, EPCM projects and asset management solutions such as operational readiness (maintenance engineering, completions, competency assurance) and operational excellence (maintenance support, operations support, competency training). As a certified Siemens Solution Partner Automation, LogiCamms was awarded the Most Outstanding Partner for Industry Automation in 2010 which recognises their world class expertise.

LogiCamms supports Australia's premier water management operators and is a member of the Water Industry Alliance. The company's additional projects include the Transfer Pipeline and Pump Station for the Adelaide Desalination Plant, the Bird in Hand Wastewater Treatment Plant, and Water Corporations' Groundwater Replenishment Trial, which was a finalist in the 2011 PACE Zenith Awards. LogiCamms supports a range of additional industries and blue chip customers such as BHP Billiton at Olympic Dam, Incitec Pivot, Newcrest and Rio Tinto.

LogiCamms is an ISO-9001 certified operator with OH&S systems certified to AS4801. Many of LogiCamms' 450 staff are members of best practice groups such as Engineers Australia and the Australian Institute of Project Management. With offices across Australia including Perth, Brisbane, Adelaide and Melbourne, the company supports customers across Australia and internationally, including South Africa, South East Asia and Papua New Guinea.

### LOGICAMMS

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## ENSURING THE WATER FLOWS HOW IT OUGHT TO

With billions of litres of water going through the systems of Australia's largest desalination plant at Wonthaggi annually, one thing Aquasure needed to be certain of is an impeccable hydraulics package. For this, the project relied on the skills and experience of Cooke & Dowsett.

The company were commissioned to supply and install a full hydraulics work package, including site establishment, potable water, sewer, storm water, irrigation and fire service systems. A complex scope of works was involved, which required 46 of their plumbers on site, plus project managers, draftspersons, administrators and designers working behind the scenes.

Their team undertook tasks such as the setup of water supply for 'Wonthaggi Maggi', the TBM (tunnel boring machine); and fire, sewer, storm water and electric service excavation for the Clyde booster pump station. They also installed the potable water supply throughout whole site (excluding the administration building); assisted with procurement; installed irrigation systems for the living roof; provided HDPE welding, and design, inspection and certification of the hydraulics systems; and completed site establishment at Kilcunda.

Founded in 1992 by Scott Dowsett, Cooke & Dowsett have over 20 years of experience in the commercial plumbing industry. Directors Scott Dowsett and Chadd Cooke have collectively over 40 years

experience in the industry and strive to continue the development of Cooke & Dowsett into a nationally renowned company. The company now employs over 300 full time employees working on commercial and industrial projects across Australia, providing comprehensive estimating services, contract administration, construction management, and design & construct packages.

Cooke & Dowsett's speciality areas include hydraulics, Design and Construct, fire services, commercial and industrial plumbing, backflow device and install testing, drainage contractors, internal and roof fire sprinkler systems, and gas pipe and fitting installations. All work is delivered to a certified ISO9001 Quality Management Standard.

Currently Cooke & Dowsett has offices in Victoria, South Australia, Western Australia and New South Wales. Other current projects include Ararat Prison, another PPP Victorian Government project; Albany Health Campus in WA; Dandenong Mental Health; and the WEHI – Walter Eliza Hall Institute.

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## THE EXPERTISE WHICH ENSURES THE FLOW

Derek Gee Installations (DGI) have an outstanding history of GRP/fibreglass fabrication and installation projects, including Australia's first desalination plant at Kwinana in Western Australia, the Adelaide Desalination Plant, and most recently our largest, the Victorian Desalination Plant at Wonthaggi.

DGI initially worked on the underground pipework assembly for Aquasure, which involves fibreglass lamination and joints for up to 6km of subsurface high pressure pipes. They are also doing all the mechanical works for the Reverse Osmosis building, which includes an extensive and complex pipe assembly task. Up to 40 DGI staff have been on site since September 2009, with work continuing well into 2012.

"We have a long history with Degrémont. We worked with them on Kwinana, as the main fibreglass contractor," said DGI Principal, Derek Gee.

"We employ all our own Quality Assurance inspectors and design engineers, and our workforce training is very specific. Our company has third party accredited Quality Assurance to ISO 9001, and comply with current national safety standards."

Since 1995, DGI has been undertaking GRP/Fibreglass fabrication and Installation projects across Australia and internationally for projects including chemical storage facilities, industrial processing plants, desalination plants, waste water treatment, mineral processing plants, and mine sites. Their contribution can range from complete Turnkey projects through to installation only, and with a large workforce of trained

laminators on staff, DGI have the capability to undertake numerous projects concurrently, around the country.

DGI's on site project management includes development of site based specific installation procedures on behalf of clients. The company also has capabilities in tank manufacture, testing and installation, both offsite and in-situ; tank lining; ducting; concrete protection; remedial site repairs to plant and equipment; exhaust stacks; reclamation and site demolition.

As a leader in its specialist field, DGI offers clients an extremely high level of experience, in addition to the benefit of solid alliances with leading GRP/FRP component suppliers. This enables them to provide a complete plan-to-purpose solution. From initial planning stage, DGI's team works closely with clients on design, material selection, preparation of budget estimates, materials delivery planning, fabrication and installation programs through to final testing and handover.

The result is the excellence - when DGI are on-site it ensures projects like Desalination Plants can reliably deliver vital water supplies for many years to come.

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## LOCAL CAMOUFLAGE BY FYTOGREEN

To help the Victorian Desalination Plant blend into the landscape at Wonthaggi, leading roof garden innovators Fytogreen undertook the challenge of creating and installing the largest green roof in the southern hemisphere. The total roof garden area totalling over 26,000m<sup>2</sup> is split between three buildings, with roof pitches ranging from 3.5 degrees to 20 degrees.

"The focus has been to integrate the industrial buildings into the coastal landscape by designing a continuity of the indigenous plant species from dune to roof," said Fytogreen Managing Director, Geoff Heard.

"The roof pitch angles create a distinctive architectural expression of the "Green Line" and are by far the most complex roof garden design in the country, requiring significant irrigation design and control input. The overall flora design to recreate the ecology present on the primary and secondary dunes to the west and to withstand the significant winds has created a number of design firsts in the area of media/mulch stabilisation within static load constraints, to meet the storm stability criteria."

This was not something that could be achieved without extensive planning, preparation, testing, and a progressive installation and commissioning period by Fytogreen's trained technicians and subcontractors. Concept design and test roof began in January 2009 and installation on site began in February 2010, progressing as roof area became available and due to conclude in April 2012. Up to eight Fytogreen staff worked on site completing the project.

The green roof is not only an aesthetic plus, it contributes to the building's sustainable performance criteria by offering thermal and

acoustic insulation; sustainable water re-use for irrigation; increased biodiversity; and overall architectural integration with the landscape.

Challenges with the project included the very large site, liaison and co-ordination with other trades and scheduling use of the crane facilities, and the local climate of wind and rain with its ongoing impacts on a construction site. Species selection and availability also took some care to comply with the DA's indigenous provenance guidelines.

"This project has been a phenomenal learning experience and one that will stand Fytogreen in good stead, giving us greater capacity and experience to complete future projects with this level of complexity," said Geoff Heard.

Fytogreen has in excess of 10 years experience in design and construction of roof gardens for Australian conditions, with over 60,000m<sup>2</sup> of roof gardens completed throughout the nation to date. The Fytogreen Roof Garden systems can be adjusted to meet project criteria for any sector, from commercial and residential through to civil and industrial. Their successes show that adding some living green goes a long way towards delivering developments which are both more beautiful, and more sustainable.

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