18.1 Operation and Maintenance of Wastewater Treatment Plants

18.1.1 Background

Waste water in Mauritius is treated at some ten plants. Most of these treatment plants are small ones where waste water is treated only at primary level for discharge into leaching fields. The main plants namely St Martin, Montagne Jacquot, Grand Baie and Baie du Tombeau have been designed to receive significant waste water for treatment at different levels.

The operation and maintenance of the small plants is carried out by the Wastewater Management Authority (WMA) team. As for the main plants, their construction was followed by an Operation & Maintenance (O&M) contract, the first one being that of Baie du Tombeau which started in January 2002.

18.1.2 Operation and Maintenance Cost – Rs 480.9 million

Operation and maintenance costs totalled Rs 480.9 million over the last three financial years as detailed in Table 18-1

<table>
<thead>
<tr>
<th>O&amp;M</th>
<th>Year 2004-05 Rs</th>
<th>Year 2005-06 Rs</th>
<th>Year 2006-07 Rs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contracts for Main Treatment Plants</td>
<td>39,420,932</td>
<td>87,537,921</td>
<td>99,970,391</td>
</tr>
<tr>
<td>paid by Government</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>O&amp;M Costs - WMA</td>
<td>73,499,040</td>
<td>83,541,180</td>
<td>96,978,604</td>
</tr>
<tr>
<td>(Small Treatment Plants, Pumping</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>stations, Sewer Network, Electricity</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>costs etc.)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>112,919,972</td>
<td>171,079,101</td>
<td>196,948,995</td>
</tr>
</tbody>
</table>

My office has examined the O&M contracts of the main treatment plants.
**General Observations**

- No proper monitoring of contracts by WMA.
- High escalation cost was incurred under one contract.
- Lack of control by WMA over waste water assets.
- Equipment was defective, unutilised or out of order, thus affecting the proper functioning of plants.
- Cost of treating waste water is high due to the fact that the plants are operating below capacity.
- No revenue has yet been derived to date from sale of treated water.
- Analysis of effluents was not always compliant with Standards.
- No training provision was made in most O&M contracts.
- No expertise of WMA staff to take over a major O&M contract.

**Ministry’s Reply**

- Equipment at small wastewater treatment plants will be renewed in Financial Year 2007-08.
- A contract has been signed between the Wastewater Management Authority and the Irrigation Authority for the sale of effluent. The Ministry is urging the Irrigation Authority to promptly settle its debts.
- Training is now being made in O&M Contracts.
- Major O&M contracts like St Martin and Montagne Jacquot Treatment Plants are now being supervised by in-house WMA Staff.

**18.1.3 High Escalation Cost**

The O&M contract for St Martin was planned to start in January 2004 but due to delay in construction phase, it started in January 2005.

**Observations**

- Due to the above delay, the escalation cost of 47 per cent included in the first payment (January 2005) rose to 110 per cent in June 2007. Total escalation costs paid for period January 2005 to June 2007 amounted to Rs 72,556,171. Based on present trend, some
Rs 100 million (116 per cent) would be deemed to be payable on completion of the O&M period in March 2008.

- In a report dated July 2006, the Works Manager highlighted the above issue and proposed that a ceiling of escalation formula of 75 per cent could be discussed and agreed upon for the new O&M contract.

- An additional cost of some Rs 16 million will have to be incurred as a result of the extension of the O&M contract.

**Ministry’s Reply**

- The implementation of the project was delayed due to unforeseen contractual issues.

- The Ministry attempted to negotiate a ceiling on the cost escalation during the O&M phase and the contractor agreed to a ceiling of 109 per cent be applied for the remaining period of the contract.

**18.1.4 Contract Administration**

The construction of the Grand Baie Treatment Plant (GBTP) was completed in April 2003. The three-year operation (O&M) contract started thereafter.

**Observations**

- Due to delay in sewer connections, adequate effluents both in terms of quality and quantity were only available at the plant as from January 2006, at a time when O&M contract was nearing completion. This is indicative of a lack of planning on the part of the WMA.

- The contract was thus extended to 30 November 2006 for which an additional amount of Rs 4 million had to be paid. Further, the Contractor did not renew the performance bond for the period of extension.

- The plant was taken over by WMA on 1 December 2006. As at time of audit in August 2007, i.e. after nine months, no taking over certificate has yet been issued.

- An additional amount of Rs 1.1 million was paid to the Contractor as interest due to late processing of claims.

- A number of defective equipment and outstanding works were not attended to by the Contractor prior to his departure and these were not cleared by the Consultant.

- There has been a lack of monitoring on the part of WMA.
Ministry’s Reply

- Despite several reminders sent to the Contractor, he did not renew the performance bond.
- The Taking Over Certificate will be issued when the O&M contract will reach an end.
- The Ministry is constantly reminding the WMA to be more vigilant and to exercise close control and monitoring over the implementation of projects.

18.1.5 Equipment

The mechanical and electrical equipment of treatment plants worth some Rs 850 million, and their proper keeping and maintenance is pivotal for the smooth running and effective operation of the plants. Records of equipment are also important so as to exercise control over these assets.

Observations

- Records such as Plant and Equipment/Spare Parts/Maintenance Registers were not available at treatment plants.
- At Grand Baie, some major equipment such as centrifuge, floodwater, pressure and diesel transfer pumps were out of order and were not attended to by the Contractor. The cost of some of the repairs and replacement has been estimated at Rs 840,000.
- Unutilised equipment for Pumping Stations at Grand Baie worth some Rs 4.7 million and handed over to WMA since May 2004 were lying idle at the GBTP. No control has been exercised by WMA over these sensitive equipment for nearly three years. On an inventory carried out by WMA in May 2007, materials, PVC pipes and equipment totalling Rs 2.2 million were found missing.
- At Baie du Tombeau Treatment Plant two band screens worth Rs 7.9 million were not operational, one as far back as October 2006. The cost of repairs of one the screen was around Rs 1.8 million. Further, the treatment plant which is fully automated makes use of special software worth Rs1.6 million which was not being used. The flow meter was also not functioning.

WMA has not exercised proper control over its assets. This is not satisfactory.

Ministry’s Reply

- The WMA is in the process of implementing a proper records system.
- The equipment for pumping stations at Grand Baie has now been installed in the newly constructed technical control room.
The Ministry has impressed on the WMA the need to exercise proper control on the assets.

18.1.6 Operational Capacity of Treatment Plant/Quality of effluent

The operational capacity of the Treatment Plants ranges from 3,500 m$^3$/day for Grand-Baie to 69,000 m$^3$/day for St Martin. The level of treatment of effluents also differs. Analytical laboratory tests are carried out on effluents of all plants.

Observations

- After four years, the Grand-Baie treatment plant was operating at only 30 per cent of its capacity. This was attributed to the fact that it was receiving an average daily flow of 1100 m$^3$. Consequently, the average cost for treating the waste water at tertiary level was very high - Rs19 per m$^3$ compared to that of St Martin – Rs 4.25 per m$^3$.

- It was only as from September 2006 that waste water was treated up to tertiary level at Grand Baie. Still, all the treated effluent was presently being injected into boreholes as no agreement has yet been reached with any potential buyer.

- At St Martin delay in finalising the agreement with the Irrigation Authority (IA) has resulted in some Rs 8.5 million of revenue being foregone as at 31 January 2006.

- Still when the sale agreement was finalised, the IA has not yet effected any payment since April 2006 despite several of reminders. Total amount due was Rs 10,948,968 as of 30 June 2007 (excluding interest). The IA has made representation to reconsider the rates of the agreement and the matter has been referred to the Ministry of Public Utilities.

- The average cost of treating water at Montagne Jacquot was Rs 3.30 per m$^3$ which was on the high side as it was undertaking only primary treatment.

- According to laboratory tests, the level of parameters in the effluents did not always comply with Environmental Standards in respect of Grand-Baï and Baie-du Tombeau. At St Martin, the waste water reaching the plant was reported to contain high level of oil and grease, in addition to chicken wastes and feathers.

- Non conformable standards of influent/effluent may therefore not only cause damage to the equipment but may also be harmful to the environment.

Ministry’s Reply

- Action is underway to connect other premises and other major stakeholders like hotels in the region as well as new housing estates.

- Despite all efforts, the cost level cannot be brought down. This is due to double pumping and high cost of chemicals, especially liquid chlorine.
18.1.7 Taking over of O&M Works

- Given the material amount of funds disbursed for the O&M contracts, namely St Martin (Rs 225 million per year) and Montagne Jacquot (Rs 35 million per year), there was a need for capacity building by WMA to take over these activities. However, works at St Martin would be outsourced again for a five year period due to lack of expertise.

- No provision was made for training of engineers and technicians in the majority of the contracts.

Ministry’s Reply

- The plant has a complex process design for which WMA is not ready to take over presently due to lack of in-house know-how.

- A training clause has been included in future O&M contracts, specially for the forthcoming St Martin O&M contract.

Conclusion

The financial position of WMA is as follows:

<table>
<thead>
<tr>
<th></th>
<th>Financial Year 2004-05 (Rs m)</th>
<th>Financial Year 2005-06 (Rs m)</th>
<th>Financial Year 2006-07 (Rs m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Financial Result: Surplus</td>
<td>37.5</td>
<td>38.8</td>
<td>66.3</td>
</tr>
<tr>
<td>O&amp;M Contract Costs</td>
<td>39.4</td>
<td>87.5</td>
<td>99.9</td>
</tr>
</tbody>
</table>

WMA runs the risk of not being financially sustainable if it has to fund entirely the O&M costs. On expiry of the O&M contracts, management will have to decide whether to continue outsourcing or to undertake the O&M itself, based on the most cost effective options.

18.2 Contract WMA 51 D - Construction of Montagne Jacquot Waste Water Treatment Plant and Pumping Stations - Rs 502.8 million

The contract for the construction of Montagne Jacquot Wastewater Treatment Plant and pumping stations was awarded in February 2005 to an overseas Company for the sum of Rs 502,841,201 (excluding contingency). The final completion date was 31 January 2007. One year operation and maintenance up to January 2008 was included in the contract.
18.2.1 Escalation Costs - Rs 84.3 million

A formula for calculating escalation cost at each certification was provided in the contract based on reference rates for labour, fuel and cement.

Observations

- The lack of sufficient ground for applying the escalation cost formula, in its present format to the whole of certified amounts was highlighted in my previous report.
- Subsequent examination of actual interim payment certificates to June 2007 has revealed that at least Rs 84.3 million of cost overruns were thus not justified as shown in Table 18-2.

*Table 18-2 Unjustified cost overruns*

<table>
<thead>
<tr>
<th>Component of certified sums</th>
<th>Details</th>
<th>Amount of unjustified escalation costs (Rs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply M&amp;E equipment</td>
<td>Rise in cost of wages and cement has no bearing on the supply of equipment</td>
<td>46,043,772</td>
</tr>
<tr>
<td>Civil Works and Installation of Equipment</td>
<td>Rise in cost of fuel has little incidence on civil works and installation costs</td>
<td>36,803,551</td>
</tr>
<tr>
<td>Operation &amp; Maintenance (Item 1)</td>
<td>Rise in cost of fuel and cement has no bearing on item 1</td>
<td>1,481,888</td>
</tr>
<tr>
<td>Operation &amp; Maintenance (Item 2)</td>
<td>Rise in cost of cement has no bearing on item 2</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>84,329,211</strong></td>
</tr>
</tbody>
</table>

It appears that the composition of the escalation cost formula had not been well thought out before inclusion in the present contract.

Recommendations

Each project has its own peculiarities and typical escalation costs formats are not applicable. This is clearly spelt out in the foreword to Fédération Internationale des Ingénieurs-Conseil (FIDIC) conditions of contract.

I have suggested that for labour, fuel and cement inputs in the Construction and O&M stages, the weight of each input in BOQ sections should be ascertained and price changes applied in corresponding sections of the certified sums.
Ministry’s Reply

Amendments would henceforth be brought to cost adjustment formulas so that these reflect as far as possible the nature of the work.

18.3 Supplier/Country of Origin

The Contractor’s proposals in respect of specifications, country of origin of the required equipment were examined by the Consultant and WMA. The agreement reached on make, country of origin and specifications was embodied in a Memorandum of Understanding (MOU) dated 20 August 2004.

Observations

- The country of origin was however changed for several equipment of which the more significant cases are listed in Table 18-3

Table 18-3 Cases where Country of Origin of Equipment supplied were not as per MOU

<table>
<thead>
<tr>
<th>MOU Item no</th>
<th>Treatment Plant:</th>
<th>Supplier/Country of origin per MOU</th>
<th>As supplied</th>
<th>Amount certified</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Hans Huber/Germany</td>
<td>Yixing-Huber/China</td>
<td>Cost US $</td>
</tr>
<tr>
<td>4</td>
<td>Inlet works fine drum screens</td>
<td></td>
<td>374,661</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Inlet works grit removal system</td>
<td>Hans Huber/Germany</td>
<td>Yixing-Huber/China</td>
<td>32,237</td>
</tr>
<tr>
<td>8</td>
<td>Chlorination neutralization tower</td>
<td>Alldos/Germany</td>
<td>Alldos/China</td>
<td>332,603</td>
</tr>
<tr>
<td>17</td>
<td>Filtrate return pumps</td>
<td>ITT Flyght/Sweden</td>
<td>ITT Flyght/China</td>
<td>19,032</td>
</tr>
<tr>
<td></td>
<td>P.A. Sables pumping station:</td>
<td></td>
<td></td>
<td>1,694</td>
</tr>
<tr>
<td>24</td>
<td>Standby generator</td>
<td>Cummins Power Generation/UK</td>
<td>Cummins Power Generation/Singapore</td>
<td>187,798</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
<td>1,044,873</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
<td>RS 35,893,953</td>
</tr>
</tbody>
</table>

- According to FIDIC terms, the Contractor was bound to communicate changes in country of origin to the Consulting Engineer. The fact that this was not done amounted to a
material breach of contract which would entitle WMA to seeking redress, especially since the above cases concern items worth at least Rs 36 million.

- Procuring equipment from China and Singapore instead of Europe may result in substantial price differentials, and receiving goods not according to specifications.

- The Consultant considered that some compensation was due to WMA.

**Recommendation**

WMA should consider examining such price differentials for an eventual claim to the Contractor.

**Ministry’s Reply**

The issue of a three year extension of the warranty following the end of the Defects Liability period is still under discussion with the Contractor.

WMA is to ensure that in future contracts, the Client is kept informed by the Consultant/Contractor of any change in country of origin.
**Water Resources Unit**

18.4 A Review of the Activities of the Water Resources Unit

18.4.1 Background
The Water Resources Unit (WRU) was established in May 1993 under the aegis of the Ministry of Public Utilities with the overall aim of assigning clear responsibilities for the effective management of water resources in the Republic of Mauritius. WRU was allocated the responsibilities for assessing, developing, managing and the conservation of water resources while those of the Central Water Authority (CWA) were reduced to only the treatment and distribution of water.

18.4.2 New Authority & Relevant Legislation

Given that the CWA has since its creation held the statutory responsibility for ensuring control, development and conservation of water resources, two years after the setting up of the WRU, Government decided to create a Water Resources Authority so as to provide an effective control on the management of water resources.

In April 1995, approval was obtained for the drafting of the new legislation which involved substantial amendments to the existing ones, namely the CWA Act 1971, Rivers and Canals Act 1863/Regulations 1941, Ground Water Act 1970 and the Environment Protection Act 2002.

**Observations**

- After more than 12 years, the Water Resources Authority Bill has not yet been finalised. Hence, the WRU has been operating without any legal framework since 1993.

- The non enactment of appropriate legislation has impacted on the proper running of the WRU and consequently the various set objectives such as prevention and control of water resources and the supervision of the enforcement of any water regulation could not be achieved.

- The Ministry which intended to take an integrated approach in respect of the new legislation has now undertaken a piecemeal approach to bring amendments to the Ground Water Act only.

**Ministry’s Reply**

The Ministry is now in a position to initiate action for the drafting of a new Water Act which will be an enabling Act covering the whole Water Sector.
18.4.3 Transfer of Assets

Following the setting up of WRU, several assets were transferred from the CWA to this new Unit. These included dams, hydrological equipment and buildings amongst others. The value of these assets was stated at Rs 136.7 million as per the Management Audit Bureau (MAB) Report 1994.

Observations

- Due to the non finalisation of the appropriate legislation, no official transfer could be effected.
- According to a sub committee of the WRU, the list of assets submitted by the MAB could not be reconciled with that of the CWA. Further, items actually transferred could not be identified.
- Another list of assets prepared by the Ministry in December 1995 was different from that of the MAB.
- No asset register was kept at the WRU.

Hence, it was difficult to ascertain whether proper physical control has been exercised over assets transferred to WRU.

18.4.4 Ground and Surface Water

Licences to abstract groundwater

Applications for a licence to abstract groundwater for industrial and agricultural purposes are submitted either to WRU or CWA although legally these have to be submitted to the CWA. WRU oversees technical issues and makes recommendations to the CWA for the granting of such licences.

Observations

- The above procedures result in unnecessary duplication of work as far as processing of applications is concerned.
- The WRU provides its technical contribution in respect of agricultural and industrial borehole exploitation. However, boreholes for domestic purposes are operated and managed solely by the CWA. This reflects unclear responsibility.
- I was informed that many users were not complying with their authorised abstraction limit and only at time of renewal of licence that letters requesting compliance were being issued. Control over groundwater abstraction was thus inadequate.
In the absence of proper records, it was not possible to ascertain the actual number of ground water users and whether proper control was being exercised over same.

Equipment/Human Resource

- Equipment used for groundwater includes mainly dataloggers, piezometres, and conductivity metres. 50 per cent of data loggers acquired in 1999 for Rs 4.5 million were either damaged or not in working condition. This has an adverse effect on the quantity and quality of groundwater data that are being collected for current and future use.

- Some 94 piezometres were defective/beyond repairs, representing about 29 per cent of total observations, where hydrological data were not being collected. Further, audit checks revealed that recording was not done at many other locations, some dated as far back as 1999.

- The conductivity meter was out of order since some two and a half years and measurement in respect of many boreholes could not be undertaken, especially those relating to sea water intrusion.

- A high percentage of equipment such as staff gauges and hydrometric structures used to record surface water level were damaged and needed replacement. Data loggers could not perform all their functionalities.

- The shortage of gauge readers at WRU hinders the collection of data on a regular basis. This has a direct impact on both the quantity and quality of data being collected.

Ministry's Reply

The Scheme of Service of Gauge Readers is being amended to attract more candidates.

Water Rights

The right to draw and use surface water is governed by the Rivers and Canals Act 1863 and the Groundwater Act 1970. The Supreme Court authorises the exploitation of surface water upon the recommendation of the CWA.

Observations

- Authorisation for using surface water has been granted for several purposes, that is, domestic, irrigation, agriculture and industrial amongst others. In many cases, the authority of the Supreme Court, as well as abstraction entitlements were not seen recorded.

- It was thus not possible for my Office to ascertain whether all the abstractions were duly authorised.

- The Rivers and Canals Act 1863 is outdated for control and management of surface water. This Act is thus impairing proper management of water resources.
Various water rights were granted as from 18th century especially to sugar estates for mill and irrigation purposes when land was substantial. Although there has been a drastic change in land use, yet there has been no alteration in the initial water right entitlement. Further, no visits were effected by the WRU as such powers are vested in the CWA.

The actual formula for the calculation of water rights is obsolete as climatic conditions, annual rainfall and normal flow of rivers have undergone major changes over the years.

Other issues

Waters in rivers, canals and streams are public property and as such no individual can trade them. My Office came across one case where one sugar estate was ‘trading’ its water right with the CEB for the purpose of power generation. Legal advice has to be sought to confirm whether this practice is legal or not.

CWA was claiming a royalty of five per cent per litre of water abstracted from two mineral bottling plants for which there has been no agreement. For financial year 2005-06, CWA received more than Rs 2 million in this respect. It appears that these payments were not regulated.

Ministry’s Reply

Legal advice will be sought on both issues.

Effluent Discharge Permit

The Environment Protection (Effluent Discharge Permit) Regulations 2003 came into force on 1 April 2004 to control the quantity and quality of effluent discharged by industries and operators. The MPU/WRU is the enforcing agency for such regulations.

Observations

After more than three years, WRU has not been able to enforce the effluent discharge permit regulations due to lack of infrastructure and staffing.

This situation is giving way for effluent to be discharged onto land and water surfaces which go uncontrolled be it in respect of quantity or quality with the potential risk of pollution of ground and surface water and the environment.

Ministry’s Reply

The WRU, with the assistance of CWA is monitoring the quality of surface and groundwater at strategic sites.
**Overall Recommendations**

- Though water legislation is a complex issue, yet too much time has elapsed to finalise the amendments/enactments. The Ministry could seek technical assistance on this issue.

- Commitment and support of the various stakeholders is of vital importance to enable the water legislation to be implemented.

- Appropriate structure and facilities should be put in place to enforce new legislation such as the Effluent Discharge Permit Regulations.

- Adequate equipment should be provided for better quality of water data collection.

- The WRU needs to be reinforced both legally and institutionally so as to address the above issues.