UPGRADE, COMMISSIONING AND PARTNERSHIPS AT WEST WODONGA WWTP

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67th Annual Water Industry Engineers and Operators' Conference
Sports and Leisure Centre - Wodonga
1 and 2 September, 2004

WEST WODONGA BNR
WASTEWATER TREATMENT PLANT UPGRADE

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ABSTRACT

Two major wastewater treatment plants, the Howard Street Treatment Plant and West Wodonga BNR Plant, previously serviced the township of Wodonga. West Wodonga BNR Plant treated the entire industrial load and approximately a quarter of the domestic load generated by the township of Wodonga. Howard Street Treatment Plant, an older trickling filter secondary standard plant located within the township itself, treated the rest of the domestic load. For various reasons a decision was made to close down the Howard St plant and divert all flows to West Wodonga.

This paper describes the history & background, the selection process – Authority's expectations of an operating company, combining the old plant with the new, commissioning – hazop with site operators, introducing a site specific quality system, plant commissioning and why partnerships? It also describes the plant upgrade by PURAC in 2002/3 to provide advanced secondary treatment by Biological Nutrient Removal (BNR) process followed by UV disinfection. The plant also includes an advanced treatment process for production of high quality reclaimed effluent for re-use on and off site.

KEY WORDS

Biological nutrient removal (BNR), Tertiary treatment,
Partnerships, Bardenpho
North East Water (NEW) Design, Build, Operate (DBO)

1.0 INTRODUCTION

North East Water had two treatment plants which serviced the township on Wodonga, Howard Street and West Wodonga. Howard Street was a trickle filter plant, in the town limits which didn't meet the new EPA discharge requirements, so the decision was to close it down and send all flows to West Wodonga plant. To do this the West Wodonga plant had to be upgraded to cope with the increased flow and loads.

The nominal capacity of the West Wodonga BNR plant was exceeded under existing loading conditions and with the continued tightening of EPA requirements on effluent quality and the increased load expected from Howard St Plant before 2001, a significant upgrade of the West Wodonga Plant was required immediately.

1.1 History of The West Wodonga Purification Plant (WWPP)

This plant is located on Old Barnawartha Road, Wodonga West. Stages 1 and 2 consisting of an oxidation ditch were commissioned in 1986. During 1989, Stage 3 was constructed, adding biological nutrient removal facilities. Stages 4A and 4B were implemented during 1992 to 1994. This involved augmentation of the aeration capacity, modification of the BNR process to the University of Cape Town process, addition of chemical dosing facilities and construction of 2 additional clarifiers.

After completion of stage 4B in 1994 the plant had a capacity of about 81,000 equivalent population (EP) on a biochemical oxygen demand (BOD basis).

In 2002/3 the plant was upgraded by PURAC to provide advanced secondary treatment by Biological Nutrient Removal (BNR) using a 5 stage Bardenpho, process followed by UV disinfection. The upgraded plant has a capacity of around 130 000 EP on a BOD basis.

1.2 Why Partnership

North East Water wanted a large international water company to design, build and operate the plant in partnership with them so that the expertise that a large company has, could enhance NEW's total business performance over the contract term. This operating period of ten years plus the option of a further 5 years plus another 5 years on agreement was preferred to give the private company the incentive to provide a quality plant that would operate reliably in the long term. This, for example, resulted in selection of good quality mechanical plant that had proven local support.

There is also the opportunity to share the risk associated with the design, construction and operations of the upgraded plant and efficiency sharing with other treatment processes within the water authority. The partnership was also favoured by the Victorian Government as it puts the large commercial business in to the local water environment. The Design, Build and Operate (DBO) framework has similarities with BOOT schemes except that in DBO project the water authority funds and retains ownership of the capital works when they are completed.

1.3 The Selection Process

North East Water called for expression of interest to design build and operate the brown field West Wodonga Waste Water Treatment Plant. There were 14 interested parties that were short listed to 4 (prior to the Tender period) based on the information provided in their submissions, also the expertise of each party and the concept solution put forward. North East Water management and operators went and visited other authorities and councils that had dealt with the companies on the short list to find out back ground information so they could make the right decision. The four short listed parties were invited to submit a tender for the project. Three tenders were received by NEW and evaluated in accordance with predefined criteria. After the long arduous process Purac won the contract to design, build and operate the plant. Robert Proctor was the engineer who designed the plant. His expertise and ability to take on board the site operators comments has made it an operator friendly plant with quality effluent that meets the licence.

1.4 Combining the Old with the New

The plant upgrade was designed to utilize the existing plant and to continue to operate while the construction of the plant was in progress. This was done in conjunction with the site operators at planned site meetings on a daily basis. The input into the plant operations to make it an operator friendly plant was taken on board even as the plant was being built by the construction staff.

1.5 Commissioning

The upgrade was commissioned in early 2003. The commissioning process went smoothly helped by use of detailed procedures for each section of the plant. It was also helped by having already thoroughly tested the new PLC/SCADA control system off site.

Operating the plant through the commissioning process was the best way to learn how the new systems all worked. As Operations Manager I had a key role, and was given the ultimate responsibility for approving when and how commissioning activities would be carried out that affected the operation of the existing plant. One example of this was bringing the new bioreactor on line, as we had to build up activated sludge in the existing bioreactor and then split the sludge between the new and old bioreactors.

1.6 From a Water Authority to Private Company

The transfer from the water authority to the new private company was something that could be considered as a bold move after having spent 18 years at the authority. The contract was written so that the operators of the site had the option to be seconded to Purac or be relocated to a new site within the water authority.

After a lot of discussions with the Managers of North East Water & Purac, two of us decided to transfer across. This is a decision that I don't regret as it was a great way of learning the way a private company operates. We went from general operating of the plant to setting up site specific Quality & OH&S systems, setting up a new control room, office, visitors centre, setting up budgets and having input into the design and construction phase.

As Purac operates other plants in Redcliffe Qld and Wellington in New Zealand I have had the opportunity to visit these plants and now have been appointed the operations manager of the Redcliffe plant.

2.0 THE UPGRADED TREATMENT PROCESS

2.1 Wastewater Characteristics

The upgraded West Wodonga plant receives 11 ML/d on average of wastewater made up of domestic and industrial components. COD load ranges from 10 000 to 18 000 kg/d. A big challenge for plant operation is that around 75% of the total COD load is from a pet food factory and an abattoir. This makes the wastewater very variable in strength depending on their production cycles.

2.2 Inlet Works (Pre Treatment)

The inlet works was retrofitted to cope with the increased flow and now includes new items of:

- Variable speed Flygt N series inlet lift pumps;
- 2 auto step screens, screen bypass channel, vortex grit removal chamber, screening washing and compaction system, grit washing system, grit and

screening skip collection system.

2.3 Odour Control System

The Inlet Works has been identified as the only area that generates significant odours (typically hydrogen sulphide and methyl mercaptan). Close fitting covers have been installed over the various odourous areas and foul air blowers draw controlled amounts of air to the Odour Control System via ductwork.

The Odour Control System is a fully self controlled, two stage system comprising Biofilter and Activated Carbon technology. An exhaust stack and all associated instruments and controls are included.

2.4 Bio Reactors

The old Bioreactor was upgraded with new mixers and replacement diffuser membranes. There was also a need for a second new Bioreactor to be provided in parallel. Flow is split approximately evenly between the two bioreactors. The bioreactors are designed to provide biological nitrogen and phosphorous removal using a five-stage Bardenpho configuration, which comprises two anaerobic zones, two anoxic zones, two aerobic zones, a post anoxic zone and a post aerobic zone.

The new bioreactor is designed to form a fully integrated process with the old bioreactor. Rather than being based on an oxidation ditch race course configuration it contains segmented anaerobic, anoxic and aerobic zones.

2.5 Aeration System Upgrade

The existing oxidation ditch is supplied with air by two duty multi stage blowers with a third blower as a standby unit. There was also further air transferred into the existing ditch by four horizontal brush aerators that also provide circulation of the mixed liquor. The gearbox drives were at the end of their life so two were decommissioned and two Flygt banana mixers were installed in their place to improve the oxidation ditch circulation.

Three new positive displacement blowers (two duty and one standby) were installed to service the new Bioreactor and Aerobic Digesters.

2.6 Clarifiers

Provision of the additional bioreactor volume enabled mixed liquor levels to be reduced so that the three existing clarifiers could service the increased plant load and throughput. Clarifier 1 was fitted with a sludge blanket level detection to monitor for potential settling problems, enabling timely rectification.

2.7 UV System and Outfall

All flows to the river are disinfected by a Wedeco UV system, prior to discharging through the outfall to the Murray River. The outfall capacity is up to 15 ML/d under gravity and up to 20 ML/d using booster pumping. Higher flows are diverted to and stored temporarily in a purpose built flow equalisation facility.

The UV system treats all flows to the river. The system has a capacity of 20 ML/d of secondary treated sewage. Instantaneous flows in excess of 20 ML/d are directed to the Flow Balancing Basin via an automated overflow weir system at the UV inlet.

The Wedeco UV system features high output, low pressure lamps which achieve high power efficiency and low fouling and compact units. Lamp power is automatically varied to suit flow rate and measured (on-line) UV intensity. The system also includes in-situ automatic cleaning.

All treated effluent is monitored by a Greenspan online analyser for Phosphorus, Ammonia, pH and nitrate which is sent back to the citec programme.

Table 1: ***Effluent Discharge Data for month of May 2004***

Description	Units	Limit	Sample Date 7/4/04	Sample Date 14/4/04	Sample Date 21/4/04	Sample Date 28/4/04
BOD recorded	mg/L	10	<5	<5	<5	<5
SS recorded	mg/L	15	4	6	7	2
Total Phosphorus recorded	mg/L	0.5	0.22	0.12	0.22	0.19
Ammonia recorded	mg/L	5.0	0.5	0.6	0.6	0.4
Total Nitrogen recorded	mg/L	15	3.8	5.9	9.7	9.6
E.Coli recorded	No/100mL	1000	10	20	10	10
pH range	pH units	6.0-8.5	6.9	7.1	7.6	7.8

2.8 Sand Filtration for Offsite & Onsite Reuse

Deep bed sand filtration is provided by a system of modular continuous backwashing filters (Dynasand). The Dynasand system provides continuous filtration through a deep sand bed that is continuously being circulated and washed (by an air lift pump system). This means separate backwash pumps and clean/dirty water storage tanks are not required.

The Dynasand system is well proven in tertiary treatment applications and has the advantage of high solids handling/removal capability.

The filter influent is pumped to the filters from the UV channel inlet chamber and dosed with alum to assist coagulation/filtration the filtrate then gravitates to a chlorine contact tank system. The dirty water from filter washing flows by gravity back to the biological process. As the Dynasand system is modular, it is relatively simple to install new parallel units to increase re-use treatment capacity in the future.

The Dynasand system provides up to 60L/s of treated water for on and off-site re-use. Off-site reuse is sent to the golf course, Latrobe University, Tafe and Victory Primary School on a pressurised demand system.

2.9 Chlorine Contact

A 30 min HRT chlorine contact tank system is provided downstream of the filters. The feed is dosed with gaseous chlorine, to achieve a chlorine residual value as measured by an on-line analyser. The treated water is then pumped to the re-use main by 2 x 50% duty pumps.

The treated water quality is continuously measured by turbidity and chlorine residual online analysers.

2.10 Sludge Wasting and Thickening

Sludge is wasted as mixed liquor and thickened in a DAF unit to achieve a solids concentration of around 4% for feeding to the Aerobic Digesters. The dewatering centrifuge can be used as a backup thickening unit. The thickened sludge is pumped directly to the Digesters by helical rotor pumps.

2.11 Aerobic Digesters

Two digesters are provided, giving a solid retention time of 30 days. This, combined with the sludge age in the Bioreactors, gives a total age of 40 days, which is enough to ensure achievement of EPA Class B (T3) stability criteria.

The digesters are fed directly from either the DAF thickener or the centrifuge. The digesters are aerated by a diffused air system, fed by the same blowers as the new Bioreactor 2. The digesters are aerated on an intermittent basis in order to denitrify and therefore minimise return of nitrogen with the dewatering liquors to the Bioreactors. As the digesters are aerobic, the release of phosphorous is reduced. However, to ensure no adverse peaks are applied to the Bioreactors, alum dosing is also provided to the dewatering return liquor system which goes back to the inlet works to go through the process.

2.12 Sludge Dewatering and Drying

The digested sludge is dewatered by a new G-tech centrifuge, with the existing Tema belt press used as a standby facility. The combination of upstream sludge thickening/digestion centrifuge dewatering enables a dewatered sludge of around 15 to 20% solids level to be achieved.

The dewatered cake will then be dried out further to approximately 60% in a sludge drying facility which is still under construction. The area will have clay lining to minimise leaching and a drainage collection/return system. Biosolids will be stored on site for a maximum of 12 months until it is taken off site for agricultural reuse to farmland.

2.13 Control System

The upgraded plant has a comprehensive automatic monitoring and control system. Advanced on-line monitoring is provided including effluent nitrate, ammonia, phosphate

and pH.

Critical alarms are sent as text messages to mobile phones carried by the operators and each operator has their own notebook computer enabling them to remotely dial into the full control system.

3.0 CONCLUSION

After the augmentation has been completed, there is extra flexibility built into the plant and we have better control of the process in order to aid nutrient removal. This will mean more consistent compliance with our EPA discharge licence.

The transfer to the private sector has been a rewarding experience with a steep learning curve that I would not change. There are more opportunities with the new company for learning technology from the experienced staff they have and it has been a rewarding career move.