RECOVERY OF OXLEY CREEK SEWAGE TREATMENT PLANT POST FLOOD EVENT IN 2011

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ABSTRACT

The Oxley Creek Sewage Treatment Plant (STP) was partially inundated in the January 2011 floods that occurred in South East Queensland as a result of excessive wet weather. The flood levels fully covered several parts of the STP, significantly compromising our ability to operate. The sewer network was also fully covered in areas. The aim of this paper is to capture conditions and recovery plans prior and post flood. Prior to flood event all the equipment was properly shut down and Energex was notified to isolate the energy feed.

Return Activated Sludge (RAS) from FST's (Final Settling Tank) was returned to the bioreactors. This conserved the biomass allowing us to re- start the process after the flood. The flood water inundated the HV room, main inlet pump station, blowers, UV disinfection, and advanced biosolids treatment facility (Thermal Hydrolysis, Digesters, chemical dosing system and Centrifuges).

The Recovery program was carried out in two phases. The first phase was to recover the liquid treatment systems (Main Pump Station, Blowers, FST's and Disinfection). This allowed us to:

- Receive sewage from the network meeting public health and customer needs
- Meet the water quality requirement thereby to protect the receiving environment.

The second phase was the recovery of the biosolids system for our operating efficiencies.

KEYWORDS

Oxley Creek STP, January 2011 Flood event, Recovery, Sewage treatment

1.0 INTRODUCTION

The Oxley Creek STP (Sewage Treatment Plant) facility serves the south-western suburbs of Brisbane. It is a 250,000 EP BNR plant and discharges the treated effluent into the Brisbane River (53 ML/d). The Oxley STP was upgraded in 2006 by BWEA (Brisbane Water Enviro Alliance) with the target to achieve the following effluent quality.

Licence Parameters

- Biochemical Oxygen Demand (BOD) - 20 mg/L
- Total Suspended Solids (TSS) - 30 mg/L
- Total Nitrogen (TN) - 5 mg/L
- Total Phosphorus (TP) - 6.5 mg/L
- Faecal Coliforms - <150 cfu/100mL

The BWEA upgrade included a new inlet works (step screens, flow splitter and grit removal chamber), stage 5 bioreactor (oxidation ditch, 55 ML/d), 5 new Final Settling Tanks (FST) and UV disinfection. The stage 1-4 (currently offline) was upgraded to a biological nutrient process (Bardenpho process) which can treat 12 ML/d of influent sewage to meet the above effluent standards. When refurbished Oxley Creek STP will treat up to 65 ML/d a 325 000 EP BNR plant.

Oxley Creek STP has a centralised sludge processing facility called CAMBI, a Thermal Hydrolysis Process (THP). The purpose of CAMBI is to increase gas production and reduce the volume of biosolids trucked for beneficial reuse. The indigenous sludge and the sludge from Brisbane STP's are imported for processing at this facility. This facility has the capacity to process 280 t/day. CAMBI currently processes 120 t/d of indigenous sludge and 150 t/d of imported sludge.

The indigenous sludge and imported sludge are stored in a bin that serves as a storage buffer. The sludge from the bin is fed to the THP. In THP the sludge is subjected to a high pressure and temperature (5 bar at 155 ˚C) for 30 minutes and released to a low pressure vessel (1 bar) which results in the rupture of the biomass cells. This process increases the volatile content of the biosolids and enhances the biogas production during the digestion process. The biogas generated from the digestion process is used to produce energy through co-generation. The digested sludge is dewatered by centrifuge and trucked away for beneficial reuse.

1.2 Duration of Flood

Over the weekend of 8th and 9th January heavy rainfall occurred in the South East catchment. On Monday 10th January rainfall continued with the flood event starting to occur in the Brisbane region on the evening of Monday 10th January, with a rapid rise of water levels. The order to evacuate Oxley Creek STP was given at 7pm Tuesday 11 January and all shift staff moved to the Luggage Point STP and began remote monitoring. By 10.30pm Energex had isolated the district from the grid. Oxley Creek STP was fully cut-off by inundation on Tuesday 11 January late night and remained flooded for multiple days. On Friday 14 January at 2pm the first crews were given access to the site by the authorities.

2.0 DISCUSSION

2.1 Prior to the Flood Event

Effluent quality

Oxley Creek STP was meeting its effluent quality as required by the development approval set by the Department of Environment and Heritage Protection (DEHP). The summary of the effluent quality achieved is given in Table 1.

Table 1: ***Oxley effluent quality prior to flood event***

Quality Characteristics	Maximum release limit as in Development approval (DA)	Measured value
Biological Oxygen Demand	60 mg/l (maximum)	2.5 mg/l
Total Phosphorus	18 mg/l (maximum)	2.74 mg/l
Total Nitrogen	15 mg/l (maximum)	2.94 mg/l
pH	Between 6.5 and 8.5	7.8 (pH units)
Dissolved oxygen	2.0 mg/l (minimum)	6.73 mg/l
Suspended solids	90 mg/l (maximum)	7.33 mg/l

Note: *The measured value represents the averages of test results sampled between July 2010 and December 2010.*

Preparing for the flood event

An incident team was activated to manage the flood event. The incident team closely monitored the flood related information. The chief source of information was from Bureau of Meteorology (BOM) and Brisbane City Council (Flood wise). As predictions of the flood level raise were updated, we checked which parts of the site that had the potential to be inundated. This activity was undertaken by going through every general arrangement drawing and comparing the process equipment RL's with the predicted flood level. By undergoing this activity QUU had a good understanding of the processes that would be affected. This helped QUU to devise a flood event management plan for Oxley STP.

A plan was created to turn down the process in a deliberate fashion as we recognised the significance of the flood event. The RAS recycle was set to maximum a few hours before the flood event and returned most of the biomass in the FST to the bioreactor. This ensured the biomass is preserved in the bioreactor for the start-up of the process after the flood event. An evacuation was ordered at 7:00 pm on January 2011 and all staff were directed to Luggage Point STP. The plant was monitored remotely through SCADA (Supervisory Control and Data Acquisition) and cameras until the power was isolated.

Energex contacted QUU about isolation of power to Oxley. The power was isolated at 10:30 pm on 11 January 2011. Before the evacuation the operator turned off the sludge stream and THP. The main liquid stream was operating until the power was isolated.

2.2 During the Flood Event

When the power was isolated there was no SCADA and camera feedback from Oxley. A meeting was organised to initiate the discussion on the recovery plan. A concrete plan could not be derived at this stage as the extent of damage to the assets was unknown.

The site was completely isolated until clearance by emergency management authorities was granted. The QUU staff entered the site at 2:00 pm on Friday 14th 2011 to assess the extent of the damage. This include physical damage to site and the residual left over of mud, debris, chemical tanks, etc. that had been washed into tanks and onto site.

2.3 Recovery After the Flood Event

The main objective for QUU was in the order of the following priority

- Pump the sewage from the catchment
- Primary treatment of the sewage before discharging to receiving water
- Recover/recommission secondary and tertiary treatment to meet the DA requirement
- Recovery of sludge handling system

The Oxley Creek STP recovery was undertaken in two phases. The first phase was the recovery of the liquid stream (first three dot points mentioned above). The second phase was the recovery of the sludge handling system (dot point four).

The recovery costs to date from the January 2011 flood at Oxley Creek STP are $32.1M.

During the first site access it was noted the following assets were damaged:

Table 2: **Processes Damaged by the Flood**

Process/Equipment	Status (fully or partially inundated)
HV (High Voltage) switch room and associated transformers	Fully inundated
Inlet Pump station	Fully inundated
Stage 1 to 4 bioreactors and FST's	Fully inundated
Stage 5 FST's including RAS pumps	Fully inundated
Stage 5 blowers and switch board room	Fully inundated
Sludge processing stream (THP, Belt Filter Press, Centrifuge, Boiler, Co-Generation, Digester Compressors, Pumps, Chemical storage, etc.)	Fully inundated
UV and chlorine disinfection	Fully inundated
Service water and recycle water system	Fully inundated
Odour Control Units (OCU's)	Fully inundated
Fibre optics and PLC's	Fully damaged
Security gates and fencing	Fully damaged

The following assets were not affected by the flood

- Inlet pumps switch board
- Inlet works (Step screens, Grit removal and switch board)
- Bioreactors (biomass in the reactor was unaffected)

The images of Oxley Creek STP before and during the flood event is as follows

Oxley before flood as on 12/09/2010 Oxley during flood as on 13/01/2011

Figure 1: ***Oxley Before and After Flood***

Pump the sewage from catchment (Phase 1 recovery)

As the main pumps were inundated, temporary pumping arrangements were setup to pump sewage from the catchment. Six Sykes pumps and two submersible pumps were sourced. The sewage from the wet well was directed to the inlet works. The submersible pumps were powered through a diesel generator loaned from Energex. This occurred within 24 hours of gaining access to site. The main pump station was restored in two weeks and the temporary pumps were stood down.

It should be noted that the HV parts had a 14 weeks lead time and the whole site was powered by the generators.

Primary treatment of the sewage (Phase 1 recovery)

The inlet works were not affected by the floods. As the HV switch room was damaged in the flood the inlet works was powered by the generator. The sewage that was discharged to the environment was primary screened and grit removed. This arrangement was made within 48 hours.

Treat the sewage to meet DA requirement (Phase 1 recovery)

The biomass in the bioreactor looked septic as it was not aerated. The examination of the sludge under the microscope showed poor activity. Investigations into sourcing seed sludge were undertaken and were found that it was not economically feasible. In two weeks one blower was made available for aeration. It was noted on the next day that the black coloured sludge turned to a light brown in colour, indicating positive activity of the biomass. This showed that the biomass had been dormant and as soon as the aerobic condition prevailed it regenerated. A part of the sewage from the inlet works was directed to the bioreactor to slowly restart and rebuild biomass volume. In three weeks time all the blowers were available for treatment.

The bioreactor started treating 100% flow in five weeks and was compliant with the DA requirement. A Temporary Environmental Management Plan (TEMP) was in place until 23/04/2011, which permitted QUU to release non-compliant effluent to the receiving environment. This allowed QUU to recommission the plant in a prudent manner while allowing DEHP to ensure any potential environmental harm from the flood was minimised. The monthly averages of the effluent quality is shown in the below table

Table 3: ***Effluent Quality Characteristics After Flood Event***

Quality Characteristics	January	February	March	April
Biological Oxygen Demand (BOD)	81.25	66.56	6.88	2.5
Total Phosphorus (TP)	10.83	5.52	0.54	2.18
Total Nitrogen (TN)	13.93	20.56	6.39	1.6
pH	7.47	7.53	7.89	7.90
Dissolved oxygen (DO)	4.63	5.02	5.61	6.33
Suspended solids (SS)	31.33	28.42	8.03	5.63

It should be noted that the first compliant sample was recorded on 21/02/2011 with BOD, TP, TN, pH, DO and SS being 2.5, 0.01, 2.8, 7.6, 6.5, and 2.5 respectively.

Most of the equipment was operated in manual mode as the fibre optics and PLC's were damaged. This made the SCADA unavailable, needing an increase in plant inspections. The SCADA was fully reinstated in early June 2011.

Recovery of sludge handling stream (Phase 2 recovery)

The recovery of the sludge handling system was staged to match up with the requirement of the process i.e. as we made more biomass, we needed the system. When phase two started the liquid stream was fully recovered and the biosolids production was at its normal rate (120 t/day).

As the digestion process was not available it had the following impact on the business:

- Since there was no volume reduction, the sludge produced on the site required transportation by the sludge trucking contractor. This triggered an increase in the number of truck loads by 40%.
- A temporary loading facility was required as the existing setup does not allow the diversion of sludge to the truck if the THP is unavailable.

The recovery of the THP, digesters and centrifuge was awarded to a contractor and was commissioned in October 2012.

3.0 CONCLUSION

To summarise, the rapid recovery of Oxley Creek STP was due to pre-planning and the work of an efficient team. The willingness and the effort of the QUU work force and the contractors to recover the asset was outstanding. A few examples worthwhile to mention would be

- The workforce worked in 12 hour shifts with the available amenities and resources
- Off-site procurement team assisted in sourcing resources in a timely manner
- Assistance offered by other utilities and consultants
- Workforce showing the ability to step out of the comfort zone working towards a common goal

Below are some of the things which can be done in a better way:

- Deciding who has the authority to delegate in early days following the event
- Reducing delays in the procuring resources due to procurement policies which can be simplified
- Documenting the movement of procured items. (e.g. on hire- off hire)

4.0 ACKNOLEDGEMENTS

I would like to thank the support of all people who assisted in the rapid recovery at Oxley Creek STP following the January 2011 flood event. Every person involved gave their best.

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