Handover Report

Kuala Langit Power Plant

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Contents

Project Overview

In January of 2016 Mr Clive Hawkes of Quantum Filtration Medium along with long-time colleague and water treatment engineer Mr Andrew Mortlock conducted a series of site visits to assess the options for upgrading the water treatment plant supplying water to the Kuala Langat Power Plant (KLPP). The goal was to highlight low cost options with a low impact on plant serviceability to increase the plant performance, efficiency and reliability, and ability to better cope with the seasonal load changes experienced in the raw water supply.

There are four mains areas of the plant where the potential for considerable improvements were identified.

- The possibility of adding bore water to the raw water supply
- Clarification of the raw water before entering the plant
- Optimisation of the flocculent/polymer dosing program (inc. type and dosing rate)
- Changing of the media in the rapid sand filters to DMI65

BORE WATER ADDITION

It was suggested that the area surrounding the plant be assessed for suitability and potential quality and quantity of several bores to add to the plant raw water supply. The addition of bores would not only provide greater flexibility in terms of seasonal blending with river water to ensure sufficient quantities of water in the dry season, but could also be used to lower suspended solids and turbidity loadings on the plant during the wet season.

There is a likelihood that there will be traces of iron and manganese in the bore water, but the use of DMI65 filtration media (see below) will remove this and provide an improvement to the usual mechanical filtration duties.

CLARIFICATION

The high turbidity and suspended solids levels in the raw water could be greatly reduced by clarification prior to entering the water treatment plant. The existing plant is fixed in size and capacity, however a pre-clarification stage will dramatically reduce the load on the current plant.

A traditional clarifier and upstream floc/polymer dosing system to handle 1ML/hr would cost well over USD $1M and take up a considerable land area to install and was therefore not practical in this case. With a very low retention time this type of system would also require very high chemical usage. We did however recognise that the existing raw water dams (Lagoon A in particular) could potentially be modified to act as a clarifier.

Due to the location of the inlet pipe and the balance pipe (which would become the outlet pipe transferring to Lagoon B) a wall could be created to divert the incoming water around the lagoon to avoid short circuiting which would greatly reduce settling time in the lagoon **(Figure 'A')**.

This would also reduce the requirement for sludge removal as a large percent of the solids will settle within the smaller walled off area of the lagoon **(Figure 'A')**. A vacuum pump could be used with automatic valves to select which line would be periodically pumped out.

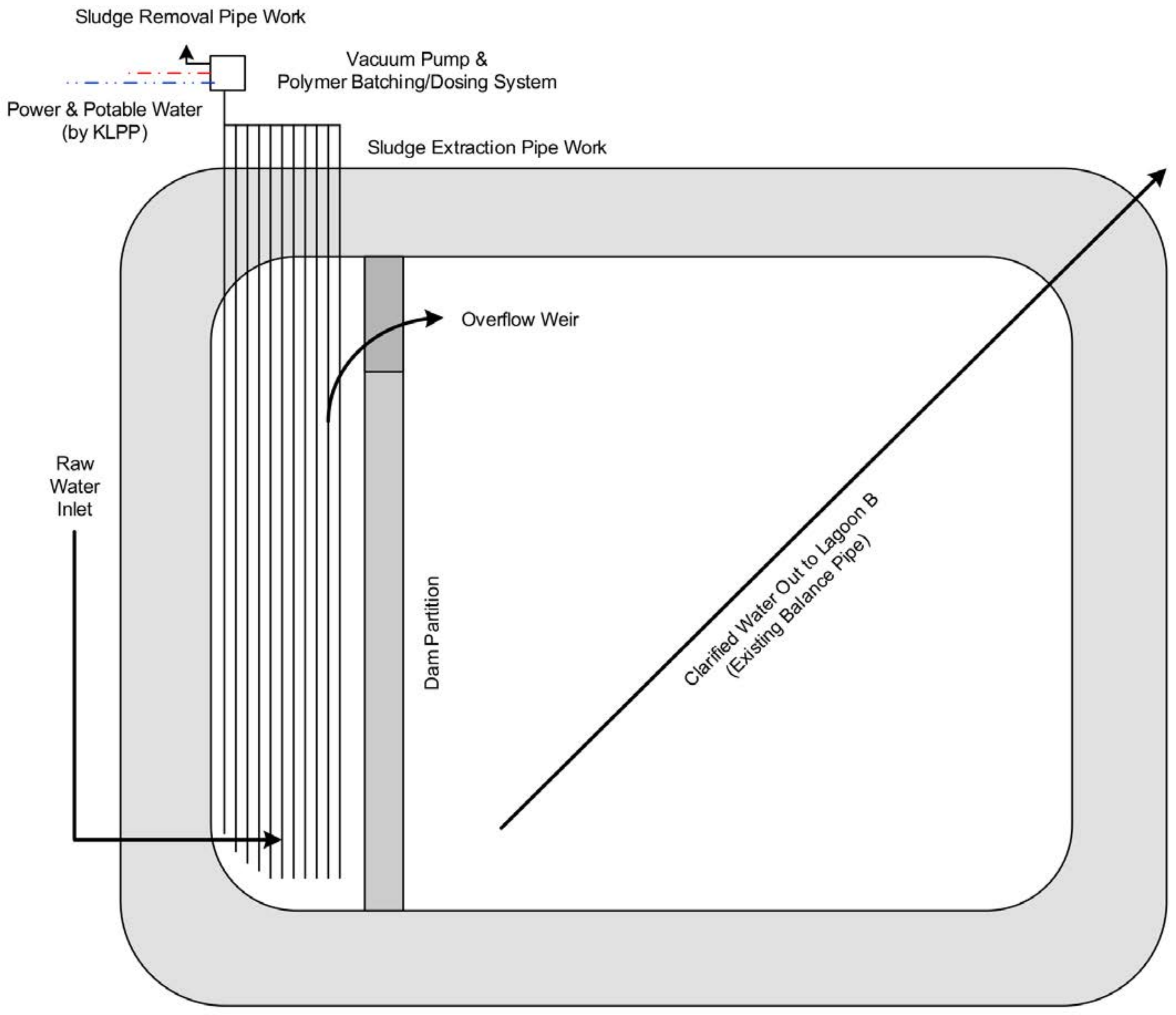


Figure 'A' - Proposed Lagoon 'A' Modifications

Ideally, polymer preparation and dosing system near to the lagoon inlet would allow mixing in the transfer line to the lagoon. As the river intake is located around 1km from the plant it is preferred that the dosing takes place within the plant area. In this case the polymer should added into the pipe before the raw water enters the lagoon to allow for maximum mixing as the water enters the lagoon. This required an additional polymer preparation & dosing near to the lagoon inlet.

Rather than build another liquid polymer system similar to the existing unit at the water treatment plant, we suggested a powdered polymer batching system be installed to greatly reduce polymer costs.

The diagram below highlights the proposed changes to the treatment process.

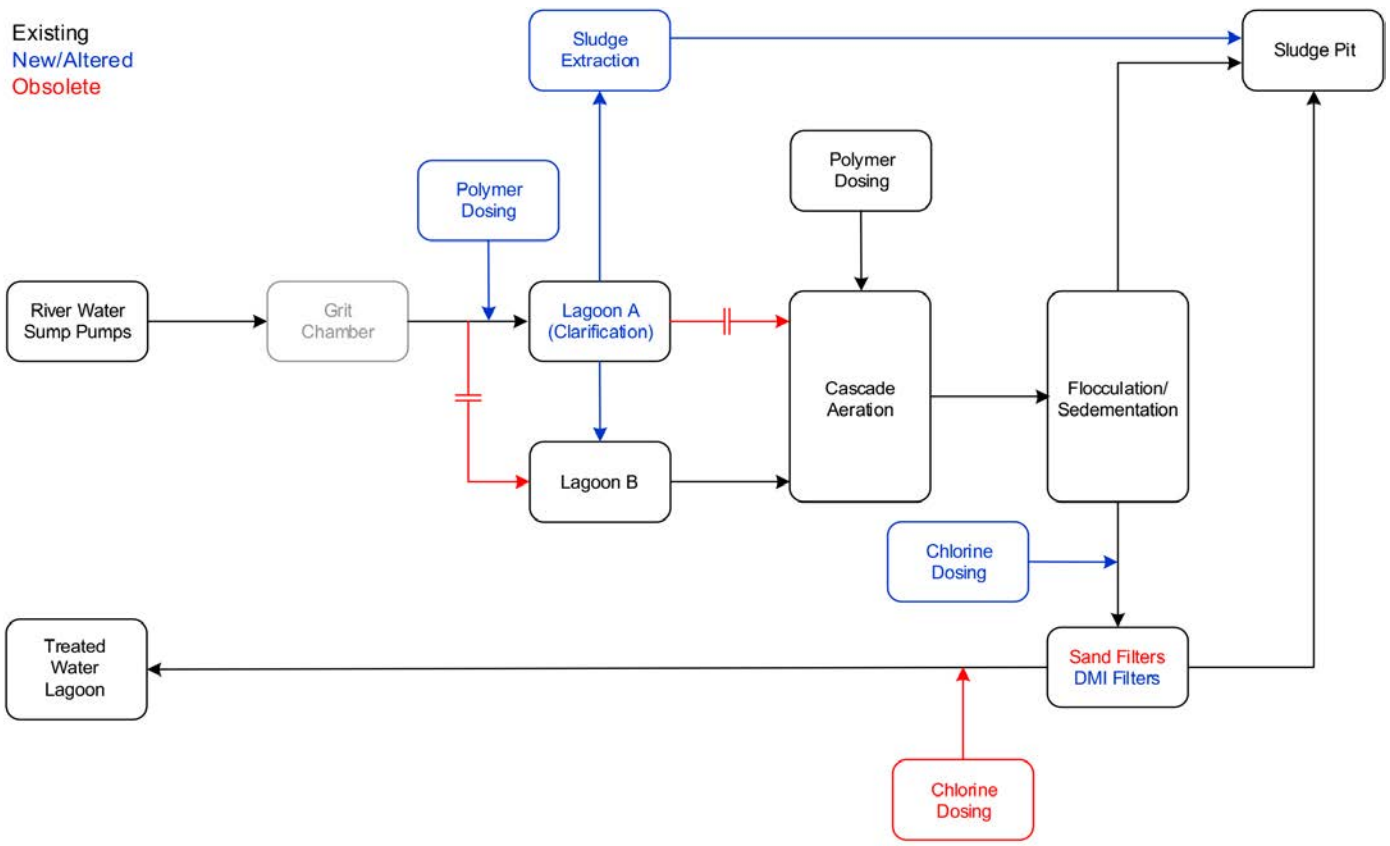


Figure 'B' - Recommended changes to the existing water treatment process

POLYMER OPTIMISATION

A range of polymer samples were supplied during the site visit. Jar testing has been carried out using the range of samples and highlighted a particular polymer most suited to this raw water. A local polymer supply company is able to supply a very similar product in powdered form and at a very reasonable price that would suit the mixing/batching system mentioned above.

MEDIA CHANGE-OUT IN RAPID SAND FILTERS

During our visit one of the rapid sand filters was drained for inspection. The sand in the filters has never been changed and is now very hard-packed and is in need of replacement. The filter was filled whilst we were watching and the infiltration rate of the incoming water was very poor with most of the water just flowing across over the top of the sand and down through cracks in the hard packed sand rather than down through it. We proposed to replace the media with DMI65 filtration media. **(Photo 1)**

The DMI65 will remove the existing and cope with any rise in iron or manganese levels that can be encountered in raw water sources with varying quality. The DMI65 requires a low level of free chlorine (0.2-0.3mg/L) to activate the media. This is easily achieved as it only requires moving of the existing chlorine dosing point to just prior to the media filters. The chlorine residual will remain and still act as disinfection for the treated water lagoon.

The DMI65 also provides the perfect filtration coefficient resulting in excellent mechanical filtration lowering suspended solids and turbidity levels.

Whilst undergoing the media change out we recommended replacement of all filtration nozzles and inspection & repairs where necessary to the actual concrete filters as site staff had already noticed some nozzles that had come free and some damage to the filter floors. **See photo 2 & 3 (below)**

Photo 1

Photo 2

Photo 3

The addition of the DMI media will and replacement of the filtration nozzles will improve not only the quality of water from the media filters, but also the quantity of water through the filters.

FORMAL PROPOSAL

A formal proposal was drawn up provided to KLPP staff. Quantum was then asked to provide a formal quotation for the proposed works. Quantum then sort quotations from local contractors to complete the recommended work on-site. This was an open book process with all local contractor quotes passed on to KLPP staff.

After all of the KLPP concerns were addressed and the scope and cost of the project negotiated Quantum was awarded the project in October 2016.

LOCAL CONTRACTOR

In liaison with KLPP local engineering firm EXPG were selected to complete the practical engineering side of the project. ExPG have worked with KLPP in the past with excellent results and have a proven record of completing projects in Malaysia.

ExPG
ExPG Engineering Sdn. Bhd.
Co. No. 641967-D

Upgrading the Water treatment Plant

ExPG were mobilised to site in early November 2016. Site inductions were completed and work commenced immediately.

BORE WATER ADDITION

After several test bores were dropped around the KKLP site it was deemed that the yield and quality of the bore water produced were insufficient to warrant the expense of utilising bore water to supplement the current river water supply to the water treatment plant.

MEDIA CHANGE-OUT IN RAPID SAND FILTERS

The water treatment Plant can run at its current capacity using only three of the 4 rapid sand filters - providing that he three 'in-service' filters are fully functional. Before taking any of the filters offline approval was granted by KLPP staff ensuring the serviceability of the remaining three filters before commencing any work.

The following work was conducted on all four of the media filters with each filter taking around six weeks to refurbish, commission and bring back into service. Due to the poor condition of the existing media and the difficult access to the media filters the old media was manually removed by a team of local labourers **(4).** The sand was removed and disposed of in an on-site landfill. The walls, floor and pipe work of the filter were then high pressure cleaned to remove the many layers of built up fouling throughout the filter.

Photo 4

Photo 5

Photo 6

(Photo 5 & 6) Once the filters were thoroughly cleaned the old filter nozzles were removed. With the nozzles removed, several cycles of filling and dumping the water from the filter were repeated in an effort to clear any sand from the flow cavity beneath the filter floor. Where a build-up of sand was detected (due to filter nozzles blowing out) the high pressure hose was inserted through the nozzle anchors to break up the sand and allow flushing.

Investigation of the filter floors conducted early on in the process highlighted a need for refurbishment and preventative maintenance. This was included in within the scope of work for the project. The repairs to the filter floor where filter nozzles had blown out and coring, re-grouting and a replacement nozzle anchors were required were quoted on a 'per nozzle' basis.

At this stage of each filter refurbishment an inspection was carried out by KLPP staff to assess which nozzles anchors were to be replaced.

(Photo 8 & 10 - next page) All of the filter nozzle anchors were tapped out to both clean the thread and assess the condition of the surrounding concrete. Half inch BSP bolts were left screwed into the nozzle anchor to ensure that they remained clean throughout the re-grouting and epoxy floor coating processes.

In areas where remedial work was required the anchors were replaced and re-grouting performed around the anchor stem. The figure below shows the extent of the repairs carried out.

Once the grouting had set the entire floor of the filter was double expoxy coated to prevent similar damage to the filter in future.

When the expoy coating was dry a further inspection was carried uot to assess the condition of the filter floor and repairs prior to installing the new filter nozzles.

Over the course of the upgrade all 11,250 fiter nozzles were replaced. The replacement nozzles wer of a finer slot spacing to cater for the finer DMI65 media.

Before adding the course sand and DMI65 media an aeration test was completed on each filter to ensure the security of the nozzles and check for an even flow of air across the filter area. The aeration pipe work was also cleaned and expoy painted.

On staisfactory completion of the aeration test the filters were drained and another check carried out to ensure that each nozzle was firmly in place.

A 100mm layer of course sand (1.6 - 3.2mm) was added to the filters. This layer of course sand protects the filter nozzles from potential blockages from fine media.

With the course sand spread evenly over the base of filter the DMI65 filtration media was added. Again, due to the poor access to the water treatment plant the media was added manually using 21kg bags. A 600mm layer of the DMI65 was added to provide suffiencient filtration bed depth and allow for a 400mm freeboard to prevent loss of media during the backwash cycle.


Photo 7


Photo 8


Photo 9

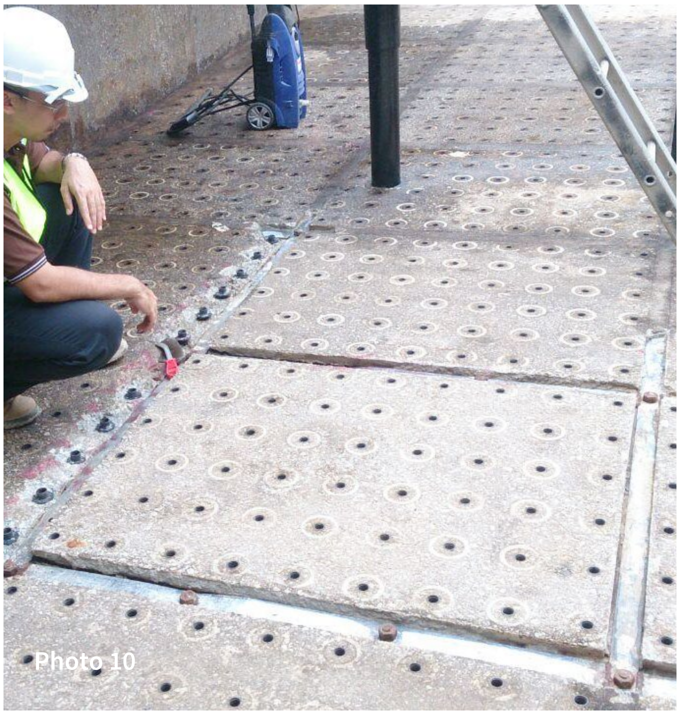


Photo 10


Photo 11


Photo 12


Photo 13

(Photo 12 & 13 - above) The filters were now filled with water and 200L of liquid chlorine was added to condition or activate the DMI65 media. This solution was left to soak overnight to give the new media the best possible preparation. KLPP staff relocated the process chlorine dosing point back to the inlet of each filter to ensure that there is free chlorine avaiable to the media during normal operating conditions.


Photo 14


Photo 15

(Photo 14 & 15 - above) The following morning the filter is ready for commissioning. Several cycles of backwashing are required to flush the chlorine solution and remove the DMI65 'fines' from the filter.

(Photo 16 & 17 - below) After five or six backwash cycles the water in the filter becomes clear. The water passing out over the overflow is clear and on completion of the backwash you can clearly see the new DMI65 media.


Photo 16


Photo 17


Photo 18


Photo 19

(Photo 18 & 19 - above) At this point the filter is commissioined and ready to be brough back on-line.

Modifications to Lagoon A

Lagoon A was drained so construction of the wall could commence. Although the solids were removed from the lagoon less than 1 year before there was well over 1 meter of mud in the base after draining. KLPP had the solids removed from the settling side of the lagoon down to around 600 - 1000mm - at this point the mud was so hard packed that it would require heavy machinery and possibly cause damage to the liner to remove.

(20) It was necessary to excavate a five meter strip of the solids along the path of the wall down to provide access to the liner. The initial plans for construction of the wall involved concrete footings. As the solids were cleared down to the level of the liner there was water pushing up from beneath the liner. Hydrology tests indicated that the water table in the area of the lagoon is too high for footings to be constructed at the required depth.

(21) An alternative plan for a floating wall connected between two concrete structures on each side of the lagoon was put forward to KLPP staff. After a little fine tuning and confirmation that the 10 year warranty on materials and workmanship would remain KLPP staff signed off on the design and construction commenced.

The liner material was cut at both sides of the lagoon to allow excavation and formwork for the two concrete walls.

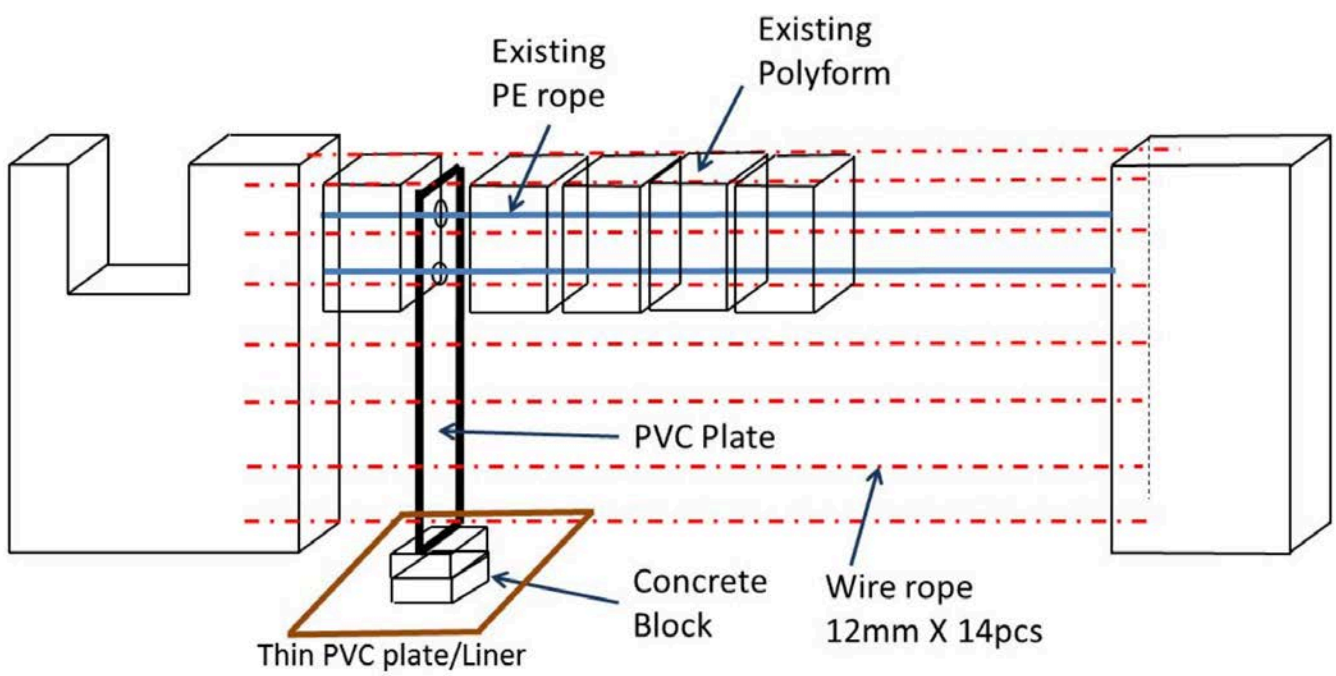
(22) Large poly foam blocks were used to float the top of the wall. The poly foam blocks were held in position by 50mm polypropylene rope strung across between the two concrete wall structures. Addition polypropylene ropes were used to hold the floating liner in place. The ropes were held in place with PVC brackets along the length of the wall to maintain spacing and form the shape of the wall.


Photo 20


Photo 21


Photo 22

(Figure C - below)



(24, 25, 26) 16mm wire cables were used a key points across the length of the wall for additional strength.

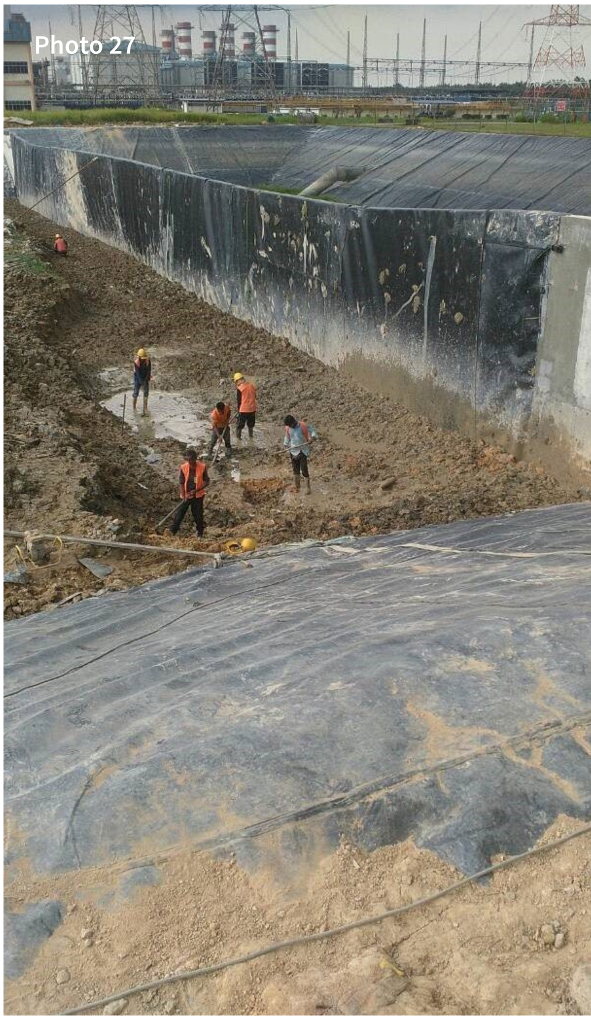

Photo 24

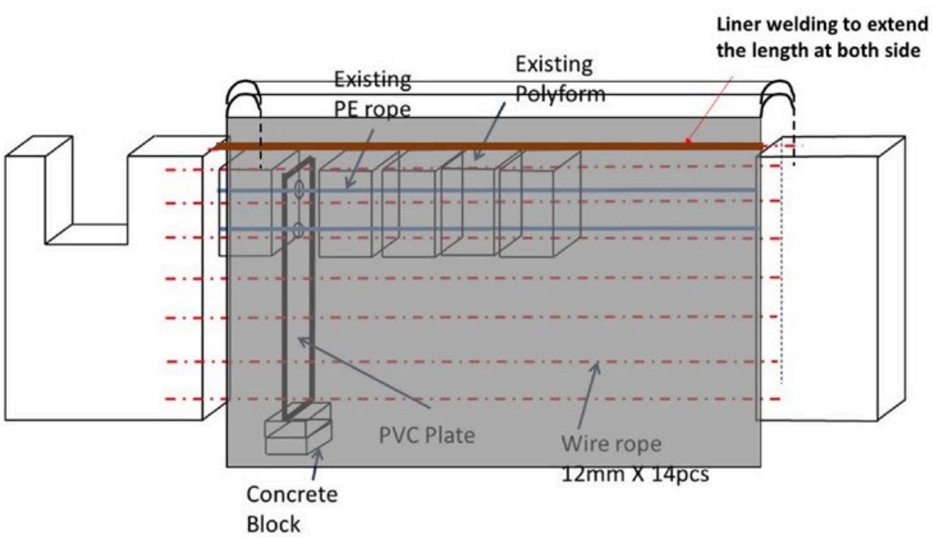

Photo 25


Photo 26

(27) The liner that was cut on the sides of the lagoon was reinstated and sealed against the concrete ends of the wall. The lower sections below the water line were welded to liner material cast into the concrete structures to ensure that no water losses occur.

(28, 29) With the basic structure or skeleton of the wall completed 2mm PE liner material was draped over the wall and welded to the existing liner in the base of the lagoon.





(above) sheets of liner material were then welded together.

Polymer Batching and Dosing System

Due to the high cost of liquid polymer a powdered polymer batching system was installed. The system was fabricated by a local supplier and installed inside the new equipment shed provided to house to polymer and sludge extraction systems. **(Photos Za, Zb & Zc)**

Photo Za

Photo Zb

Photo Zc

(Photo Zd) A polymer pump set was also installed with pipe work allowing the dosing of polymer into either the grit chamber or the inlet pipe to lagoon A.

SLUDGE EXTRACTION SYSTEM

As the addition of polymer aids settling in the inlet side of lagoon A (settling chamber). 100mm polyethylene pipes with holes drilled along the length were installed along the base of the settling area. Each of the 12 pipes has a check valve and automatic actuated valve attached and are connected to a common sludge removal manifold.

Photo Zd

Photo Zf

Photo Zg

(Photo Ze) A large vacuum sludge pump was installed to suck the sludge out of each line periodically. An automatic controller has been provided to allow for full automatic sludge removal or manual control over the pump and each individual valve through a series of control switches on the new distribution and control panel installed in the new equipment shed.

SAMPLING AND TESTING RESULTS

The main purpose of the upgrade was to increase the reliability of the plant across varying river water inlet conditions by reducing the high levels of solids and turbidity prior to the main Water Treatment Plant (WTP).

The table below was provided by KLPP staff as a guide to expected river water Total Suspended Solids (TSS) and Turbidity (NTU) values across the wet and dry seasons.

TABLE 1		
	DRY SEASON	WET SEASON
Total Suspended Solids (TSS)	< 70	150
Turbidity (NTU)	< 100	200

Throughout the sampling period we have seen the river water TSS as high as 600 and NTU as high as 1000, while the outlet of lagoon A has recorded average measurements of 38 and 58 respectively. This shows the ability of lagoon A post modifications to cope with a wide range of inlet water quality conditions whilst maintaining consistently low levels of TSS and Turbidity into lagoon B and on into the main WTP.

(Photo Zh) The photo below shows the inlet side of lagoon A on the left and the outlet to lagoon B on the right of the lagoon wall.

Photo Zh

The main goal of the upgrade was to reduce TSS - dropping most of the solids out in the settling chamber and then a high percentage of the remaining solids in the larger area of lagoon A. This will have an enormous impact on the amount of solids deposited in lagoon B, and further flow on to reduce the cleaning requirements of not only lagoon B, but the plate clarifiers in the main WTP and then eventually onto a reduction in backwash of the media filters.

The photo below shows the flocculation and suspended solids in the settling chamber after the addition of polymer.

The initial target for the upgrade was a percentage reduction across the lagoons of 90%. While we have seen percentages >90% during times of high rainfall where we see high TSS and turbidity, it will be impossible to achieve 90% when the incoming water is far cleaner. For example, where we see figures of 53mg/L TSS and 69 NTU turbidity, a system with flows as great as experienced here with a fixed volume (reduced now by the build-up of solids in lagoon B) will never produce results of 5.3mg/L and 6.9 NTU straight from lagoon B. In times like these the carryover of solids into lagoon B is so low that it is still in fact flushing or cleaning the lagoon, and providing clean water to the main plant - with figures as low as 14mg/L TSS and 25 NTU turbidity.

Trials were run at higher polymer dosing rates and concentrations to ascertain the benefits. There is no doubt an improvement in water quality can be achieved when more polymer is added. At 2 ppm of polymer at the inlet to lagoon A the effect was minimal. At 3ppm the additional flocculation was clearly noticeable, but the difference in water quality at the weir would in our opinion not warrant the additional costs.

It would be possible to achieve 90% reduction more often and at lower incoming TSS and NTU, but the cost would be 6 times the current polymer dosing programme costs and this is not in line with the objectives of the project.

Sampling Programme

To highlight the effectiveness of the lagoon A modifications sampling and testing have been carried out over the past month. Inlet water quality samples need to be compared to samples taken at the overflow weir, at the outlet of lagoon A and also at the inlet to the cascade aerator to assess the flushing and cleaning of lagoon B. Samples have been taken and tested twice daily throughout the course of commissioning.

The diagram below shows where in the system samples have been taken. The sampling points are described as follows:

Sample Point A - Inlet water quality from the river as measured at the grit chamber

Sample Point B - Water quality before the water crosses the weir at the end of the settling chamber of lagoon A

Sample Point C - Water quality at the balance pipe (outlet) between lagoon A and lagoon B

Sample Point D - Water quality at the cascade aerator or inlet the main water treatment plant

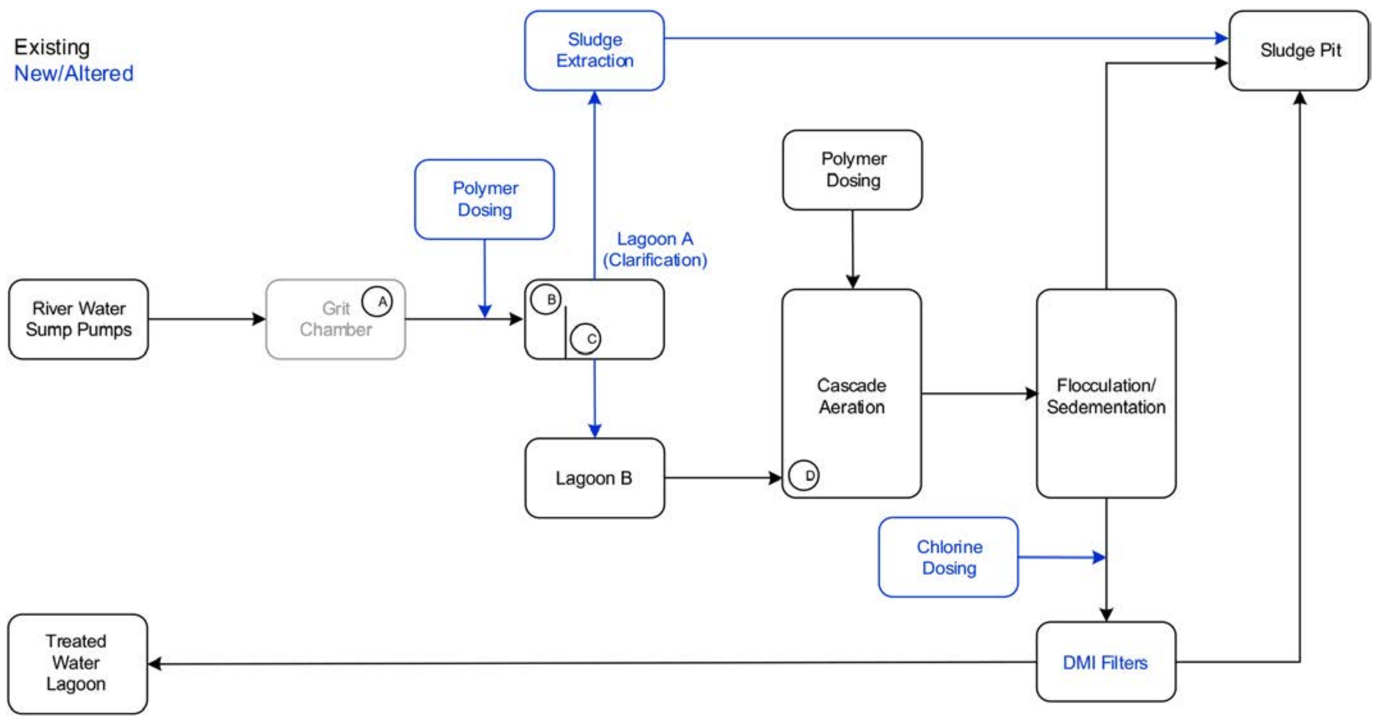


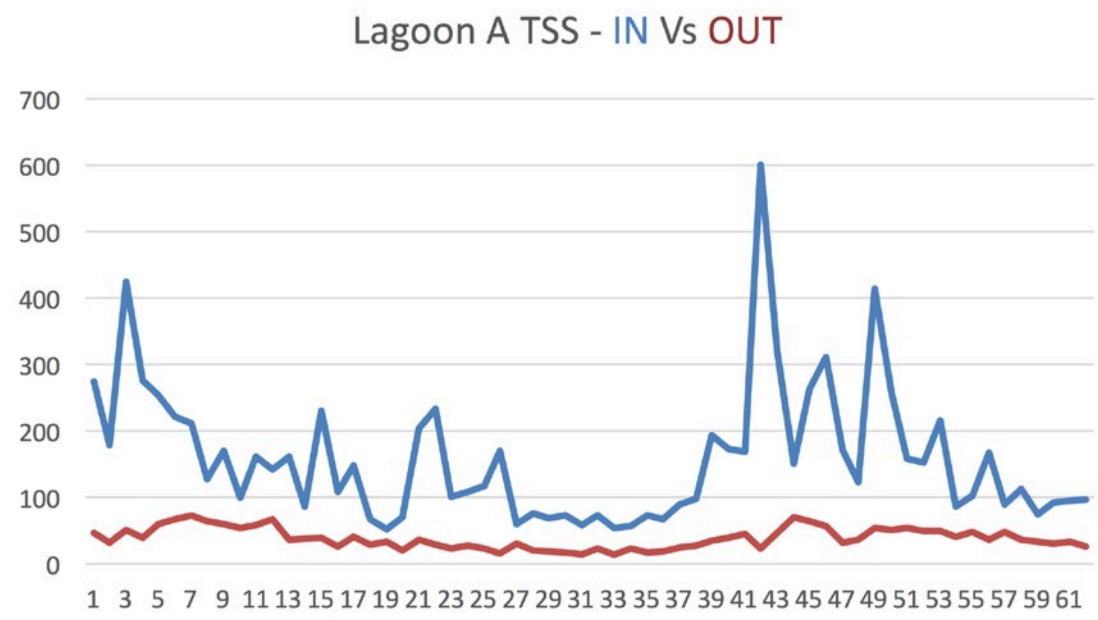
Figure 'C' - Test Programme Sample Points

The photo below shows the effect of the polymer dosing and the lagoon wall in separating the dirty inlet water from the clean side of the weir - Sample Point B

Sample Results

The sample results have been recorded and presented as a series of graphs below.

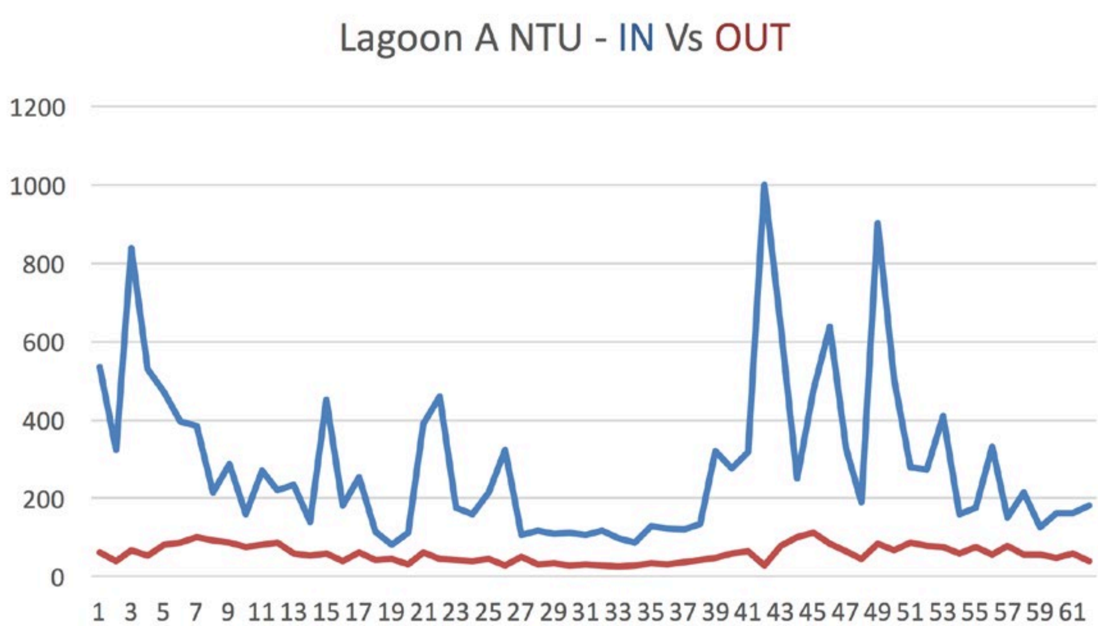
Graph 'A' - Inlet TSS (A) Vs Lagoon A Outlet (C) TSS



Graph 'A' highlights just how much the river water can vary, not only across the seasons, but daily depending on local and upstream rainfall.

With a peak TSS of 600 and an average inlet TSS of 159 you can see that the outlet of lagoon A has been maintained generally within 20 - 70mg/L at an average of 38.6mg/L (the start of commissioning was spent tuning the polymer dosing rates and dose point for best performance).

Graph 'B' - Inlet NTU (A) Vs Lagoon A Outlet (C) NTU



Sample Results

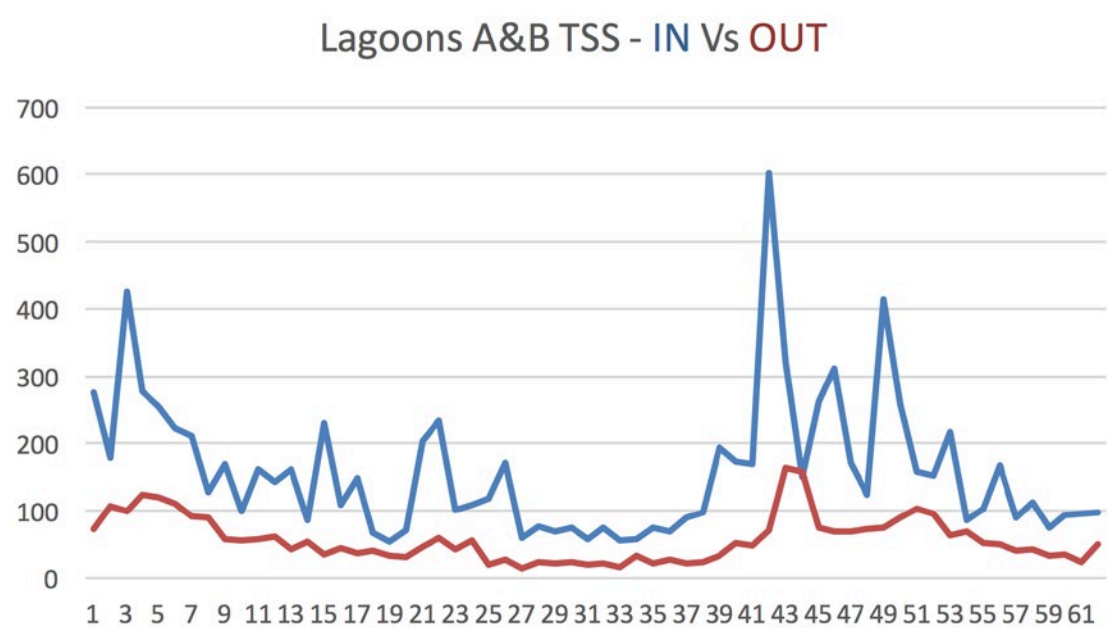
Graph 'B' - Results (continued)

Lagoon B is currently around 75% filled with sediment and sludge. The first part of commissioning was spent trying to clear lagoon B of the unsettled solids and undiluted river water it was being filled with prior to the upgrade. The results from lagoon B have not been as high as expected during the design stage of the project. The design was carried out using the lagoon drawings for volume and retention calculations.

Due to the extremely high amount of solids in lagoon B the results leaving the lagoon and on into the plant have more often than not been higher in TSS and turbidity than the water leaving lagoon A. This is due to the higher velocity scrubbing the dirty lagoon floor and lower retention time in Lagoon B.

This is effecting the water quality into the man WTP. Once lagoon B has been cleaned and restored to its full operating volume the water quality out of the lagoon and into the main WTP will improve dramatically as the water will not be picking up additional TSS and turbidity, but considerably lower both due to a cleaner lagoon and higher retention time allowing additional solids to drop out.

Graph 'C' - Inlet NTU (A) Vs Lagoon A Outlet (C) NTU



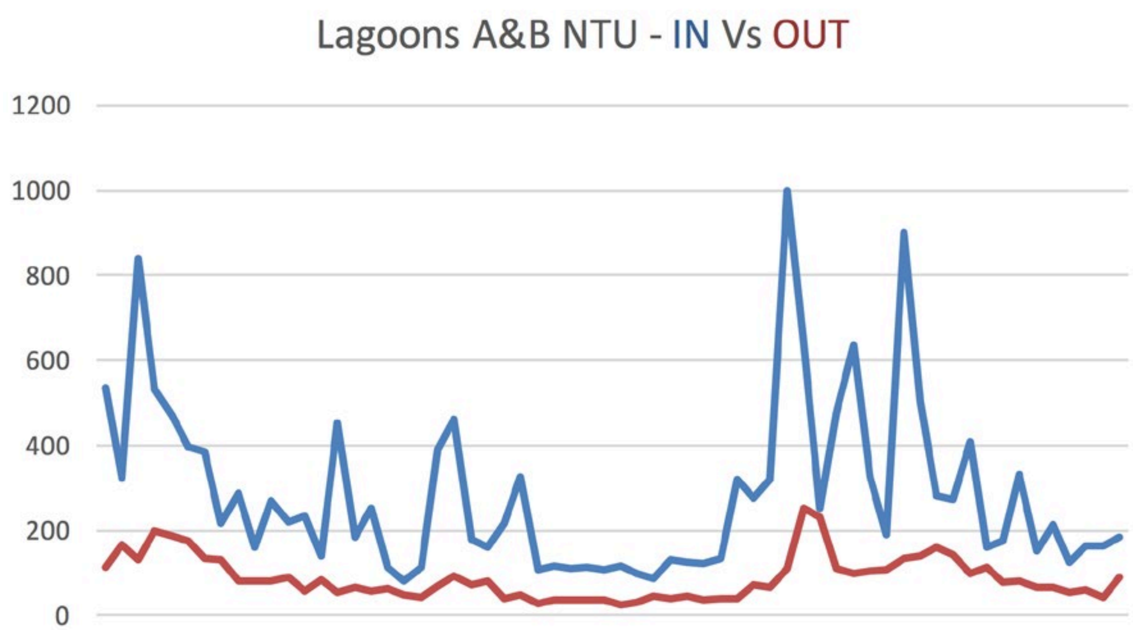
Graph 'C' highlights the period in which the clarified water from lagoon A has been flushing out lagoon B (which was full of dirty river water from the wall construction period).

With a peak TSS of 600 and an average inlet TSS of 159 you can see that the outlet of lagoon B has been maintained generally within 20 - 80mg/L with an average TSS of 56.5mg/L.

This equates to an average percentage reduction in TSS across lagoon A & B of 61% for the entire period, but increasing as lagoon B is flushed clean after the start-up period.

Sample Results

Graph 'D' - Inlet NTU (A) Vs Lagoons A & B Outlet (D) NTU



Graph 'D' shows the period in which the clarified water from lagoon A has been flushing out lagoon B.

With a peak NTU of 1000 and an average inlet TSS of 286 you can see that the outlet of lagoon B has been maintained generally around 80 NTU with an average of 86 NTU.

This equates to an average percentage reduction in turbidity across lagoon A & B of 65% for the entire period, but increasing as lagoon B is flushed clean after the start-up period.

OVERALL PLANT OUTPUT

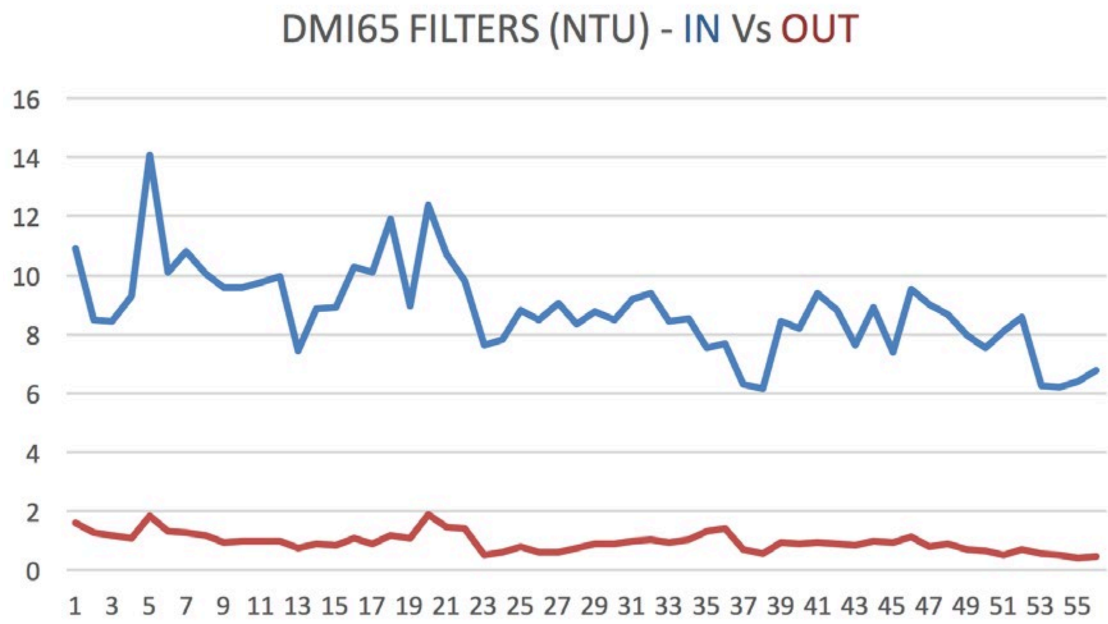
The results from the plant post media filters after the replacement of the old sand media with the new DMI65 media have been consistently excellent.

The expected results from the media filters after the upgrade were:

- TSS < 5mg/L
- Turbidity < 2 NTU

Sample Results

Graph 'E' - Media Filter Performance - NTU In Vs Out



Graph 'E' shows the turbidity of the water entering the media filter at an average of 8.84 NTU. The output of the filters is tested 4 times per day and has averaged 0.96 NTU with zero readings over the 2 NTU target.

When tested TSS post media filters has been below 1 mg/L. TSS testing in the treated water storage reservoirs has been recorded as 0 mg/L throughout the test period.

COST SAVINGS

Another aspect of the upgrade was to reduce the overall operating costs of the plant. The cost savings can be broken down into two main areas:

- **Polymer Costs**
- **Sludge/Solids Removal**

POLYMER USAGE

The existing plant uses liquid polymer procured from China at a cost of around USD $6.50/Kg or MR 27.50 (based on current exchange rate @ 4.23). The daily usage amount specified prior to the upgrade was:

·Wet Season - 60Kg/Day

·Dry Season - 150 - 200kg/Day

This equates to a daily expenditure of:

·Wet Season - MR 1,650/Day

·Dry Season - MR 4,125 - 5,500/Day

The addition of the powdered polymer batching system means that the liquid polymer dosed in the lagoon is produced at a fraction of the cost of the liquid polymer used in the main WTP.The powdered polymer we are using is priced at RM 16.75/Kg or around USD $4/Kg.

During the trial we found the best results dosing 450L/Hr of the liquid polymer at a solution strength of 0.1% for dry (or low TSS & NTU) conditions and 0.05% after periods of rain.

This results in a daily usage of:

·Wet Season - 5.4Kg/Day

·Dry Season - 10.8Kg/Day

This equates to a daily expenditure of:

·Wet Season - MR 90/Day

·Dry Season - MR 180/Day

Initial trials carried out to reduce the polymer consumption at the main water treatment plant have been affected by the lower than expected water quality coming from lagoon B.

Lagoon B has actually increased TSS & turbidity by 46% and 51% respectively over the trail period. Lagoon B will need to be cleaned after which a further reduction in TSS and turbidity from the >70% reduction at lagoon A will be seen. This will produce a much higher quality of water into the main plant and should lead to a reduction in polymer usage.

SLUDGE/SOLIDS REMOVAL

A considerable headache for KLPP staff has always been the build-up of solids in both lagoons A & B. As the river water was pumped directly into both lagoons A & B a portion of the suspended solids was settling out prior to the water being pumped into the cascade aerator in the main WTP.

The total amount of solids entering the lagoons at the current sampling average of 159mg/L TSS is:

1,000,000 / 159 (mg/L) * 1,000,000 Lt/Hr = 159 Kg/Hr

This equates to nearly 3.8 tonnes of solids being pumped into the lagoons each day.

The current lagoon cleaning/sludge removal process is both time consuming and costly with one lagoon at a

time being shut down for maintenance every 3 years.

An average reduction (including the start-up period) of 56% TSS in the settling chamber and the addition of the sludge removal system means that only 44%, or around 1.65 Tons per day of solids passing through to the larger storage side of lagoon A. This will lead to an increase in the cleaning/maintenance period of lagoon A to around 6 years.

An average reduction (including the start-up period) of 71% TSS in lagoon A means that only 29%, or 1.1 Tons of solids per day passing through to lagoon B. This will lead to an increase in the cleaning/maintenance period of lagoon B to around 9 - 10 years.

It is harder to accurately predict the percentage reduction across lagoons A & B due the flushing period at the beginning of the sampling period (where lagoon B was full of dirty water and high level of solids due to being the only lagoon in use throughout the wall construction period), but it is safe to say that with time, and especially after the initial cleaning post upgrade, that the amount of solids passing through to the main WTP will continue to reduce.

Recommendations

Several recommendations have been made to plant staff to ensure that they continue to get the best possible results from the upgrade to their plant.

RIVER WATER SUMP PUMP CONTROL

One of the most important areas is level control in the lagoons. Previously, when there was a low tide or high demand event and the water level in the lagoons was lower than normal operators would turn on several pumps to rapidly increase the level in the lagoons. This was resulting in a high velocity through the settling chamber, upsetting the sludge layer and carrying over a considerable amount of solids.

The initial calculations for residence time in the settling chamber were based on the lagoon drawings. Once lagoon A had been drained it was clear that thick layer of solids had settled on in the base of the lagoon in the 1 year period since it was last cleaned. While attempts were made to clear the solids it was deemed too dangerous to clear the solids down to the lagoon liner for risk of damage to the liner.

The layer that was left in the base of the lagoon is around 600 - 1000mm across the entire area of the lagoon. This has significantly reduced the operating volume of the lagoon and therefore the retention time in the settling chamber.

To allow for this we have recommended that operators bring the level in the lagoons up at a slower rate using only one or two pumps at a time. The system will always achieve better results with a higher retention time and minimising the flow rate is the simple and practical method. The plant as a whole produces around 24ML/Day so running on one or two pumps at a time should not lead to any water shortages, even considering varying loads on the system and tidal issues at the river water source.

The results obtained through the sampling period have been obtained with inlet flows between 900 - 1,400m^3/hr with one or two pumps running.

POLYMER CONCENTRATION & DOSING RATE

As mentioned above the polymer demand on the incoming water is dependent on the quality of the water from the river. This is handled by varying the polymer concentration at the polymer batching system. A simple adjustment to the screw feeder timer allows operators to vary the concentration of the polymer being produced.

To maintain a proportional dose rate into the inlet stream the polymer dosing rate will also vary as the incoming flow varies when the second river water sump pump is switched on.

The table below contains the recommended polymer concentration and screw feeder times for the various incoming water quality.

TABLE B		
	WET SEASON - TSS & NTU >200	DRY SEASON - TSS & NTU <200
POLYMER CONCENTRATION	0.05%	0.1%
SCREW FEEDER TIMER	2 MIN 02 SEC	4 MIN 4 SEC

The table below contains the recommended polymer dose rate settings for the various incoming water volume.

TABLE C		
	ONE RIVER WATER SUMP PUMP ON FLOW RATE APPROX 900m3/H	TWO RIVER WATER SUMP PUMPS ON FLOW RATE APPROX 1,400m3/H
DOSE PUMP #1 FLOW RATE	450 L/H	450 L/H
DOSE PUMP #2 DOSE RATE	250 L/H	250 L/H
DOSE PUMP #1 ON/OFF	ON	ON
DOSE PUMP #2 ON/OFF	OFF	ON

ADDITIONAL POWDERED POLYMER SYSTEM

Quantum also recommends that a powdered polymer batching system the same as we have installed at lagoon A be purchased and installed at the main WTP. The cost of liquid polymer is very high and the system installed as part of the upgrade has shown that high quality liquid polymer can be produced on-site at a far lower cost.

By producing powdered polymer on-site at a very low cost it could be dosed a high rate into the cascade aerator providing very low turbidity and TSS into the media filters. This would result in far less frequent backwashing providing considerable savings in treated water.

AUTOMATIC SLUDGE REMOVAL

The sludge removal system has an automatic controller to turn on the vacuum sludge pump and open the actuated control valves for each of the sludge lines. The sludge lines are paired into two to allow sufficient flow through the sludge pump.

Sludge from each pair of sludge lines (stations) should be monitored periodically to assess the amount of sludge from the individual pairs. The controller allows for different times to be set for each pair so each pair only need run as long as sludge is being produced. For example; if sludge is settling at a higher rate in lines 11 & 12 (furthest from the overflow weir) then this pair (station 6) can be run for a longer period than the others.

Over time as the sludge and solids levels increase in the settling chamber these times will need to be increased to keep up with the sludge production.

The controller allows for the program to be run up to four times per day with the varying pre-set times for each of the six stations.

Sludge from the settling chamber is improving daily with a higher sludge concentration and longer sludge production times. Below are the current settings for the automatic sludge removal system.

TABLE D		
	ONE RIVER WATER SUMP PUMP ON FLOW RATE APPROX 900m3/H	TWO RIVER WATER SUMP PUMPS ON FLOW RATE APPROX 1,400m3/H
DOSE PUMP #1 FLOW RATE	450 L/H	450 L/H
DOSE PUMP #2 DOSE RATE	250 L/H	250 L/H
DOSE PUMP #1 ON/OFF	ON	ON
DOSE PUMP #2 ON/OFF	OFF	ON

The photo **(next page)** shows the sludge removal and sample with high solids content.

FILTER MAINTENANCE

Due to the condition of the media filters after the sand media had been removed and the unpredictable nature of the river water quality, Quantum recommends that the media be removed and replaced every 12 months.

During this maintenance activity the filter nozzles and filter floor should be thoroughly inspected and replaced or repaired as necessary. High pressure cleaning of the walls and pipe work should also be carried out along with epoxy painting of any exposed pipe work to prevent further degradation.

Summary

Quantum believes that the upgrade has been a success, addressing the main objectives of the upgrade with excellent results.

INTRODUCTION

Quantum - “This proposal is the outcome of a recent visit to assess the options for upgrading the water treatment plant supplying water to the Kuala Langat Power Plant (KLPP) to increase efficiency and reliability and better cope with the seasonal load changes experienced in the raw water supply”.

CLARIFICATION

Quantum - “The high turbidity and suspended solids levels in the raw water could be greatly reduced by clarification prior to entering the plant. The existing plant is fixed in size and capacity, however a pre-clarification stage will dramatically reduce the load on the current plant”.

The upgrade has reduced the TSS and turbidity of the water entering the main WTP by 71% and 74% respectively.

KLPP - “High sludge built up at Lagoon B decreases the lagoon capacity”.

With a percentage reduction in Total Suspended Solids (TSS) into lagoon B of 71% the amount of solids entering Lagoon B has been dramatically reduced which will result in far less sludge build up and far less cleaning and maintenance.

MEDIA FILTERS

Quantum - “The combined effects of the additional clarification, polymer optimisation, new filters nozzles (finer slots) and the addition of DMI65 filtration media (mechanical filtration of 5-10 microns) will see the plant achieve water quality well below TSS & NTU of 5 year round and will allow for increased throughput capability of the plant in times of high load”.

KLPP - “During high conductivity of river water (300 – 400μm) and low turbidity <100 - drought season causing treated water quality after sand filter goes up more than NTU 5 and suspended solid carry over through sand filter. This happen due to the low suspended solid in the raw water”.

The conditions throughout the commissioning period have been consistently as described above with turbidity into the main WTP <100 NTU (averaging 87 NTU, TSS 57mg/L including start-up period). Under these conditions the output of the media filters has seen a turbidity averaging below 1 NTU and a TSS consistently below 1 mg/L. There have been no readings higher than 2 NTU turbidity and TSS has been generally undetectable and recorded as zero.

CONCLUSION

“The outcome of the proposed upgrade is to provide low cost options utilising existing plant and equipment to increase the quality and quantity of water to the power plant, whilst reducing maintenance and on-going operating costs”.

We have managed to deliver cost savings and reduced maintenance whilst improving the quality of the water produced by the plant across a wide range of varying raw water qualities.

For more information please vist our new website:

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