



**Water Utilities Corporation  
(WUC)**

## **Mambo Wastewater Treatment Plant Rehabilitation**

**TERMS OF REFERENCE (TORs)  
FOR  
CONSULTING SERVICES TO CARRY OUT  
AN ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT**

**February 2017**

## **I. Introduction**

1. These Terms of Reference (TOR) are based on a review of the Retrospective Environmental Management Plan (EMP) for the Mambo Wastewater Treatment Plant (WWTP) prepared by the Water Utilities Corporation as part of the design to rehabilitate and expand the Mambo WWTP. A summary of the existing findings from the Retrospective EMP is provided, along with the detailed requirements for preparing a full-scale Environmental and Social Impact Assessment (ESIA) for the rehabilitation of the Mambo Wastewater treatment plant. The ESIA shall be prepared in consistent with the World Bank Safeguard Policies for a Category A project, and also with the Environmental laws and regulations of the Government of the Republic of Botswana, to the extent appropriate. Gaps identified in the Retrospective EMP prepared by the Water Utilities Corporation (WUC) will be addressed within the scope of the current assignment to ensure compliance with the World Bank's Safeguard Policies.

## **II. Background**

2. The objective of the proposed development is to improve operational performance of the Mambo WWTP and limit pollution of downstream water sources. The wastewater received from Francistown and Tati Siding is currently not treated to the required Botswana Standards. The effluent discharged to Tati River, which feeds into the Shashe River, and subsequently into the Dikgatlong Dam (50 km downstream) is high in COD, ammonia, phosphate, turbidity, solids, total coliforms and faecal coliforms. The Project aims to improve wastewater treatment process to ensure that these parameters are reduced to levels that are acceptable before discharged to the environment; and reduce the risk of pollution to the environment, groundwater sources, and the downstream Dikgatlong Dam. The WWTP serves about 120,000 people as well as commercial and industrial users in Francistown and Tati Siding.

3. The Water Utilities Corporation (WUC) of Botswana, in compliance with Botswana EIA laws and regulations, commissioned an Environmental and Social Impact Assessment in 2013 in support of the designs for rehabilitation and expansion of the WWTP. The assessment undertaken was termed "retrospective" because the WWTP was constructed prior to the enactment of the Botswana EA Act of 2011, hence no environmental and social impact assessment was conducted to ensure that the plant complies with acceptable environmental and social standards. The need to address environmental issues became urgent when a WUC commissioned National Occupational Safety Association (NOSA) Health and Environment baseline audit revealed that the plant was releasing inadequately treated raw sewage into the Tati River, which in turn flows into the Dikgatlong Dam. A Preliminary Environmental Impact Assessment was consequently undertaken in 2011, following which the Department of Environmental Affairs (DEA) required WUC to prepare an Environmental Management Plan.

4. The "Retrospective EIA" concluded that the Mambo WWTP is inefficient, running beyond capacity and a threat to public health. It recommended that the inefficiency of the Mambo WWTP be addressed by one of the following three options, (i) Plant Upgrade, (ii) Plant Expansion, and (iii) Plant Closure. The third option (plant closure) was rejected because it is considered unrealistic given the lack of current alternatives and the likelihood of worsening the situation in the short to medium term while a replacement option is put in

place. The plant was constructed in 2003 and designed for a 10-year life span and a capacity of 15,000 litres per day. Although the effluent reaching the plant has not yet reached its full design capacity of 15,000 litres per day (estimates put influent levels at 9,000 litres per day), it currently cannot cope with the volume of sewage it receives (to which surface run-off is added during rainfall season) and the composition of waste it receives (a large quantity of untreated industrial waste is received by the plant). The 1<sup>st</sup> and 2<sup>nd</sup> options on rehabilitating and expanding the WWTP were therefore considered to be more pragmatic and cost-effective.

5. The World Bank has agreed to support the rehabilitation of the WWTP as a means of protecting Botswana's water resources, by averting the potential pollution of the Dikgatlong dam; addressing pollution of nearby water sources - including groundwater, which is relied on by communities downstream of the WWTP; and improving the quality of effluent – such that options for wastewater reuse can be expanded. In order to comply with the World Bank's Safeguard Policies a full scale ESIA would need to be prepared to address the gaps identified in Section III below.

### **III. Bank Review of the Retrospective Environmental Impact Assessment for the Mambo WWTP:**

6. The objective of the review of the retrospective ESIA, was to ascertain its compliance with the World Bank Safeguards Policies, and to make recommendations on what needs to be done to update the document so as to comply with the required standards.

7. As noted above, the assessment undertaken by WUC was termed "retrospective" because the WWTP was constructed prior to the EA Act of 2011. HERBCO Technical Services, based in Gaborone, was selected to carry out the assessment and prepare the EMP. This exercise was completed in April 2013.

8. **The appropriate environmental safeguard tool to deal with a development that was not covered by an environmental impact assessment at construction stage, would have been an environmental audit. In line with World Bank procedures this would provide a more systematic evaluation of the nature and extent of all environmental areas of concern (including Occupational Health and Safety) at the WWTP.** However, as a typical environmental audit focuses on: (1) compliance of the plant's existing facilities and operations with relevant environmental laws, regulations, and national requirements, and (2) the nature and extent of significant adverse environmental impacts, **the "retrospective EIA" has largely achieved these objectives.** The retrospective EIA identifies key areas of concern identified and outlines remedial measures.

9. As part of the "retrospective assessment", two separate studies were carried out: 1. An Archaeological Impact Assessment; and 2. Effluent quality tests.

a. The Archaeological assessment concluded that the plant does not pose any threat to the archaeology of the area but provided for measures to be taken in case of chance finds. **This is in line with World Bank's OP/BP 4.11 (Physical Cultural Resources) policy.**

b. The Effluent quality tests, for their part, showed that the effluent released by the plant poses "significant" health and environmental risks. **However, the risks have not been**

**adequately assessed as no laboratory tests were conducted at different points between the plant and the entrance to the Dikgatlhong Dam (located 50 km away). Test points would be required on the Tati and Shashe Rivers which receive the effluent from Mambo WWTP. The Shashe River feeds directly into the dam. Shashe River only meets the effluent at the confluence of the two rivers.**

10. The retrospective review also undertook **fairly extensive consultations with key stakeholders (including farmers). A summary of key issues raised has been included in the report.** The level of consultations, the records of meetings, and the weight given to the stakeholders' points of view in the assessment are satisfactory and would have been in conformity with World Bank's Safeguard Policies.

11. In conclusion, the "Retrospective EIA" recommended that the inefficiency of the Mambo WWTP be addressed by one of these three options: 1. Plant Upgrade; 2. Plant Expansion; and 3. Plant Closure.

12. The discussion of the first two options, provides a detailed description of the composition of the sewage and the best available treatment methods to ensure that i) the quality of the effluent adheres to national effluent standard BOS 93:2012, and ii) it is safe for discharge into the environment or for reuse in agriculture. As noted above, the third option (plant closure) was rejected because it is considered unrealistic, given the lack of current alternatives. In summary, the study recommends option 1, which involves upgrading of the WWTP by "fixing the plant components that are not operating and improving processes". It was estimated that this option would require a 3-6 months implementation time period. WUC intends to also prepare detailed designs for option 2 – the eventual expansion of the plant.

13. **The Environmental Management Plan, which is currently the main environmental safeguard instrument, together with the monitoring plan, is inadequate.** It does not meet the requirements of the World Bank Safeguard Policies as the description of mitigation measures, their schedule for implementation and cost estimates are not comprehensive enough to ensure adequate monitoring and reporting during implementation.

14. The EMP should also include measures designed to support effective implementation of environmental aspects of the project components. An assessment of the institutional capacity, roles and responsibilities of environmental units on site or at the WUC and ministry level, and if necessary, the strengthening of such units, and the training of staff, to allow effective implementation of EMP measures would be required. In addition, in order to strengthen environmental management capability at the plant and at the WUC, the EMP would need to evaluate the need for training programs and even organizational changes, if necessary.

15. **The approach to and/or method for disclosure of any documents would also need to be described** in accordance with WB safeguard procedures. It is assumed that there was no disclosure of the retrospective EIA to the public.

16. In conclusion, the upgrading of the WWTP at Mambo poses risks (in terms of World Bank requirements) in the sense that the plant has potential adverse environmental impacts on human populations or environmentally important areas, however these adverse impacts can be mitigated by the application of effective measures. **It is therefore advisable that a new**

**full-scale Environmental and Social Impact Assessment be carried out to include both a comprehensive and detailed Management and Monitoring Plan according to the World Bank Safeguard Policy OP/BP 4.01. This report will build on findings from the retrospective review.**

#### **IV. Objective**

17. The objective of the Environmental and Social consultancy services is to evaluate the design of the Mambo Wastewater Treatment Plant rehabilitation works, carry out a full-scale Environmental and Social Impact Assessment (ESIA) and prepare the associated Environmental and Social **Management** Plan (ESMP) and an Environmental and Social **Monitoring** Plan to ensure sustainability of the project through recommending appropriate environmental and social preventive, mitigation and monitoring interventions.

18. The ESIA should inform the Government of Botswana, WUC, interested and affected parties and other stakeholders about the potential environmental and social impacts and risks associated with the rehabilitation works at the Mambo WWTP. This will include those potential impacts at the WWTP site and surrounding areas, any upstream and/or downstream impacts and risks.

#### **V. Scope of Work**

##### **Task 1. Scoping**

19. The initial task is to define the Project Area of Influence in terms of both direct and indirect impacts to include the relevant sections of the Tati and Shashe River courses and the Dikgatlong Dam, review of the existing documentation that is relevant to environmental and social impact of the proposed WWTP rehabilitation, and to identify where there are (i) gaps, (ii) deficient or contradictory issues, or (iii) issues to be updated. The institutional arrangements will be reviewed for implementation, monitoring and reporting on the Environmental and Social Management and Monitoring Plans.

##### **Task 2. Description of the Proposed Project**

20. Based on the preliminary design study for the Mambo Wastewater Treatment Plant, the description of the project shall include:

- The Project Development Objective, description of the project activities, and the expected result,
- Project Components, and with regard to the Mambo WWTP, include (i) the current design parameters of the plant, (ii) details of the current sludge management in terms of quantity generated, treatment, transport and disposal/usage of,
- A description of the proposed pre-treatment of industrial waste,
- A description of the current customers of the WWTP and their existing and future wastewater disposal requirements,

- A description of the current status of WWTP operations, including the level of functionality of different facilities, based on results from lab and other tests conducted by WUC and DWA,
- A description of the planned improvements to the WWTP to bring it into compliance with standards; and to serve other future needs. This should include the proposal to expand the plant in the future and details of the future sludge management in terms of quantity generated, treatment, transport and disposal,
- Describe layouts, cross-sections, and other rehabilitation details for the WWTP construction and operation schedules, including scheduling of site mobilisation, and construction activities,
- a description of the responsible parties, including organization structure and staffing for the WWTP,
- Stakeholder consultation program with all project affected groups (social and environmental), and other stakeholders with the Project Area of Influence.

### **Task 3. Description of the Environment**

21. This section should include robust baseline information (quality and quantity) about the receiving surface waters for use in the assessment of the current impacts. This will be used also to demonstrate that the upgrades are delivering improvements in water quality (operational monitoring), and managing ecological flows. The baseline should sample the area impacted by discharges (i.e. from outfall to the Dikgatlong Dam as a minimum), include sampling from control points (upstream of outfall), and include COD, BOD, pH, TSS, Nitrogen, Phosphorus, coliform bacteria, etc.

Adequate information should be gathered about the environmental and social attributes of the receiving watercourses (navigation, recreation, irrigation, fishing, drinking, etc.) to establish a site-specific discharge quality that is consistent with the most sensitive use as well as with regulatory, National Standard, and WBG EHS Guideline requirements: the discharges should consider the assimilative capacity of the receiving water.

The air emissions and odours of the current plant shall be monitored (as pertinent to the treatments being carried out: e.g. Hydrogen sulphide, Sulphur dioxide, VOCs, Chlorine, Ammonia etc.) and measures built into the design of the new facility to minimise emissions/odours from proposed treatments, and to address any concerns raised during consultation. (Reference should be made to sector-specific WBG EHS Guidelines for further information)

22. The environment shall be described through assembly, evaluation and presentation of baseline data on the following:

#### **Physical environment:**

- nature of surrounding environment (including homes, farms, forest areas, industry, small business enterprises and other establishments) and proximity to these;

- description of the existing topography and the proposed areas which will be affected by any aesthetic impact;
- determination of the geology of the area through a geological description of borings and geophysical testing in order to determine the hydraulic characteristics of the groundwater;
- determination of all groundwater recharge areas and use of groundwater downgradient from the WWTP;
- condition and present and planned use of the effluent receptors and standards for discharge to the receptors;
- determination of meteorological data (net infiltration, temperature variations and prevailing wind directions).

**Biological environment:**

- survey all major terrestrial flora and fauna.
- collect any information on sensitive habitats in the area and any rare, endangered or commercially important species.
- identify any nearby protected areas.

**Socio-cultural environment:**

- describe past and present use of the location and surrounding land and any historical, religious, archaeological or cultural significance of the area, and a description of land ownership and land and non-land base livelihoods;
- determine the demographic character of the surrounding neighbourhoods;; and the sensitivity of the public to the proposed WWTP, including perception to increased odour, and aesthetic appearance;
- other planned development activities on the location and in the nearby surroundings.
- an assessment of the project impact on these groups and a determination of any land to be acquired or livelihoods that will be affected

**Task 4. Legislative and Regulatory Considerations**

23. The national and local legislation, and World Bank Group EHS guidelines (including the pertinent aspects of the general guidelines and the specific guidelines for WWTPs) are to be described and the authorities responsible for monitoring of construction and the environment are to be noted, including:

- The standards to be met for pre-treatment of influent from industrial customers;
- The standards for discharge of WWTP effluents during operation and during the rehabilitation/construction phase; and
- Occupational and community Health and Safety requirements

24. Discuss needs for education, inspection and enforcement to comply with existing and proposed legislation and any other requirements needed to ensure fulfilment of the proposed environment and social monitoring at national and local level.

#### **Task 5. Additional specialist studies**

- Implement an intensive monitoring program of influent and of all stages of treatment, to gain a better understanding of actual flow and loading conditions. The results should then be subjected to a plausibility check, based on the catchment area's characteristics, and finally the calibrated data shall be used to facilitate a proper design of all rehabilitation measures at Mambo WWTP.
- The assessment/EIA should also look into industrial pre-treatment at the main polluting industries. Such pre-treatment is always more cost-efficient than end-of-the-pipe solutions.
- Cumulative Impact Assessment (including modelling flows as appropriate)
- Groundwater analysis
- Occupational Safety and Health Plan

#### **Task 6. Determination of Potential Impacts of the Proposed Project**

25. Identify and describe all potential major environmental and social impacts from the WWTP rehabilitation which will be significant over the long-term. To include direct and indirect impacts, and cumulative impacts, from the rehabilitation and operation of the facility.

#### **Task 7. Analysis of Alternatives to the Proposed Project**

26. Describe the main alternatives that were examined in the course of conducting preliminary design and assessment of the proposed rehabilitation. Describe the main alternative designs for construction and operation which were examined. Include the "no action" alternative of the WWTP not being rehabilitated, but continuing with the existing WWTP as it is currently being operated.

27. Compare the alternatives in terms of key potential environmental and social impact (which are irreversible, unavoidable and which can be mitigated), capital and operation costs, sustainability under local conditions, and institutional, training and monitoring requirements. To the extent possible, quantify costs and benefits of each alternative.

#### **Task 8. Development of Environmental and Social Management Plan (ESMP)**

28. Recommended feasible and cost-effective mitigation measures to prevent or reduce significant negative impacts to acceptable levels. Indicate the impacts and costs of those measures, and of the institutional and training requirements to implement them.

29. Prepare management plan (including budget estimate, staffing requirements, monitoring, institutional and strengthening requirements and other necessary support) to implement the mitigating measures. The ESMP will identify clearly at what stage (design, construction, operation) each measure is to be implemented, and who will be responsible for ensuring that each measures is implemented.

30. The environmental and social management plan (ESMP) shall be prepared in a level of detail specific enough for incorporation into a tender package for potential construction works, and will be reviewed against the contract specifications and requirements to ensure that the ESMP does not weaken standard contract provisions. The ESMP will include a line item requiring the contractor to prepare a Construction ESMP that sets out the detailed actions that the contractor will take to deliver the mitigation measures and safeguard environmental and social features. The tender package will require the mitigation measures in the ESMP that have been identified as the responsibility of the contractor to be adequately priced and become part of the successful bidder's works contract. The ultimate aim is to foster on the ground implementation of effective measures during the project execution and operational phases.

#### **Task 9. Identification of Institutional Needs to Implement Environmental and Social Assessment Recommendations**

31. Review and describe the institutional capacity to implement, manage (including contract management during rehabilitation) and monitor (in the short term as well as in the long-term) the proposed rehabilitated WWTP. Recommend, if necessary, institutional strengthening at all levels.

#### **Task 10. Development of an Environmental and Social Monitoring Plan (ESSMP)**

32. The ESMP shall be prepared in such a manner that environmental and social requirements (mitigation measures and monitoring, technical specifications) related to the construction phase could be incorporated in the bidding/contract documents. The draft and final ESMP report will be revised in consideration of the comments of the relevant authorities in Botswana and the World Bank. The content of the final ESMP should include the following in reference to the World Bank's requirements of the OP 4.01- Annex C:

- (i) a mitigation plan that identifies and summarizes all expected potentially environmental and social impacts; describes each mitigation measure with technical details (e.g., designs, equipment description, related operating procedures) including the type of impact to which it relates and the condition under which it is required; and provides linkages with any other mitigation plans (involuntary resettlement/land acquisition framework or action plan, if any) required for the Project,
- (ii) a monitoring plan (ESSMP) including a specific description of monitoring measures (affiliated with the mitigation measures proposed in the mitigation plan) with the parameters to be measured, methods to be used, sampling locations, frequency of measurements; specific description of institutional arrangements, and the reporting procedures, and

(iii) an implementation schedule for mitigation, capacity building and monitoring measures proposed in the above plans and cost estimates and sources of funds for implementing the ESMP.

(iv) set up a monitoring plan for the operation of the rehabilitated WWTP.

#### **Task 11. Assist in Inter-Agency Coordination and Public/NGO Participation**

33. Prepare together with the Department of Environmental Affairs and local governments a meeting to which all relevant ministries and departments are invited. At this meeting, present the project, the environmental and social issues related to the project and the responsibility, involvement and commitments of the relevant ministries and departments.

34. Prepare also, together with the Department of Environmental Affairs and local governments, a public hearing to which all affected parties and relevant NGO's are invited. In the public hearing, present the project and all environmental and social issues related to the project. Keep records of these meetings.

#### **Task 12. Reporting**

35. The environmental and social impact assessment report shall be concise and limited to significant environmental and social issues. The main text must focus on findings, conclusions and recommendations, supported by summary of data collected and citation for any references used in interpreting those data.

36. The main report of the ESIA shall have the following outline:

- Executive summary: Non-technical summary, describing the outcomes of the ESIA as relevant to decision-makers and managers.
- Policy, legal and administrative framework (including limit values) that will apply to the project, and its implications for the project
- Baseline description (physical, biological and socioeconomic)
- Project description
- Environmental impacts
- Social Impacts
- Analysis of alternatives
- Environmental and Social Management Plan (ESMP) including details and costs of mitigation measures
- Environmental and Social Monitoring Plan (ESSMP) setting out the parameters to be monitored and the corresponding actions to be taken.
- Appendices: Technical details: Details of technical installations, prediction methods, a Chance Finds Procedure, and appendices of the baseline information, such as water quality and quantity monitoring points and data, air emission monitoring points and data, locations of sensitive natural habitats that are close to the works or that may be impacted by the works

- Report of public consultation and participation. Example of invitations in newspapers, other materials used to inform people. Minutes of meetings with the public and Non-Governmental Organisations (NGOs). Including details of how the comments raised have influenced (or other) the design development/implementation of the project.

## **VI. Deliverables**

37. The Consultant shall submit to the Client the following:

- 2 hard copies of Environmental and Social Impact Assessment (ESIA) report that includes an Environmental and Social Management Plan (ESMP) and an Environmental and Social Monitoring Plan (ESSMP) as one document within 12 weeks of commencement of the assignment,
- 8 soft copies of the reports (on flash disks) also containing copies of all word, excel, AutoCAD or other similar files used in compiling the report.

## **VII. Review of ESIA Deliverables**

38. All of the ESIA deliverables will be subject to review and approval by WUC, Botswana Department of Environment Affairs and the World Bank. Adequate time and resources should be allowed for this review and approval process,

## **VIII. The Outputs of, and timetable for, the consultancy:**

39. It is anticipated that the Consultant would complete the work over a maximum duration of three to four months. The expected outputs of this assignment are as suggested in the following schedule:

- (i) Inception Report no later than 2 weeks after signing the contract which will include inputs from first public consultation, and detailed work program,
- (ii) Draft Baseline Report no later than 4 weeks after signing the contract,
- (iii) Final Baseline Report no later than 6 weeks after signing the contract,
- (iv) Draft ESIA, Environmental and Social Management Plan (including draft bills of quantities for monitoring, mitigation and impact management for inclusion in tender documents for all works), and Environmental and Social Monitoring Plan no later than 8 weeks after signing the contract,
- (v) One day public consultation on the draft ESIA with ESMP/ESSMP approved by the Bank and Client,
- (vi) Final draft ESIA with ESMP and ESSMP,
- (vii) Final ESIA, ESMP and ESSMP incorporating Bank and Client comments no later than 10 weeks after signing the contract.

## **IX. Team Composition:**

40. **Consulting Team – Key experts: qualification and experience**

The Consultant team shall include professionals covering all skills and relevant experience (at least 10 years), including experience in similar projects, required to carry out the described tasks. The selected team shall have knowledge of the current national environmental legislation and procedures, the WBG EHS Guidelines, as well as the World Bank ESIA requirements, including experience on organizing public consultations. The team will include the following experts:

- (i) **project leader:** graduate engineer with extensive experience in environmental management aspects related to wastewater treatment plants; minimum 10 years of working experience in the relevant field, including minimum two assignments with tasks as a projects leader of similar projects;
- (ii) **environmental engineer/specialist** with expertise in pollution control and knowledge of river biology; minimum 10 years of working experience in the relevant field, with at least two assignments that included similar tasks;
- (iii) **Hydrology/hydrogeology specialist**, graduate civil engineer in the field of water resources engineering, minimum 10 years of working experience in the relevant field, with at least two assignments that included similar tasks;
- (iv) **Social Scientist/Socio-economic specialist**, with expertise in social and economic impact assessment and social science research methods with; minimum 10 years of working experience in the relevant field, with at least two assignments that included similar tasks.

**Annex I – Below are the proposed activities to be implemented at the Mambo wastewater treatment plant** (subject to change as per detailed designs)

Proposed key investments and technical recommendations are described below and shown on the accompanying plans:

**Design, Build and Operate**

- Prepare design, build and operate contract for Mambo Wastewater Treatment Plant (WWTP) to meet requirements of BOS 93: 2012 2nd ed. (Waste water – Physical, microbiological and chemical requirements - Specification), and WBG EHS Guidelines (whichever is the more stringent).
- Provide for required onsite and offsite training for various WUC personnel to enable independent operation of Mambo WWTP beyond contract operation period. Training to be continuous and sustainable ensuring appropriate skills transfer for the long term.

**Inlet Works and Pre-treatment**

- Design, supply installation and commissioning of a new mechanical septage receiving and screening (Night soil receiving bay);
- Design, supply, installation and commissioning of new preliminary treatment with 2 automatic fine screens of rotary drum sieves with circular 3mm openings and 2 automatic 25mm coarse screens;
- Design, supply, installation and commissioning of new aerated grit chambers for combined and efficient grit and fats, oils and grease (FOG) removal downstream of the new screens;
- Design system for improved handling of screenings.

**Primary Treatment**

- Design, supply, installation and commissioning of new primary sludge pumps and pipeline;
- Improve scum removal for both primary settling tanks, scum collection box and humus tanks;
- Design, supply, installation and commissioning of (mechanical) sludge thickeners and pumping system.

**De-nitrification Tank**

- Refurbishment of sludge re-circulation pump station;
- Downstream of the screens new aerated grit chambers;
- Design, supply, installation and commissioning of sludge removal pumps;

- Design, supply, installation and commissioning level and process control system.

#### Trickling Filters and Humus Tanks

- Design, supply, installation and commissioning of new Trickling filters with plastic media and active filter depth of about 5 meters;
- Rehabilitation of humus tanks;
- Design, supply, installation and commissioning of new pumping station (if required).

#### Sludge Digesters

- Major rehabilitation of digesters and gas holder;
- Design, supply, installation and commissioning of co-generation or micro turbines for the combined production of thermal energy and electric energy;
- Design, supply, installation and commissioning of sludge heating and circulation system for efficient operation of digester;
- Design, supply, installation and commissioning biogas collection and circulation system for the combined production of thermal energy and electric energy.

#### Control and Instrumentation

- Rehabilitation of existing C&I system;
- Configuration of the pumps and all equipment, instruments on PLC's for Mambo Plant PLC control and monitoring as per developed FDS;
- SCADA Development ( SCADA Engineering at Mambo Works Control room for all, SCADA graphics design, animation, trending, alarms, event logs, etc);
- Rehabilitation and configuration of existing flow metres;
- Supply, installation and commissioning of additional flow meters for the various treatment process.

#### Other Works

- Rehabilitation of water re-use system;
- Design, supply, installation and commissioning of new and improved effluent disinfection system;
- Design, supply, installation and commissioning of a new compressed-air reticulation system;
- Rehabilitation of chlorination and auxiliary plant;
- Rehabilitation of old ponds, pipeline and final pump station for diversion of excessive sewage flows;
- Construction of maturation ponds for polishing of effluent before discharge into environment;
- Rehabilitation of existing motor control centres and electrical installation;
- Rehabilitation of existing mechanical installations not covered under any of the above.