



## TERMS OF REFERENCE

### **INDEPENDENT PANEL OF EXPERTS (IPE) FOR THE IMPLEMENTATION OF 4<sup>TH</sup> NAIROBI WATER SUPPLY PROGRAM: NORTHERN COLLECTOR TUNNEL PHASE 1**

#### **1. BACKGROUND INFORMATION**

The total developed water production capacity for Nairobi City is 520,000m<sup>3</sup>/day against a current projected demand of 670,000m<sup>3</sup>/day. To meet the deficit and ensure water security for the City and Satellite Towns a Water Master Plan was launched in 2012 that provided a development blue print comprising least cost development options identified and selected based on a multi criteria analysis to meet demand up to a 2035 horizon.

The phased developments include:

- i. **Phase 1(2012-2015):** Ground water exploration and development subject to supporting results from exploratory phase, yield 45,000m<sup>3</sup>/d
- ii. **Phase 2(2012-2016):** Northern Collector 1 and downstream works, yield 140,000m<sup>3</sup>/d
- iii. **Phase 3(2017-2020):** Maragua dam, South Mathioya tunnel and downstream works, yield 132,000m<sup>3</sup>/d
- iv. **Phase 4(2021-2025):** Northern Collector 2 and downstream works, yield 120,000m<sup>3</sup>/d
- v. **Phase 5(2026-2029):** Ndarugu 1 dam and downstream works, yield 216,000m<sup>3</sup>/d

The Government of Kenya through Athi Water Services Board (AWSB) is undertaking implementation of Phase 2 of the Water Supply Masterplan for Nairobi City and satellite towns. The project involves:

- i. Construction of the Northern Collector Tunnel Phase 1 to divert parts of the flows from rivers Maragua, Gikigie and Irati into the existing Ndakaini dam
- ii. Construction of community schemes in Muranga County to serve people in the areas where the water is being abstracted.
- iii. Construction of Kigoro Water Treatment Plant with a capacity of 140,000m<sup>3</sup>/day
- iv. Construction of raw and treated water pipelines from Ndakaini dam to Kigoro and to Gigiri
- v. Upgrading of Nairobi City water distribution network

Procurement of a design-build package for the Kigoro Water Treatment Plant is underway.

The construction of the Northern Collector Tunnel 1 has been contracted and the contractor mobilized. The works are scheduled to be completed by December 2017. Procurement for the construction of the raw and treated water pipelines is ongoing and the works are expected to commence by December 2015.

## **2. OBJECTIVE OF THE INDEPENDENT PANEL OF EXPERTS (IPE)**

Athi Water Services Board, a state corporation under the Kenya Ministry of Water and Irrigation intends to establish an Independent Panel of Experts (IPE).

The Independent Panel of Experts will be mandated to provide an independent assessment and review of technical, environmental and social issues associated with the project. **The Panel is required to act independently from central or county government institutions** such as the Government of Kenya, Athi Water Services Board, Nairobi Water and Sewerage Company and others. It has to act in accordance with relevant Agence Française de Développement/French Development Agency (AfD) and World Bank guidelines. Both of these agencies providing finance for parts of the project.

The Independent Panel of Experts will play a decisive role through the implementation of the project and during the initial operational phase of the project.

All members of the Independent Panel of Expert will be procured in accordance to World Bank's guidelines for selection and employment of consultants: Individual Consultants. AWSB will engage an independent evaluation committee headed by the Water Sector Regulator (WASREB) to constitute the panel. The selection committee will also consist of representatives from the Institution of Engineers of Kenya, the Geological Society of Kenya, the Hydrological Society of Kenya and the Environmental Institute of Kenya.

The IPE will:

- i. Provide an independent review and guidance for the environmental and social aspects of the hydraulic infrastructures based on the ESIA Report and Environmental and Social Management Plan developed by Athi Water Services Board, the client, and make proposals to strengthen the environmental and social monitoring, if needed. The IPE should be able to review the project components from various disciplines' perspectives in an integrated manner.
- ii. Provide general/broad guidance on the treatment of environmental and social issues associated with the project, providing advice to relevant stakeholders including the Development Partners on project compliance with environmental and social directives and recommending remedial action.
- iii. Conduct a review of all technical and social aspects of the community projects' design and implementation.
- iv. Conduct a technical and safety review of the project infrastructure including the diversion/intake weirs, tunnel, Kigoro treatment plant, raw and treated water pipelines

and community projects based on the detailed designs and engineering procedures. The detailed designs have been prepared by technical consultants.

- v. Review the dam safety report on the current condition of the storage reservoir, Ndakaini Dam (dated January 2013), the dam instrumentation plan, Emergency Preparedness Plan and Operational and Maintenance plan to be prepared by a technical consultant under procurement. The IPE will also conduct a review of the dam's basic design and operational philosophy. The panel of expert should provide guidance and recommendations for the development of a working operational philosophy following implementation of the Northern collector tunnel Phase 1 project and develop a TOR for the same if need be. The IPE will further give recommendations and guidance on any modifications to the detailed design and construction of remedial works, the Emergency Preparedness Plan (EPP), the reservoir Operation and Maintenance plan, and the dam Instrumentation Plan which will be developed by AWSB through a technical consultant.
- vi. Advise on environmental policies and standards, geotechnical standards, hydrological assessment, water resource development and technical-level support for environmental remediation and litigation processes, including remediation system design and determination of regulatory applicability.
- vii. Review the quality and sufficiency of geological investigations, interpretation thereof, correctness of the geological and hydrological models, engineering implications with respect to foundation designs, and stability of natural and excavated slopes, support of surface and underground excavations and the design of temporary and permanent support systems and lining.
- viii. Review the construction techniques, scheduling and quality control procedures, including the design, schedule and risk factors of diversion works during construction. The IPE will also review the potential risk and hazard for downstream areas of both the intake diversion weirs of Maragua, Gikie and Irati rivers and downstream areas of Ndakaini Dam
- ix. Review the technical report prepared by Muranga County on the Construction of the Northern Collector Tunnel phase 1 works and provide recommendations.
- x. Review written concerns from any stakeholders and prepare a written response to the stakeholder(s). AWSB will publish the concerns raised and the IPE's response unaltered on their webpage.

The opinion of the IPEs will be provided to the Project Steering Committee through the Chief Executive Officer: Athi Water Services Board. The project steering committee will comprise of appointed members from Ministry of Water and Irrigation (MWI), Ministry of Finance, Athi Water Services Board (AWSB), Muranga County, Nairobi City Water and Sewerage Company (NCWSC), National Environment Management Authority (NEMA) and Nairobi City County (NCC). The project steering committee will play an oversight role for the Northern collector Tunnel Phase 1 Program including downstream works.

The IPE's opinion will be considered and reflected in the final products of the design and supervising consultancies' reports. The project safety function of the IPE will be guided by

the Government of Kenya's legislations, regulations and guidelines and relevant safeguard policies of the Development Partners.

### **3. DETAILED SCOPE OF WORK**

The IPE will conduct a review of the proposed Northern Collector Tunnel Phase 1 and related upstream and downstream works with emphasis on the points detailed below.

A Dam Safety Inspection was carried out by Egis Bceom International, and Mangat, I.B. Patel & Partners, and a report dated January 2013 prepared. AWSB is in the process of procuring a consultant to undertake design of the proposed remedial measures and prepare a detailed Dam Safety Plan under World Bank's OP4.37 (Safety of Dams Guidelines). The dam safety plan will comprise of: Instrumentation Plan, Upgraded Operation and Maintenance Plan and an Emergency Preparedness Plan.

The IPE will also therefore conduct a review of this dam safety plan of the existing Ndakaini Dam with emphasis on the following points:

#### **Hydrological Aspects, and Reservoir Operation**

- A. Review the results of hydrological assessment as well as water balance and safe yield analysis of the Maragua, Gikie and Irati Rivers.
- B. Review the existing Ndakaini Dam reservoir operation philosophy and rule curve for flood control, water supply, hydropower generation, and in-stream flow requirements
- C. Define terms of reference if need be for revision of the Ndakaini Dam Operation philosophy following implementation of the Northern Collector Tunnel Project.
- D. Review the adequacy of the adopted design standards for all hydraulic structures including those related to (i) flood hydrology/ frequency analysis, (ii) tunnel design criteria, capacity and construction procedures, (iii) Ndakaini reservoir operation, and (iv) Design and operation of the Kigoro Water Treatment plant.
- E. Review safety related monitoring records, instrumentation plans and the proposals for emergency system operation, and evaluate their safety and reliability.
- F. Review the structural and electro-mechanical design of the control gates at the diversion weirs and other inlet/outlet structures, lifting mechanism, control system, and operational procedures/arrangements.
- G. Inspect the conditions of gate support piers and gate block anchoring systems, any exposed reinforcement steel bars, and concrete conditions and effects of additional loading.

#### **Geotechnical Aspects**

- H. Review the geotechnical aspects of the design of the Tunnel, Kigoro Treatment plant and Raw and Treated Water pipelines including zoned materials, filter/drain arrangements, foundation / abutment treatments, reservoir rim stability, erosion control of downstream banks, and seismic analysis/design.
- I. Evaluate the competency of the main embankment dam, foundations and abutments to accommodate the additional load which would be created by the construction of

the Tunnel. Assessment to include future operation and identification of potential risks and recommendation of remediation measures

### **Environmental and Quality Control Plan**

- J. Review the overall implementation procedures and schedule of the completion works.
- K. Review the Environmental, Social, Quality Control management plans developed by the technical consultants and compliance with set international guidelines
- L. Review the construction technique, scheduling and quality control procedures, including the design, schedule and risk factors of diversion works during construction,
- M. Review the potential risk and hazard for downstream areas of both the Tunnel and downstream areas of Ndakaini Dam

### **Stakeholder Consultations**

- N. The proposed Northern Collector Tunnel Phase 1 and related upstream and downstream works environmental and social impacts, consultation will provide a series of opportunities to create understanding about the project among those it will likely affect or interest, and to learn how these external parties view the project and its attendant risks, impacts, opportunities, and mitigation measures. Stakeholder concerns and feedback is considered a valuable source of information and can improve project outcomes and help identify and control external risks.

In undertaking stakeholder consultation, the Environmentalist and Community Water Specialists will undertake among others the following:

- ❑ Review the entire consultations process and AWSB communication strategy that have been undertaken and implemented since project formulation and identify opportunities for improvement.
- ❑ Prepare a stakeholder consultation process plan and submit to Project Steering Committee for review. The plan will identify who needs to be consulted, over what topics, and for what purpose and when, and which IPE members need to be engaged in these consultations and when, in addition to AWSB and its experts.
- ❑ Receive the stakeholder concerns on various aspects of the project, document feedback received during the consultation process, and prepare responses. Both the concerns received and the IPE's responses will be published on AWSB's webpage.
- ❑ Identify any proposed mitigation measures, or development benefits and opportunities for consideration by the PSC.
- ❑ Integration of women and other gender perspectives in the proposed consultation process
- ❑ Document the process and results of consultation

### **Operation & Maintenance and Instrumentation Plan**

- O. Review the Operation & Maintenance (O&M) Plan that covers organizational structure, staffing, equipment and facilities needed to operate and maintain the NCT1 system and Ndakaini dam; O&M procedures and funding arrangements

including long term maintenance and safety inspections and make recommendations for modification if required.

- P. Recommendations/modifications for revising and upgrading the O&M Plan for the dam and reservoir system at the higher operational level that would cover the O&M programs and manual preparation for safe and sustainable operation and maintenance to be considered and reflected in the final O&M Plan.
- Q. Review the design of dam instrumentation plan and the program for collecting, analyzing and maintaining data as well as operational support tools using collected data.
- R. Any proposals for revision of the instrumentation plan for the completed system to monitor hydro-meteorological data, structural behavior/dam safety related data, and operation support/communication tools if should be reflected in the final Instrumentation plan.

#### **Emergency Preparedness Plan**

- S. Review the framework plan which covers the responsibility for dam operations decision making and for the related emergency communications, the assessment of current flood warning system and procedures for evacuating threatened areas and mobilizing emergency forces and equipment; and emergency drill/training needs.
- T. Overall review the Emergency Preparedness Plan (EPP) and provide recommendations for any additional required analytical studies and system development to be undertaken during and after project implementation.

#### **4. IPE TEAM COMPOSITION AND QUALIFICATIONS**

The IPE is composed of six experts: (i) Principal Dam Specialist (Chairperson), (ii) Hydrology and Hydraulic Specialist, (iii) Geotechnical Specialist, (iv) Community Water Supply Specialist, (v) Environment and Ecological Specialist, and (vi) Tunnel Expert.

The Principal Dam Specialist will chair the IPE and coordinate with other panellists to ensure the memberships objectivity and to provide balance to its reviews and recommendations.

The chairperson should be a professional with proven experience in orchestrating groups of multidisciplinary experts in relation to important dam projects. In particular s/he should have been involved in balancing the environmental and social aspects with engineering requirements of large water infrastructural projects.

The chairperson will also be responsible for preparing the minutes of the meeting and IPE report in coordination with other experts. The person responsible for the official correspondence with the chairperson will be the Chief Executive Officer AWSB.

The required qualifications and roles for each expert are described below.

##### **a.) Principal Dam Expert**

The Principal Dam Specialist should have at least 25 years of experience in planning, designing and supervising large dam projects. S/he should be a renowned dam specialist who

has worked with experts from different disciplines in hydrological, geotechnical, mechanical and other fields. S/he must be fluent in English.

His/her main tasks would be in the following but not limited to:

- ❑ Lead in inspecting the current status of the Ndakaini Dam, analyzing dam safety monitoring records and O&M procedures and instrumentation plan;
- ❑ Review the Dam's original design and stability analysis for normal and extreme loading conditions including determination of seismic loading criteria; the review will include assessing the conditions of the spillway gates anchoring and any exposed reinforced concrete blocks as well as required tests and mitigation measures
- ❑ Review the strength parameters and characteristics of construction materials for embankment materials, filters, and placement requirements as well as concrete aggregate sources, characteristics, and strength design parameters;
- ❑ Lead in the review and if need be developing the terms of reference for the preparation of revised operational rules for Ndakaini Dam following implementation of Northern Collector Tunnel Phase 1 and provide guidance on water releases from the reservoir.
- ❑ Review the Emergency Preparedness Plan (EPP) and give recommendations on required analytical studies and system development to be undertaken during and after project implementation.
- ❑ Review the dam instrumentation plan and provide recommendations for any revisions of the instrumentation plan for the completed system to monitor hydro-meteorological data, structural behavior/dam safety related data, and operation support/communication tools.
- ❑ Review the current Operation & Maintenance (O&M) Plan that covers organizational structure, staffing, equipment and facilities needed to operate and maintain the NCT1 system and Ndakaini dam; O&M procedures and funding arrangements including long term maintenance and safety inspections and make recommendations for modification
- ❑ Following the above review, provide guidance on upgrading the O&M Plan for the dam and reservoir system at the higher operational level that would cover the O&M programs and manual preparation for safe and sustainable operation and maintenance.
- ❑ Lead in reviewing the design, costs, and construction procedures of all other hydraulic infrastructures to be built under the project;
- ❑ Facilitate discussions among the IPE members; summarize key findings and recommendations including additional investigations if required.
- ❑ Lead in preparing the minutes of IPE meeting in coordination with other IPE members.

### **b.) Tunnel Expert**

The Tunnel Specialist should have at least 25 years of experience in planning, designing and supervising tunnel projects. S/he must be fluent in both English.

His/her main tasks would be in the following but not limited to:

- ❑ Review the tunnel's design and stability analysis for normal and extreme loading conditions including determination of seismic loading criteria;
- ❑ Review the strength parameters and characteristics of tunnel construction materials for placement requirements as well as concrete aggregate sources, characteristics, and strength design parameters;
- ❑ Review the design, costs, construction and monitoring procedures of other hydraulic infrastructures to be built along with the tunnel;
- ❑ Review monitoring and instrumentation reports on the effect of the tunnel on surrounding underground water sources during and after construction and advise on remediation measures

### **c.) Community Water Management Specialist,**

The Water Management Specialist will have a Master's Degree in Water Management or Civil Engineering with 10 years professional experience in Water Management project in developing countries including experience in sub Saharan Africa. He/she will have demonstrated competences at both policy level and field implementation level. The expert should be fluent in English and a Kenyan National.

The community Water Management Specialist will provide leadership on participatory water management approaches, options and issues in the project and will work closely with water user associations, water community based organizations, County/Local authorities, design and implementation technical consultants,

Specifically he/she will

- ❑ Review water allocation plans for the county
- ❑ Review the Integrated Water Supply Masterplan for Muranga County to be developed by AWSB using a consultant
- ❑ Review the catchment protection plans and provide guidelines and recommendations on their implementation
- ❑ Review strategies and procedures for regulation of water releases to the main rivers both to meet compensation flows and also prevent wastage of water that causes flooding and drainage problems;



- ❑ Interface the project implementing agency (AWSB) and key stakeholders including Nairobi City County, Muranga County, Nairobi Water and Sewerage Company on project issues and play an advisory role.
- ❑ Lead the stakeholder consultation process

#### **d.) Geotechnical Expert**

The Geotechnical Specialist should have a degree in Geology from a recognized University and a master's degree in Civil Engineering with a major in geology. The personnel should be a professionally registered geologist.

The expert must have demonstrated expertise and at least 20 years of experience in geotechnical investigations, in-situ and laboratory tests, and analysis for large tunnel projects.

S/he should also have a top notch expertise and experience of the design of treatment works for foundation, abutment and reservoir rims. S/he must be fluent in English and fluency in other languages will be added advantage.

His/her main task would be as follows but not limited to:

- ❑ Developing geotechnical standards and criteria to guide in the implementation and performance of the various infrastructural works.
- ❑ Review the regional and local geological characteristics and seismic conditions for all hydraulic infrastructures to be built under the project;
- ❑ Review the analytical results of foundation conditions and material sources including results of borehole excavation, laboratory testing, in-situ tests for all hydraulic infrastructures under the project;
- ❑ Review the proposed designs of foundation treatment, proposed excavation, foundation strength parameters and seepage control measures for all hydraulic facilities under the project;
- ❑ Review the identified and tested results of burrow materials for concrete aggregates and embankment materials for all hydraulic infrastructures under the project
- ❑ Critically review testing results, design recommendations and documents detailing the studies conducted.
- ❑ Review monitoring and instrumentation records accumulated during the operation of the Thika Dam to assess performance standards and/ or any structural behavior requiring special investigations; the above in light of dam's ability in performing safely and reliably under the new loading conditions after water level raising.

#### **e.) Hydrologist and Hydraulic Expert**

The Hydrologist and hydraulic specialist must be a licensed qualified engineer/hydrologist and should have demonstrated expertise and at least 20 years of experience in hydrological

monitoring, assessment and simulation. Should have a master's degree in civil and structural engineering with a major in hydrology.

S/he should also have top notch expertise and experience in the design of tunnels and inlet/outlet works as well as hydraulic analysis and structural designs. S/he must be fluent in English.

His/her main task would be as follows but not limited to:

- ❑ Review hydrological monitoring and assessment results; and proposed instrumentation plan and reservoir operational procedures;
- ❑ Review the results of water balance and safe yield analysis as well as flood hydrology simulation for determining the tunnel design flood and dam operational rules;
- ❑ Review the adequacy of the adopted design standards for all hydraulic structures including those related to (i) flood hydrology/ frequency analysis, (ii) tunnel design criteria, capacity and construction procedures, (iii) Thika reservoir operation, and (iv) Design and operation of the Kigoro Water Treatment plant
- ❑ Review the Ndakaini Dam reservoir sedimentation estimates and proposed mitigation measures, such as flushing operations and sluicing gates;
- ❑ Review the proposed capacity, layout, design and operational procedures of diversion/intake weirs
- ❑ Review the proposed designs and technical specifications of the project electro-mechanical equipment for gates control and back-up systems;
- ❑ Review the proposed design of inlet and outlet works, including hydraulic designs, capacity for emergency reservoir drawdown, regulation range and other factors of all hydraulic structures;
- ❑ Review the layout and design of the raw water pipeline and pumping stations as well as associated hydraulic structures.
- ❑ Review hydraulic models and advise the technical team on flow problems and procedures of various activities such as dredging, cutoffs, placing jetties/piers and constructing levees to stabilize streams or open water ways.
- ❑ Review the existing Ndakaini Dam reservoir operation philosophy and rule curve for flood control, water supply, hydropower generation, and in-stream flow requirements
- ❑ Together with the Dam Expert define terms of reference if need be for any revision of the Ndakaini Dam Operation philosophy following implementation of the Northern Collector Tunnel Project.

**f.) Environmental and Ecological Expert**

The Environmental and Ecological specialist must be a licensed lead Environmental Expert and should have demonstrated expertise and at least 20 years of experience in Environmental

Impact assessment, Environmental Audit and Ecological assessment. The expert must be fluent in English and demonstrate experience in World Bank and French Development Agency financed programs.

The expert must demonstrate expertise in tropical biodiversity conservation, utilization and management.

His/her main tasks would be in the following but not limited to:

- ❑ Advise on environmental policies and standards
- ❑ Review Environmental Management, Social Management and Quality Control Plans developed by the technical consultants and compliance with set international standards.
- ❑ Review the construction technique, scheduling and quality control procedures, including the design, schedule and risk factors of diversion works during construction,
- ❑ Review the potential risk and hazard for downstream areas of both the three river intake diversion structures and downstream areas of Ndakaini Dam
- ❑ Provide technical-level support for environmental remediation and litigation processes, including remediation system design and determination of regulatory applicability.
- ❑ Review ecological assessment reports and provide interpretation of the information
- ❑ Keeping the relevant technical teams updated with environmental policies and legislation based on ecological findings.
- ❑ Develop and oversee the implementation of all season monitoring program of the aqua fauna in the three rivers including trout.
- ❑ Plan and participate during the stakeholder consultations.

## **5. IPE MEETINGS SCHEDULE AND ARRANGEMENTS**

- ❑ The IPE meetings are scheduled semiannually for around the month of May and October. The number of days allotted for this work will be thirty (30) working days. The work will involve 2 visits to Kenya of 8 days each and 4 days of preparation and follow ups at the home location of each expert.
- ❑ The AWSB Project Manager will arrange the meetings and field visits in coordination with the panelists and other relevant agencies as required.
- ❑ The AWSB shall provide clerical, drafting and reproduction services for the preparation of IPE reports. The Government shall take necessary actions to allow

prompt travel clearance for the IPE members and provide field trip arrangements to the project sites.

- ❑ The Technical Consultants for design and supervision of the Tunnel, Raw and Treated Water pipelines and the design and build contractor under recruitment will be invited to selected IPE meetings at its request. The IPE will be provided necessary background information, any relevant data, notes or explanations regarding the designs, computations or methods used. The IPE may ask the Technical Consultants to conduct additional studies to assist in the panel's evaluation of the matters relating to project safety issues.
- ❑ The World Bank, AFD and other donors' representatives financing the project may attend the IPE meetings as observers.
- ❑ The IPE will be maintained on-call basis during project implementation period to provide technical review and guidance for the tunnel, treatment plant and reservoir to be sustainably operated and maintained. The operational and maintenance manuals/plans for the new maximum level developed by the works contractors for the Tunnel, Ndakaini dam remedial works, Kigoro Water Treatment Plant and NCT1 raw and treated water pipelines should be reviewed by the IPE. The O&M manuals are prepared based on specifications, manufacturer's and supplier's proposals.

## **6. IPE REPORTING**

- ❑ The chairperson of the IPE will take a lead in preparing the minutes of each meeting. The minutes shall be signed by all IPE members and presented to the Implementing Agency prior to departure of the members.
- ❑ The minutes shall summarize the IPE's findings and recommendations. It should outline areas of concern, request for additional analysis and present recommendations for action, if any.
- ❑ The implementing agency, AWSB, will provide reference materials for the IPE members and conduct follow up actions in coordination with other agencies.
- ❑ The IPE meetings should be normally held at the project site and shall be attended by all members. Inspection of the site by individual members should occur only under special circumstances and in such cases the member will send his report to other panel members for joint issuance of a final report by the panel.

## **7. IPE PROCUREMENT ARRANGEMENTS**

All members of the Panel of expert will be procured in accordance with the procedures set out in the World Bank's *Guideline for Selection and Employment of Consultants: Individual Consultants*