COUNCIL, THE BUILDER – A SUCCESSFUL "DIY" OPERATION !

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ABSTRACT

Historical under-investment has led to deterioration in sewerage collection and wastewater treatment systems in Mount Isa, a mining town in Northwest Queensland. Population growth and increasing community and compliance pressure has prompted Mount Isa City Council to embark on a series of improvement programs to achieve compliance and better environmental outcomes.

An extensive and capital intensive upgrade was initially proposed to address poor conditions of existing assets and lack of automation and instrumentation in the existing wastewater treatment plant. However, as a result of the downturn in the resource sector causing financial strain on Council budgets, a "back to the drawing board" scenario was proposed.

Given the required technical and environmental objectives, little could be done to reduce the plant and process required. Therefore, an innovative approach to project delivery was developed.

Council, themselves, proposed to act as a Head Contractor by utilizing their own resources. They managed the suppliers (with technical input from consultants) and local sub-contractors.

As this was a 'first', it was decided to trial the scheme with the new inlet works. This not only proved to be very successful, but also achieved massive savings in capital cost. Based on this successful venture, Council decided to proceed with the construction of the tertiary treatment plant. Again, this was also successful and economic. The savings in capital have now allowed Council to bring forward other projects, which were originally planned for future years.

The authors of this paper would like to share their experience, with particular discussion on:

- Ambivalence of various parties involved
- Challenges faced in technical and contract management
- Lessons learnt – what could have been better
- Suitability of this approach
- Advantages and disadvantages
- Capital savings – hard facts

KEYWORDS

Innovative Delivery, Wastewater Treatment, Effluent Reuse, Contract Management
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1 INTRODUCTION

1.1 MOUNT ISA

Mount Isa City is a mining town of 21,000 people, located in North-West Queensland. Because of the rich mineral resources in the area, there is a cluster of relatively large heavy industries in Mount Isa and its vicinity.

Mount Isa is fairly remote from the state capital, Brisbane, and North Queensland regional centers such as Townsville and Mackay. The distance between Mount Isa and Townsville is approximately 910km or a flight time of 1.5 hours.

The local climate is relatively dry and comprises of three seasons; mid-temperatures with low humidity from May to August, hot temperatures with low humidity from September to December, and hot temperatures with high humidity during January to April. 75% of rainfall occurs between December and March. The summer period also sees the highest evapotranspiration, and therefore a higher demand for irrigation.

Figure 1: Mount Isa Location

1.2 MOUNT ISA WASTEWATER INFRASTRUCTURE

There are 18 sewage pump stations within Mount Isa, and wastewater is collected and pumped to the wastewater treatment plant (Mount Isa Wastewater Reclamation Plant, WWRP) in the northeast. Figure 2 below shows the locality of the WWRP relative to the city.

Figure 2: Mount Isa Wastewater Reclamation Plant Locality

The scheme was built in the 1970s, designed for secondary wastewater treatment. The treatment plant had minimal automation and plant monitoring instrumentation.

Figure 3 below presents the original wastewater treatment plant configuration.

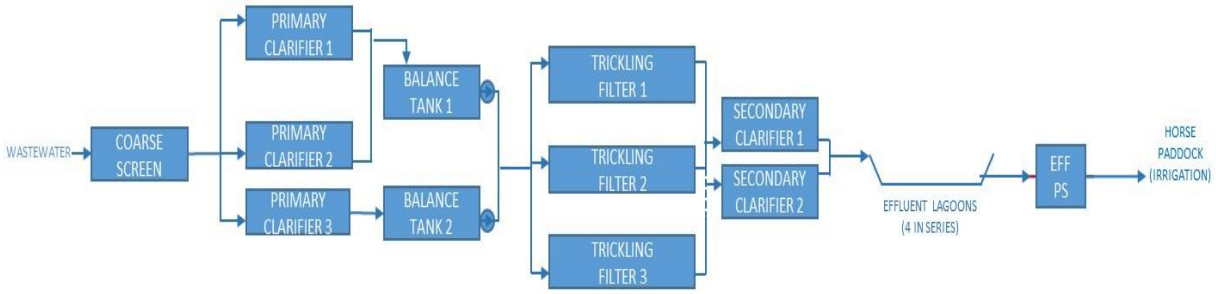

Figure 3: Mount Isa Wastewater Treatment Original Configuration

Since the construction of the second process train (Trickling Filter #3 and Secondary Clarifier #2) in the mid- 1970s, minimal capital has been invested in the facility. As a consequence, the condition of assets has significantly deteriorated over time, which has adversely affected performance of the plant. Furthermore, the retirement of the main plant operator in mid 2000s resulted in a significant loss of the institutional knowledge.

In 2009, Harrison Grierson was engaged by Mount Isa City Council (MICC) to assess the sewerage infrastructure needs to cater for the anticipated growth in the resource sector at the time. Subsequently, a three stage augmentation program was approved by MICC for implementation, as presented in Figure 4 below.

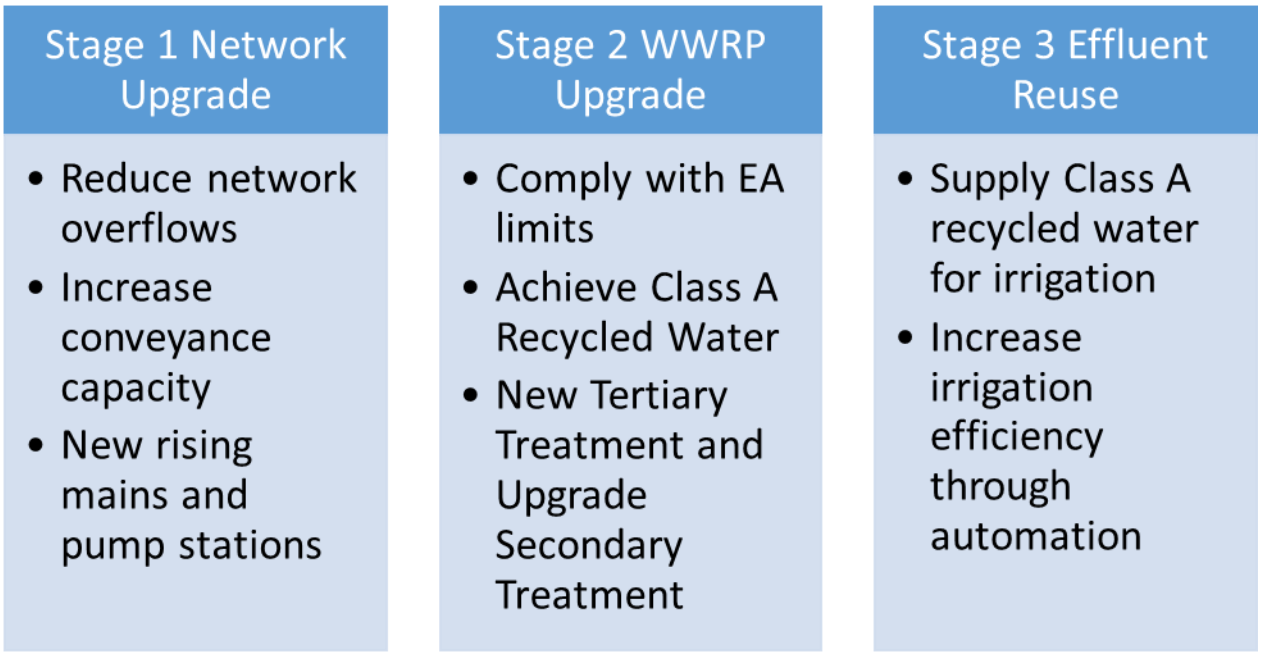

Figure 4: Mount Isa Three Stage Sewerage Augmentation Program

Between 2012 and 2013, MICC undertook a major AUD$15M construction project to improve its sewerage collection and conveyance network. In particular, the following assets were built:

- New terminal pump station with a peak conveyance capacity of 365L/s
- New rising main to the treatment plant
- New rising mains to the new terminal pump station to remove capacity bottleneck
- New pump stations to service new catchment in the southern part of the city

In early 2014, MICC commissioned Harrison Grierson to undertake concept and developed designs of the wastewater reclamation plant and effluent reuse system upgrades. The estimated capital cost of the two upgrades through conventional contracting and delivery method were $8.8 and 10M respectively. They represented a significant capital investment to renew and reinvigorate the old, aging infrastructure to the level of service desired by MICC and the community.

2 COUNCIL AS THE BUILDER

At the end of 2013, the new sewerage network system upgrade (Stage 1 augmentation) was successfully completed, and MICC's project objectives of reducing sewer overflows and provision of future growth/capacity were achieved.

By mid-2014, the effect of resource sector downturn was widely felt in Queensland. This put significant pressure on the MICC staff to explore alternative methods of reducing capital expenditure while at the same time maintaining and improving the level of their services and activities.

Historically, the remoteness of Mount Isa from the metropolitan areas and major regional centers has led to higher overhead and margins charged by the major contractors, mostly based in other locations. MICC not only pays for a premium on construction costs, but also on servicing and maintenance of key assets and equipment.

Therefore, in an effort to save construction costs, MICC decided to self-perform by being the Head Contractor. However, this was a major undertaking, and legitimate concerns were raised by some stakeholders. In order to allay those concerns, MICC decided to trial this alternative delivery method based on a smaller project component (the Inlet Works upgrade), as described in Section 2.1 below.

2.1 TRIALLING ALTERNATIVE CONSTRUCTION PROCUREMENT

MICC decided to implement the wastewater reclamation plant (WWRP) upgrades in a staged manner, subject to the availability of external funding provided by state and federal governments.

The first upgrade was to replace the old coarse screen with two new inlet works package plants, each consisting of a fine screen and an aerated grit removal system. MICC selected and ordered the new inlet plants in late 2014.

Three tenders from mid-tier contractors were received for the Inlet Works installation and civil construction contract in early 2015. These tenderers were found to be more than 30% higher than the available budget, from both internal and external funding sources.

To proceed the works within the budgetary constraints, MICC decided to adopt an alternative delivery method. This required MICC to take up the role as the lead constructor, to manage and co-ordinate various local resources as sub-contractors.

This alternative approach was expected to have a lower cost as it cuts down the overhead costs and travel & accommodation expenditures, commonly associated with the mid to top tier contractors, who are based in the metropolitan or major regional centers. This also provides employment opportunities for the local community.

To maximize the use of local resources, the Inlet Works Installation and Civil construction contract was broken down into nine packages. HG provided technical inputs to MICC in setting up the packages and technical support during construction and installation, while MICC utilized its own plumbing and construction crews to undertake the pipeline installation works, as well as contracting to the small local contractors for various specialist inputs such as steel fabrication, civil excavation and concrete construction.

By end of 2015, the new Inlet Works plant was commissioned, and the project was delivered within the budget allowance. The installation works took longer than the initial programmer due to less experience in managing multiple subcontractors. Also, there

were commissioning delays due to supplier's defects and incomplete contractor's documentation.

Nevertheless, this "trial" of using alternative delivery method was considered a success.

Figure 5: Mount Isa WWRP – New Inlet Works with the disused old concrete inlet channel on the left

2.2 WASTEWATER RECLAMATION PLANT UPGRADE

After successful implementation of the new Inlet Works, further external funding was available to MICC to upgrade other parts of the WWRP.

2.2.1 PROJECT SCOPE DEFINITION

The total funding available for the treatment plant upgrade was $5.2M, which was significantly less than the capital expenditure estimate in 2014. To investigate the delivery of the project within the available budget, a project scope definition study was undertaken, and the key upgrade items were identified as shown in Figure 6 below.

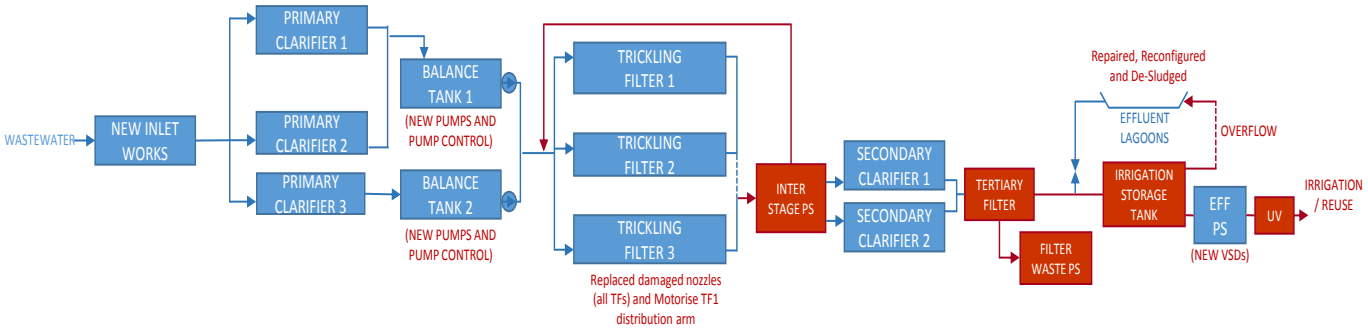

Figure 6: Mount Isa WWRP Upgrade Works

The two key plant upgrade objectives of improving effluent quality compliance and Class A recycled water standard were expected to be met by the following plant modifications:

- Improving Effluent Quality Compliance
    - New pumps in Balance Tanks and changes to pump operation and control
    - Trickling Filter nozzle replacement
    - Modifications in operation and configuration of the Trickling Filters
- Class A Recycled Water Standard
    - Tertiary Filter
    - Effluent Storage Tank
    - UV Disinfection
    - Final Effluent Hypochlorite Disinfection

2.2.2 PROJECT PACKAGES AND PROCUREMENT

After the treatment plant upgrade scope was defined, MICC and HG immediately developed the procurement plan to select and order the long lead items such as Effluent Storage Tank, Tertiary Filter and UV. The procurement plan specified various packages to complete the treatment plant upgrade, as shown in Figure 7 below.

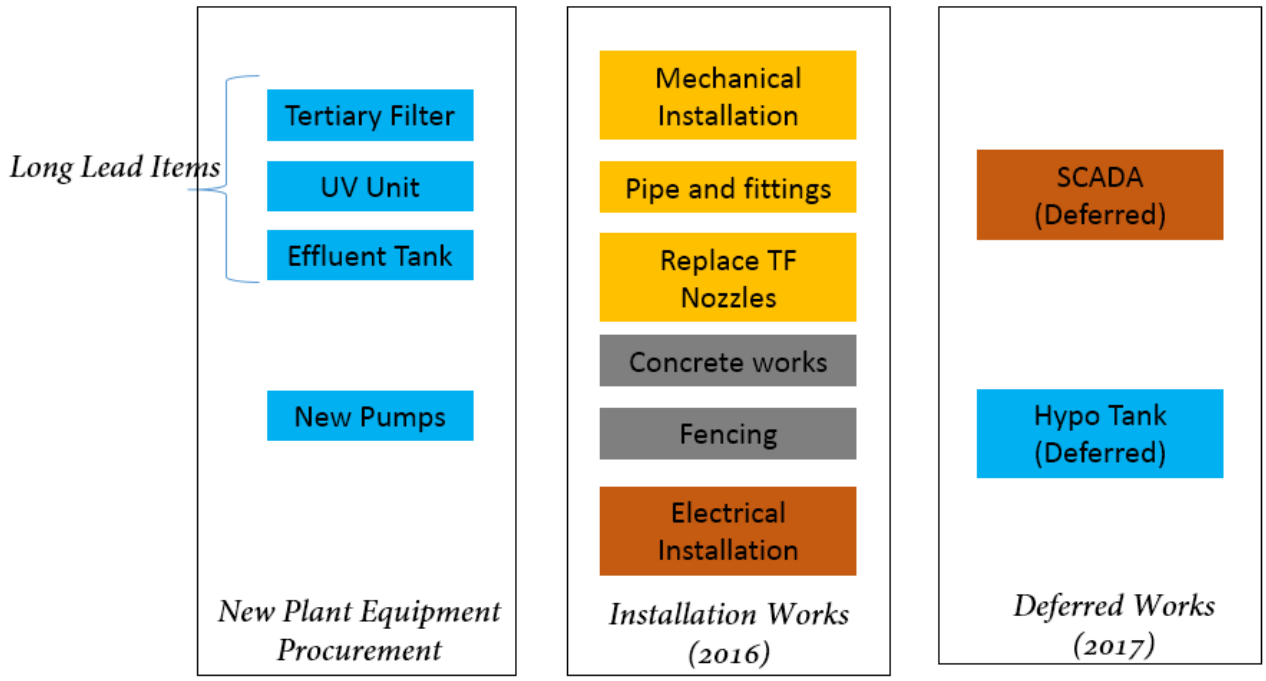

Figure 7: Mount Isa WWRP Upgrade – Packages

There were several major steps in implementing the packages:

- Order for long lead items were placed by late 2015;
- Detailed design drawings were finalized by early 2016;
- Electrical installation contract was awarded to a Mount Isa based electrical contractor in early 2016;

In addition, two of the improvement works, the final effluent hypochlorite dosing and the SCADA system upgrade were deferred to late 2016/early 2017.

2.2.3 CONSTRUCTION AND INSTALLATION

After the detailed design drawings were finalized, the MICC Water and Sewerage Team Leader and Technical Services Manager took on the roles of the construction manager and project manager to engage the local companies for several smaller work packages such as concrete works construction, security fence erection and supply of pipe works and fittings.

MICC coordinated the construction activities with inputs from technical consultants, including managing multiple interfaces to keep the overall project on track. Moreover, MICC staff also queried and undertook value-engineering as the construction works progressed. One of the key changes made during the construction and installation phase was to purchase prefabricated concrete pump stations to streamline the site installation.

MICC foremen were frequently onsite to supervise the construction and installation works. Because of the continual site presence, construction queries were resolved in a timely and efficient manner.

3 OUTCOMES

3.1 UPGRADE WORKS COMPLETION MILESTONES

The installation of new plant equipment took place into a few stages:

- Effluent Storage Tank was delivered and installed in June 2016;
- Trickling Filter nozzle replacement was completed by August 2016;
- Balance Tank new pump controls were commissioned and operational in mid-September 2016;
- New tertiary filter and support equipment (service water pump station, filter waste pump station) were commissioned and operational in late September 2016;
- New UV unit and automation of effluent pumps were commissioned in late November 2016.

Figure 8: Mount Isa WWRP Upgrade – New Tertiary Filter

Figure 9: Mount Isa WWRP Upgrade – New UV Unit

3.2 ACHIEVING THE PROJECT OBJECTIVES

Table 1 below presents the final effluent quality before and after the plant upgrade works.

Table 1: Mount Isa WWRP Upgrade – Improvement in Plant Effluent Quality

PERIOD	FINAL EFFLUENT QUALITY (MEAN VALUES)						COMMENTS
	$CBOD_5$ (mg/L)	TSS (mg/L)	AMMN (mg/L)	TN (mg/L)	TP (mg/L)	E COLI. (CFU/100mL)	
Jan15 - Aug16 (Before Upgrade)	25	43	30*	40*	5	640	**Clarifier effluent samples, instead of pond effluent*
Nov16 - Jun17 (After Upgrade)	3	3.5	4	29	6	<1	*UV outlet samples*
Compliance Requirements							
EA Limits	<10	<10	-	<30	<8	<100	*Mean values*
Class A Recycled Water	-	-	-	-	-	<10	*Mean value*

As seen from the latest effluent results in Table 1, the treatment plant upgrade works has successfully achieved the project objectives of (i) Compliance with the discharge limits and (ii) Achieve Class A Recycled Water Standard.

3.3 FINANCIAL SAVINGS

The plant improvement and upgrade works were delivered well under the budget cap of $5.2M, as shown in Table 2 below.

Table 2: Mount Isa WWRP Upgrade – Project Financials (as of Dec 16)

Items	Amount
WWRP Stage 2B Budget Cap	**$5.2M**
Actual Cost incurred for Stage 2B	
Balance Tank Pumps	$0.2M
Trickling Filters/Inter-Stage PS	$0.3M
Tertiary Filter / Bypass Pipe	$0.8M
Effluent PS and Lagoons	$0.3M
Effluent Storage Tank and Pipework Mod	$1.3M
UV Reactor and Hypo Tank	$0.4M
Electrical	$0.7M
Unscheduled Items	$0.4M
Subtotal for Stage 2B	**$4.1M**
Savings including deferred tasks	**$1.1M**

The cost savings were approximately $1.1M which allowed MICC to proceed with the deferred tasks as well as additional improvement works, as outlined in Section 3.4 below.

3.4 ADDITIONAL UPGRADES

The cost savings enabled a number of additional improvement works to proceed:

- Automation of existing equipment in the old plant area via a Plant PLC;
- Instruments to be added to monitor the existing (old) process units;
- Effluent lagoons clean-up and de-sludge;
- Replacement of old effluent pumps with modern higher efficiency pumps;
- Remote solar-powered radio-communicated field actuators (16x) to regulate flow to different irrigation areas;

In particular, the installation of remote field actuators partly achieved the original Stage 3 upgrade objectives (refer Figure 2). A photo of one of these remote field actuators is shown in Figure 9 below.

Figure 9: One of the 16 new remote irrigation actuators at Mount Isa

3.5 GOOD PROJECT OWNERSHIP

Throughout the project, it was found that the MICC team were highly motivated and engaged in delivering this project, due to their heavy involvement during the design and construction phases. The plant personnel showed immense interest in improving and optimization of the plant operation.

This alternative project delivery method resulted in better staff engagement, as they had a strong interest to ensure this project was a success. The team gained confidence during the project, and is already planning to build on this experience in future upcoming projects.

3.6 OPPORTUNITIES FOR IMPROVEMENTS

As in any project, there are a number of opportunities to make further improvements:

- Construction Program – this was found to be challenging at times, especially with the local subcontractors, often consist of very small teams. There were a number of unexpected delays due to their commitment on other projects such as the ones in the nearby mines. It was difficult for MICC to exercise the penalties on delays or late completion as they were fully aware of the potential effect on the local businesses.

- Interface Management - This complex multi-disciplinary project has multiple interfaces at various points. This challenge was made more complicated as MICC project managers had to balance their commitment with their "day job". A

weekly/fortnightly teleconference was held to assist MICC project managers to keep track of progress and management of interfaces. However, there were times when the vendors and local subcontractors did not effectively communicate their issues (e.g. delays in delivery or equipment communication protocol) which resulted in delays and demanded additional effort.

- Construction Quality Documentation – The construction QA and the documentation were managed by the MICC team. These QA documents were less comprehensive than those typically expected of experienced, mid to top tier constructor.

4 FINAL REMARKS

Overall, this Mount Isa Sewerage Augmentation Stage 2 project has been successfully delivered and completed via an unconventional delivery method, where the MICC team took on this complex, multi-disciplinary project as the lead constructor and the pipework installer. MICC were able to achieve this by leveraging on specialist subcontractor skills available locally, as well as inputs from technical designers/consultants.

The whole team have adopted a united, no-blame approach, which was fundamental in delivering this project and exceeded the initial expectations.

5 ACKNOWLEDGEMENTS

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