Procurement of Transaction Advisory Services for Project Preparation of Olifantsfontein Wastewater Treatment Works Water Reuse Project

Issued under the Water Reuse Programme and Water Partnership Office

ANNEX A: TECHNICAL REQUIREMENTS AND SCOPE OF THE PROJECT

This set of documents includes the following:

Terms of Reference for Transaction Advisors
Annex A: Technical Requirements and Scope of the Project
Annex B: Table of Contents of the Feasibility Study
Annex C: Terms of Reference Technical Options
Annex D: Terms of Reference ESIA
Annex E: Terms of Reference for Socio-Economic Analysis
Annex F: Gender Action Plan

This document, Annex A - Technical Requirements and Scope of the Project, is a template for use by the Project Owner and the WPO when preparing the Request for Proposals documentation for:

1. Wastewater treatment works, sludge treatment plants and new water reuse plants
2. Improvements to and/or rehabilitation of, existing wastewater and/or sludge treatment plants, and either of these combined with,
3. Plants for the reuse of treated wastewater for Direct Potable Reuse (DPR) or Reuse Treatment Plants (RTP) configurations for other uses such as industrial applications

This document should be read in conjunctiuon with the template for Scope of Work of Technical Consultants for advisory services to DBSA (WPO) in the development of the above projects.

This document is written to be a Technical Annex for inclusion in a Draft Agreement. It could be subdivided into separate annexes on design, performamce and monitoring.

These types of project(s) will invariably include conveyance systems and pumping stations, and although the text assumes that this will be the case, more definition will be required for specific projects. The assumption made here is that the Technical Consultant will have prepared a feasibility level design and estimated capital cost of the project.

It is important to understand that this is Annex and is tailored to suit the individual circumstances of any project to which it will be applied.

Notwithstanding, and once an initial draft is ready, it must be thoroughly sense and logic checked preferably by a third party, to ensure that it addresses all of the needs of the subject project.

An Annexure is included in which additional clauses and/or phrases are drafted for projects which will include wastewater reuse. It must be recognized that a potable reuse project is one with a much higher profile than general wastewater treatment water reuse as for example a supply to industrial customers. Selection of Concessionaires for these projects must be especially careful to ensure that the short-listed firms have sufficient experience of water reuse specifically if reuse is for the potable circuit.

Table of Contents

1. Scope of the Project

1.1 Overall Objective of the Project

The overall objective of the project is to implement the best technical option to treat wastewater for reuse at the Olifantsfontein WWTW and supply fee paying contracted off-takers for the reuse water.

<< add information >>

1.2 The Project Components

<<describe project components if needed>>

1.3 Phasing of the Components

<<describe specific phasing of the technical requirements if needed>>

2. Wastewater Flows, Characterization, Organic Loads and Water Reuse

2.1 Wastewater Flows and Water Reuse Flows

The following definitions are used in this annex:

- Sanitary Wastewater Flow. The flow of wastewater from residential areas, including flow from commercial and government premises.
- Industrial Wastewater Flow. The flow of wastewater from industrial premises.
- Infiltration Flow. The flow of ground water into the sewer system.
- Inflow Flow. The flow of surface water into the sewer system.
- Annual Average Flow (AAF). The annual average of all flows in a sewer system arriving a specific point.
- Dry Weather Flow (DWF). The average flow arriving at a specific point in a sewer system after a period of dry weather.
- Dry Weather Peak Day Flow (DWPDF). The peak **day** flow arriving at a specific point in a sewer system after a period of dry weather.
- Dry Weather Peak Day Flow Factor (DWPFF). The ratio of DWPDF to DWF.
- Dry Weather Peak Hour Flow (DWPHF). The peak **hour** flow arriving at a specific point in a sewer system after a period of dry weather.
- Dry Weather Peak Day Flow Factor (DWPHFF). The ratio of DWPHF to DWF.
- Peak Flow (PF). The peak hour flow arriving at a specific point in a sewer system, usually during heavy rainfall.
- Peak Hour Flow Factor (PHFF). The ratio of PF to DWF.
- Volume of treated wastewater from the wastewater treatment works that is available water reuse treatment and customers

The usual unit of measurement of flows is in megalitres per day (MLD), except for infiltration, inflow and peak hour flows which can be in cubic metres per second (m^3/s) or litres per second (l/s). Design reports and technical information is available for the Olifantsfontein WWTW.

2.2 Existing Flows and Available Flows for Water Reuse

Design reports and technical information is available for the Olifantsfontein WWTW. (*This section should describe the output from flow records and analysis from the Client and Technical Consultant, presenting conclusions using the above definitions*)

2.3 Projected Flows for Water Reuse

Design reports and technical information is available for the Olifantsfontein WWTW. *(This section should present the flows which bidders should use for the design of the conveyance system and WWTP water reuse which are subject of the contract, The assumptions made in the estimation of all the elements of projected flows should be listed, what risks are implicit in those assumptions, and who carries those risks, the flows which are to be contractual are to be clearly identified as such.*

3. Wastewater Characterization and Water Reuse Characterization

3.1 Background

Design reports and technical information is available for the Olifantsfontein WWTW. (*The basis for development of the projected concentrations for water reuse treatment plant should be explained*)

3.2 Existing & Projected Concentrations of Treated Wastewater for Reuse Plant

Design reports and technical information is available for the Olifantsfontein WWTW. (*A list of water reuse characteristics, and projected average and maximum concentrations at design horizon)*

*Tables **such as** the following (Table 1 and Table 2) should be included>>*

Table 1: Biological Parameters

Parameter	Existing Average Concentration mg/l	Projected Average Concentration mg/l	Projected Maximum Day Concentration mg/l
COD			
BOD_5			
NH_4 - N			
PO_4 - P			
TSS			
Oils, Fats and Grease			
Total Coliforms			
Faecal Coliforms			

Table 2: Metals

Parameter		Existing Average Concentration mg/l	Projected Average Concentration mg/l	Projected Maximum Day Concentration mg/l
Arsenic	As			
Boron	B			
Cadmium	Cd			
Chromium III	Cr^{3+}			
Copper	Cu			
Cyanide	CN^-			
Fluoride	F			
Iron	Fe			
Lead	Pb			
Manganese	Mn			
Mercury	Hg			
Nickel	Ni			
Selenium	Se			
Zinc	Zn			

4. Treated Wastewater Organic Loads

4.1 Background

Design reports and technical information is available for the Olifantsfontein WWTW. (Explain the principle of average and maximum expected daily load of the organic parameters).

4.2 Projected Organic Loads for Reuse Plant

Design reports and technical information is available for the Olifantsfontein WWTW. <<the existing loads arriving at the Water Reuse Plant calculated as average concentration tables ***such as*** *Table 3 the following should be included>>:*

Table 3: Projected Organic Loads for Reuse Plant

Parameter	Existing Average Load kg/d	Projected Average Load kg/d	Projected Maximum Day Load kg/d
COD			
BOD_5			
NH_4 - N			
PO_4 - P			
TSS			
Oils, Fats and Grease			

5. Water Reuse Plant Influent Thresholds

Design reports and technical information is available for the Olifantsfontein WWTW. (*This section summarises the contractual influent flows and loads to the water reuse pant)*

5.1 Treated Wastewater Effluent Requirements and Water Reuse Plant Influent

Design reports and technical information is available for the Olifantsfontein WWTW. (*State the current name of the receiving body. State the national standards and the specific receiving body requirements)*

5.2 Conveyance System Performance Requirements

Design reports and technical information is available for the Olifantsfontein WWTW. (This will depend on the specific water reuse technology and plant.)

6. Water Reuse Plant Performance Requirements

6.1 Hydraulic Capacity

Design reports and technical information is available for the Olifantsfontein WWTW. (The design hydraulic capacity must be clearly set out for the Water Reuse Plant)

6.2 Biological Treatment Capacity

The design organic load capacity must be clearly set out)

6.3 Biproducts Treatment and Disposal

6.3.1 Solids Management

The Water Reuse Plant shall include the solids management processes within the pr treatment area:

6.3.2 Concentrate Liquid Material Management

The Water Reuse shall include a process for removal of any concentrated liquid material within the treatment area.

6.3.3 Fats, Oils and Greases Management

The Reuse Plant shall not necessarily include a dedicated process for removal of fats, oils and grease.

6.3.4 Sludge Management

All sludges for the water reuse treatment plant shall be concentrated before digestion to a water content appropriate for the digestion process.

7. General Design and Technical Requirements

7.1 General

Designs off the conveyance system and Water Reuse Plant shall include all required disciplines including process, hydraulics, geotechnical, civil and architectural, mechanical and electrical, automation control and telemetry, access, ventilation and natural hazard management.

The design shall make allowance for redundancy and process units that are taken out of service for maintenance or repair, such that the water reuse pant can continue to treat wastewater from the WWTP to the required standard.

The Water Reuse Plant layout shall include necessary security infrastructure and landscaping features such as green areas, trees, shrubs and, where needed, boundary tree screens.
The Water Reuse Plant design shall include a supervisory data control and automation (SCADA) system of a form to be agreed with <<contracting authority>>.

7.2 Technical Specifications

Technical specifications will be <<insert list of national references for civil, mechanical and electrical engineering>>.

7.3 Reporting

The Concessionaire shall prepare monthly reports reflecting the results of all monitoring requirements as outlined in all sections above; i.e. i) for the contract KPIs, ii) compliance with standards, iii) operational monitoring of the treatment and iv) water quality hazards and intervention. Information to be collated into an Annual Project Report and submitted to the WPO at the end of the calendar year. **Note:** Funding Activity Agreement (FAA) reference - Project level monitoring: Undertaken as per the project specific log frame that will be compiled for each sub-project funded by the WRP. The project teams will be required to report to the WRP biannually based on the project log frame. As part of the monitoring the WRP will establish baselines for each paradigm shift dimension to develop the paradigm shift scorecard using the approach outlined by Green Climate Fund (GCF) in the Integrated Results Management Framework (IRMF) Handbook.

8. Qualifications and Experience Requirements of Design Team

8.1 General

The design team must be qualified and experienced in the design of wastewater conveyance and treatment projects. It must include expertise in:

- Water quality
- Treatment process design
- Concentrated material and sludge disposal
- Civil, structural, mechanical and electrical engineering
- SCADA and
- Water reuse treatment regulatory requirements

8.2 Key staff experience requirements

The design team will include as a minimum experience as per Table 4.

Table 4: Minimum Experience

Position	Minimum Experience
Team Leader	15 years of international experience engineering design, of which at least 10 years must have been in the water/wastewater sector, and at least 3 years of experience with projects in <<*the project region or country*>>.
Water Reuse Treatment Engineer or Scientist	15 years of experience in wastewater treatment plant design, of which at least 3 years must have been on treatment processes for treatment plants in <<*the project region or country*>>.
Solids Management specialist	10 years of experience in wastewater solids management and disposal strategies, of which at least 1 year must have been in country
Structural Engineering Specialist	8 years of experience of structural design in the water/wastewater sector, of which at least 1 year must have been in <<*the project region or country*>>.
Mechanical Engineering Specialist	8 years of experience of mechanical engineering design in the water/wastewater sector, of which at least 1 year must have been in <<*the project region or country*>>.
Electrical Engineering Specialist	8 years of experience of electrical engineering design in the water/wastewater sector, of which at least 1 year must have been in <<*the project region or country*>>.
Regulatory Specialist	15 years of experience in the wastewater treatment regulatory environment

Annexure A: Additional Clauses relating to Reuse Projects

The following clauses are intended to be added to the body of the preceding document in cases where the wastewater treatment plant is to be followed by a reuse project component.

The reuse component will always include a Reuse Treatment Plant (RTP) and will always include a conveyance system which will invariably include a pumping station.

In the case of Indirect Potable Reuse (IPR), the conveyance system will terminate in an environmental buffer, which will be a reservoir or an aquifer, which in turn feeds water to a Drinking Water Treatment Plant (DWTP). In the case of Direct Potable Reuse, the conveyance system will terminate at an existing DWTP.

This Annexure assumes an IPR type of project, but the RTP requirements will be very similar for a DPR type of project.

1 Scope of the Project

1.1 Overall Objective of the Project

<<to include the reason for reuse, the form of reuse (IPR or DPR), and the reuse product water flow>>.

1.2 The Project Components

<<to include the reuse components of RTP and conveyance>>

1.3 Phasing of the Components

2 Wastewater Flows, Characterization and Organic Loads

2.1 Wastewater Flows

2.1.1 Definitions

2.1.2 Existing Flows

2.1.3 Projected Flows

2.2 Wastewater Characterization

2.2.1 Background

2.2.2 Existing and Projected Concentrations

2.3 Wastewater Organic Loads

2.3.1 Background

2.3.2 Existing and Projected Organic Loads

3 Contractual Influent Thresholds at Wastewater Treatment Plant

4 Treated Wastewater Effluent Requirements

5 Wastewater Conveyance System Performance Requirements

6 Wastewater Treatment Plant Performance Requirements

6.1 Hydraulic Capacity

6.2 Biological Treatment Capacity

6.3 Biproducts Treatment and Disposal

6.3.1 Screenings Management

6.3.2 Grit Management

6.3.3 Fats, Oils and Greases Management

6.3.4 Sludge Management

7 Reuse Water Quality Standards

7.1 Standards

The quality of the Reuse Water of the Reuse Plant shall comply with the standards as specified in the <<*national drinking water standard*>>, with selected adjustments, as follows.

Nutrient parameters <<*if needed in relation to environmental buffer WQ*>>

Bacteriological (microbiological) parameters <<if needed in relation to environmental buffer WQ>>

7.2 Sampling and Compliance

7.2.1 Bacteriological (microbiological) parameters

When the RTP is delivering water to <<*the environmental buffer*>>, grab samples will be collected twice per day (early morning and afternoon).

If any sample collected during the day exceeds the standard, then the RTP will be non-compliant with the Reuse Water Standards and deemed unavailable for that entire day.

7.2.2 Nutrients

A minimum of one grab sample to test for nutrients will be collected daily.

If the monthly average of the collected samples exceeds the standard, then the RTP will be non-compliant with the Reuse Water Standards and the Performance Liquidated Damages for failure to meet the Reuse Water Standards will be applicable for this entire month.

For the avoidance of doubt, the monthly average is determined for each calendar month and the Concessionaire must communicate this monthly average to the Contracting Authority no later than the first day following the past calendar month.

7.2.3 Chemicals

When the RTP is delivering Reuse Water to <<*the environmental buffer*>>, samples for inorganic micro-determinants (including heavy metals) shall be collected daily. If the monthly average of test results from the collected samples exceeds the applicable Reuse Water Standards, then the RTP will be non-compliant with the Reuse Water Standards and the Performance Liquidated Damages for failure to meet the Reuse Water Standards will be applicable for this entire month.

For the avoidance of doubt, the monthly average is determined for each calendar month and the Concessionaire must communicate this monthly average to the Contracting Authority no later than the first day following the past calendar month.

7.2.4 Additional Parameters

Frequency of sampling and reporting of additional parameters shall be related to the type of risk associated with each parameter, i.e.: acute health, chronic health, aesthetic or operational risks and the frequency of sampling and testing shall be determined on the basis of Best Industry Practices.

Organic chemical parameters (such as residues of pesticides; associated with chronic health risks) shall be carried out on a monthly basis:

- Once a month a grab sample shall be taken and analyzed on organic chemical parameters.
- If a parameter has not been detected for three consecutive months, it may be waived from analysis for the next three months.
- If detected, the frequency of sampling and analysis for that parameter shall be increased to twice a month.

To address potential risks from CECs, sampling and testing of WWTP influent and RTP produced water on all possible contaminants. If any such chemical is detected it shall be added to the list of 'routine' tests.

8 Reuse Treatment Plant Performance Requirements

8.1 Hydraulic Capacity

Treated Effluent from the WWTP shall be used as feed water for the Reuse Treatment Plant (RTP) and shall be available at a steady rate during 24 hours per day. Volumes of Reuse Water produced shall be optimized, such as by recycling of backwash water.

The Reuse Treatment Plant (RTP) shall be of <<*XX*>> MLD produced water capacity.

8.2 Treatment Capacity

8.2.1 Drinking Water Standards

The RTP shall produce water of a quality which complies with <<*the standards described above in 7.1*>>.

8.2.2 Microbial pathogens

In addition, the RTP shall achieve performance targets for microbial pathogens log reduction as shown in the following table:

	Enteric bacteria (Campylobacter)	**Enteric viruses (noroviruses)**	**Enteric protozoa (Cryptosporidium)**
Minimum log reduction values in Reuse Plant[1]	8.5	9.5	8.5

During pre-commissioning of the Reuse Plant, the performance shall be verified by undertaking on-site testing. This shall be done by measuring LRVs of the reference pathogens as listed above. Alternatively, surrogate organisms can also be used provided a correlation or conservative relationship with the reference pathogens is established.

8.2.3 Multiple Barriers

In addition, the RTP shall incorporate multiple process barriers as follows, by contaminant category:

- Trace organics and disinfection by-products - four barriers
- Microbiological pollutants - three barriers
- Physical and organoleptic parameters - two barriers
- Inorganics (i.e. heavy metals) - two barriers

In the count of numbers of barriers, a barrier may be effective against more than one category of contaminant. The multi-barrier criteria shall apply to the RTP only and shall be exclusive of possible barriers in the WWTP, the <<*environmental buffer*>>, and downstream drinking water treatment.

9 Reuse Water Conveyance System Performance Requirements

<<*this will depend on the specific project*>>

<<*what must be clear is the max flow that is to be conveyed*>>

[1] a log reduction value (LRV) of 1 represents 90% removal, an LRV of 2 represents 99% removal, etc.

<<if the conveyance system includes and pumping stations, the expected storage capacity should be stated, the maximum pump discharge through the pump main>>

10 Reuse Water Quality Hazards and Intervention

10.1 Monitoring Programme

In addition to the requirements normally imposed on drinking water quality, special attention is given to the hazards from using treated wastewater. Of major concern for water safety are the high bacterial loads in the WWTP effluent, the risk of industrial discharges to sewer containing toxic metals and compounds, and the possible presence of CECs in urban wastewater.

A Monitoring Programme shall be planned and implemented to address such water quality hazards and shall take account of the following aspects:

- Distinction shall be made between acute health risks and chronic health risks. The possible presence of microbial pathogens in reuse water is the greatest concern with respect to potential acute impacts on human health. If these occur, they call for emergency measures. Chronic risks, usually from potential chemical concentrations, are generally associated with long-term exposures and would not require implementation of emergency measures.
- The potable reuse system, consisting of the WWTP (activated sludge process) and a series of treatment steps in the RTP, is configured such that, under normal operation conditions, the water quality standards are achieved and the health requirements are met. Control thus consists of appropriate monitoring of the entire treatment process in order to adjust the operation of the treatment process if necessary and take additional measures if so required.
- The mitigation of hazards and risks to the water quality requires more stringent monitoring is needed. Continuous monitoring to confirm that individual treatment barriers are operating within design criteria provides assurance that drinking-water quality targets are being achieved. Both acute and chronic risks must be managed.
- The presence of microbial pathogens is the greatest concern with respect to potential acute impacts on human health. If these occur, they call for emergency measures. However, because of the environmental buffer there would be no immediate health concerns in case the product water of the reuse plant occasionally (and for short durations) does not meet the bacterial standards. However, it is advised that changes in operational monitoring parameters implying a lesser level of microbial removal or inactivation should trigger immediate corrective responses such as reducing water flow rates or boosting disinfectant doses.
- Chronic risks, usually from potential chemical concentrations, must also be managed. While deviations in operational parameters for chemical contaminants should be corrected as rapidly as feasible, risks are usually associated with long-term exposures and usually would not require implementation of emergency measures.
- Monitoring of unit processes at control points within a treatment train requires identification of appropriate parameters and target criteria to define operational performance acceptability. Target criteria can take the form of operational limits and critical limits.

  Critical limits for treatment processes used in potable reuse separate acceptable from unacceptable performance and loss of confidence in water safety.

  Operational limits are typically used as early warning signals that performance of control measures is deteriorating and enable implementation of corrective action before critical limits are breached.

Parameters for monitoring, which may include indicator parameters that represent a group of contaminants, shall be selected to that allow for a meaningful and rapid assessment of

performance. Where possible, the selected parameters should allow for on-line monitoring. This shall be supported by more comprehensive but less frequent monitoring.

10.2 Reporting and Incident Protocol

A Reporting and Incident Protocol shall be planned and implemented to ensure effective response in instances of water quality hazards. The Protocol shall take account of the following:

- Special attention shall be given to situations where actions are to be taken in response to incidents and emergencies. Considered and controlled responses to incidents that may compromise water safety are essential for protecting public health and maintaining consumer confidence. In many cases the key to maintaining safety will be implementation of rapid and effective responses. Responses to incidents need to be planned, coordinated and executed in an orderly and timely fashion. In the event of significant incidents or emergencies, maintaining consumer trust is essential. This will be influenced by how incidents and emergencies are handled and communicated. All agencies involved in responses need to be fully informed, aware of their responsibilities and act in a coordinated manner.
- The presence of microbial pathogens is the greatest concern with respect to potential acute impacts on human health. Changes in operational monitoring parameters that imply a lesser level of microbial removal or inactivation will require immediate corrective responses such as reducing water flow rates or boosting disinfectant doses. Chronic risks, usually from potential chemical concentrations, must also be managed. While deviations in operational parameters for chemical contaminants should be corrected as rapidly as feasible, risks are usually associated with long-term exposures and usually would not require implementation of emergency measures.
- Indicative content of incident protocols:

  Incident criteria such as:
  - Non-conformance with health-based targets;
  - Non-conformance with critical limits (e.g. exceedance of filtered water turbidity, failure to meet UV intensity required for advanced oxidation, failure to meet disinfectant Ct values);
  - Accidents/spills that increase levels of contaminants (e.g. discharge of industrial waste into sewerage systems);
  - Treatment failure;
  - Prolonged power outage; and
  - Extreme weather (e.g. floods, droughts) and natural disasters.
- Requirements to report unforeseen and undefined incidents that could represent significant risks.
- Reporting requirements including timelines and methods (e.g. significant incidents notified verbally within one hour).
- Information to be collated into an Annual Project Report and submitted to the WPO at the end of the calendar year.
- Responsibilities of all stakeholders.
- Communication protocols and strategies including notification procedures (internal, regulatory authorities, key agencies, senior management, consumers and media).
- Communication protocols between wastewater and reuse plant operator and the drinking water treatment plant operator.
- Emergency contact lists.

Each incident shall be evaluated on whether the response has been optimal and effective.

11 General Design and Technical Requirements

11.1 General

Designs off the wastewater conveyance system, WWTP, RTP and reuse conveyance system shall include all required disciplines including process, hydraulics, geotechnical, civil and architectural, mechanical and electrical, automation and control, access, ventilation and natural hazard management.

The design shall make allowance for process units that are taken out of service for maintenance or repair, such that the WWTW or RTP can continue to treat wastewater, reuse water and sludge to the required standard.

The WWTP and RTP layout shall include landscaping features such as green areas, trees, shrubs and, where needed, boundary tree screens.

The WWTP and RTP design shall include a supervisory data control and automation (SCADA) system of a form to be agreed with <<contracting authority>>.

11.2 Technical Specifications

12 Reporting

13 Qualifications and Experience Requirements of Design Team

13.1 General

The design team must be qualified and experienced in the design of wastewater conveyance and treatment projects, and in reuse projects. It must include expertise in:

- Water quality
- Water Reuse treatment process design
- Solids and sludge disposal
- Reuse water conveyance design
- Civil, structural, mechanical and electrical engineering
- SCADA
- Wastewater treatment regulations

13.2 Key staff experience requirements

The design team will include as a minimum:

Position	Minimum Experience
Team Leader	15 years of international experience engineering design, of which at least 10 years must have been in the water/wastewater sector, and at least 3 years of experience with projects in <<*the project region or country*>>.
Treatment Engineer or Scientist	15 years of experience in wastewater treatment plant design, of which at least 3 years must have been on treatment processes for treatment plants in <<*the project region or country*>>.
Solids Management specialist	10 years of experience in wastewater sludge management and disposal strategies, of which at least 1 year must have been in <<*the project region or country*>>.
Reuse Water Treatment Engineer or Specialist	8 years of experience in potable reuse water treatment, of which at least 1 year must have been in <<*the project region or country*>>.

Position	Minimum Experience
Structural Engineering Specialist	8 years of experience of structural design in the water/wastewater sector, of which at least 1 year must have been in <<*the project region or country*>>.
Mechanical Engineering Specialist	8 years of experience of mechanical engineering design in the water/wastewater sector, of which at least 1 year must have been in <<*the project region or country*>>.
Electrical Engineering Specialist	8 years of experience of electrical engineering design in the water/wastewater sector, of which at least 1 year must have been in <<*the project region or country*>>.
Regulatory Specialist	15 years of experience in the wastewater treatment regulatory environment