Republic of the Sudan

National Audit Chamber

Specialized Audit Sector

Performance Audit Directorate

PERFORMANCE AUDIT REPORT ON SANITATION SERVICES IN KHARTOUM STATE SANITARY CORPORATION

June 30, 2019

Vision

Is to develop control work to be done in efficient, effective, high quality way and to contribute to strengthen of the institutional good governance.

Mission

NAC as the highest financial control and accounting institution reviews the income and expenditure of the government entities at all levels with high professionalism, impartiality and integrity to evaluate the financial performance and contribute to empowerment of the legislative Government agencies to carry out their duties toward accountability and guidance.

Goals

The First Goal:

Improving the quality, efficiency and impact of audit work in order to enhance accountability, integrity and transparency in the management of public funds and enable the National Council and state legislative bodies to perform their duties effectively and efficiently.

The Second Goal:

Achieve higher institutional performance.

The Third Goal:

Strengthening and sustaining the independence of the National Audit Chamber.

Fourth Goal:

Improving internal and external communications to raise the level of the National Audit Chamber with key employees and stakeholders.

Core Values

Independence
Integrity
Objectivity
Impartiality
Professional secrecy
Competence

Professionalism

Innovation
Team Spirit

بسم الله الرحمن الرحيم

Republic Of The Sudan

National Audit Chamber

Date: .....: التاريخ

Date: .....: الموافق

جمهورية السودان

ديوان المراجعة القومي

الخرطوم

الرقم/ دم ق/.....

H. E.
The Minister of Energy and Mining

Subject: Performance Audit Report on Sanitation Services in Khartoum State Sanitary Corporation for the Periods 2015 – 2018

I would be pleased to enclose you a copy of the Performance Audit Report on Sanitation services in Khartoum state sanitary corporation for the period 2014 – 2018 2015 – 2018 which includes?

- Letter of Issuance
- The Report

The report includes our observations and proposed recommendations to address the reasons for these observations, as a contribution from us to improve performance, hoping your implementation of these recommendations. The National Audit Chamber will follow up the implantation process.

Regards

30/07/2019

MohammedNour A. Abdelraheem
Deputy Auditor General - SAI Sudan

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بسم الله الرحمن الرحيم
جمهورية السودان
Republic Of The Sudan
ديوان المراجعة القومي
National Audit Chamber
مكتب المراجع العام

التاريخ : _____
الموافق : _____
الرقم/ دم ق/ _____

Date: 30. Jul .2019

H. E.
The Minister of Infrastructure and Transport

Subject: Performance Audit Report on Sanitation- Khartoum State for the period 2014 – 2018

I am pleased to attach a copy of the Performance Audit Report on Sanitation- Khartoum state for the period 2014 – 2018.

This audit has been prepared according to the Article (I/2/6) of the National Audit Chamber Act 2015, and the INTOSAI performance audit standards- (ISSAI, 300- 3000 – 3100).

The National Audit Chamber (NAC) would like to see actions to be taken to implement the recommendations of the audit report. And would be looking forward to receiving your feedback in this regard .NAC will follow up the progress to assess the procedures taken by your side as to these recommendations. NAC will also make performance audit for other topics and areas in the future.

In conclusion, I would like to thank you and the NAC audit team for conducting the audit, as well as the KSSC and the other partners for their cooperation.

Best Regards

El Tahir Abdel Ghayoum Ibrahim * Auditor General * Rebublic Of The Sudan

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List of Abbreviations:

NAC	-	National audit chamber
SA	-	Specialized Audit Sector
PA	-	Performance audit
KSSC	-	Khartoum State Sanitary Corporation
SDG	-	Sudanese pounds
KS	-	Khartoum State
SDGs	-	Sustainable development goals
OX	-	Oxidation ponds
BOD	-	biological Oxygen
COD	-	Chemical Oxygen Demand
SBR	-	Sequential Batch Reactor
B.O.T	-	Build operates and transfers
N-NH3	-	Nitrogen as nitrates
CL	-	Chlorides
PH	-	Power Hydrogen
TBC	-	TOTAL Bacterial Count
TC	-	Training course
TSS	-	Total Suspended solids

List Of Glossary Of Terms:

Inlet	- Water entering (before treatment)
Outlet	- Water outlet (After treatment)

List Of Images:

IMAGE1: Floods of sewage water on streets of Khartoum……16
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Executive Summary:

Background of the audit:

Sanitation service is the hygiene methodology to enhance healthcare. It also cares about the healthy precautions through sanitation, e.g.; collection of waste, disposal of wastewater. Sanitation system includes the management of human waste and sewage water storage and transfers and treatment or reusing of it. Sewage water is the brackish water resulting from usage of water inside building and installation, either for human or industrial or commercial use for different purposes.

Khartoum State Sanitary Corporation is responsible for the provision, development, expansion and management of the Sanitation net[1] in the state and the sanitation net user like (citizens, companies, factories or hospitals). Although Khartoum state has started sanitation services since1954, still the percentage of coverage does not exceed 7% of the State[2.] The shortage of covering the entire State with sanitation services resulted in the unhygienic sewage disposal by the citizens. The lack of proper treatment of Sewage water has a negative effect on the environment; on soil, water as well as human and animal health. Disposal of sewage water has become one of the most disturbing issues that concern the whole world; for it seriously endangers health and economy as well.

According to the World Summit conference and the Strategic Objectives for Sustainable Development Goals (2015-2030) goal no (6.3) is to provide safe sanitation.

The second strategic plan for the state of Khartoum (2012-2016).Indicates that rehabilitation and construction of infrastructure and sanitation also the strategic plan for the state of Khartoum (2017-2030) goal no (6). Indicates that Coverage of the state with a comprehensive and sophisticated sanitation system. In addition the newspapers, public opinion issues and social networking sites discussed the deterioration of the sanitation service in the state.

For all the reasons above the Auditor-General considered it important to conduct

A performance audit on provision of sanitation services in Khartoum state.

Objectives and Scope of the Audit:

The main objective of the audit is assess whether the procedures and activities (planning, execution and follow-up of the Sanitation net development and maintenance process taken by the Khartoum Sanitary Corporation;),are work efficiently, effectively and economically to ensure good sanitation service.

The audit has covered all planning, project execution, operation and maintenance of all sanitation utilities. Moreover, it covers the collection, pumping, lifting, treatment plants and the activities run by Khartoum state Sanitary Corporation during (2014-2018).The audit has focused on Khartoum State only for the non-existence of sewage system in other states of Sudan.

[1] **Including Waste water treatment plants waste water, Sewage and pipelines for such water, including outlets for buildings, pumping and lifting equipment and all related installations.**

[2] **www.moiat.gov.sd**

Methods Used in Gathering Audit Evidence:

We conducted the audit in accordance with the International Standards of Supreme Audit Institutions (ISSAIs) issued by the International Organization of Supreme Audit Institutions (INTOSAI) as well as relevant SAI standards and guidelines applicable to performance auditing. We gathered audit evidence through document review, interview and physical verification.

Summary of Findings:

- Uncompleted execution of the electromechanical works for Bahri main pumping station which was part of the annual plans since 2014, also the treatment plant which assimilates the wastewaters for this project, was not listed in the annual plans of the KSSC as well. The planning of Bahri Project first stage was partially executed since 2011 (which is the Sanitation net pipes, 4 lifting and main pumping stations) has led to freezing the funds (87m.SDG) in the unused or operated Projects Instead of using the comprehensive system (collection, transfer, treatment and disposal of wastewater) This was due to not prioritizing the project plans.
- There were no feasibility studies or designs for the projects this is due to the department plant to made projects without collecting sufficient information before the execution, which result in inaccuracy estimations cost, work load and time limits for the budgeted funds estimations were far from the actual funds.
- There is no optimal use of resources, whereas 30 new pumps imported to stations for developments during 2015 witch costs 20m.SDG which Equivalent to a percent 8% of the budget allocated to the Construction, rehabilitation of pipe lines, net &stations during the year 2015 see Appendix (3). Only (8) were installed in station (21 ,20 ,9, and 6), the remain of the pumps were not installed despite the existence of (4) stations using (by pass) system (it is a system of pumping wastewater outside the main stream line without making the necessary treatment when it goes through the main stream line. This was due to the slow executing procedures of the new pumps for Bureaucracy procedures.
- The pipes had been imported to establish a pumping carrying line project between Suba station and Suba agricultural project. This project is of 16 Kilometers length and 1000 mm witch costs 50M.SDGs which Equivalent to a percent 7% of the budget allocated to the Construction, rehabilitation of pipe lines, net &stations during the year 2017. An amount of 38M.SDG was paid (percent 77% of the total cost), these pipes are stored under the sun since 2017 and are not installed till the drafting of this report This was due to unprepared deigns and non-definition of the line stream and KSSC was not made adjustment to the conflicts with land owners, which was explained by executing company in its reports to the KSSC.
- No preventive maintenance made to the stations, the maintenance was limited to curative whenever a problem or leakage occurred this due to unplanned preventive maintenance. This resulted on frequent complaints occurred in many areas which assure the augmentation of problems in stations for lack of preventive maintenance.
- Lack of control over the Sanitation net users:

1. There are some factories in the Sanitation net area, but still they have private sanitary wells Due to the non-Impose strict control on compliance with sanitation laws through enhancing controls and periodical inspection of the Sanitation net users, as that the wastewater of those factories is not treated and the use of those private wells will contaminate the surface water
2. No Internal primary treatment unit established for five numbers of factories out of ten visited. Due to not- obligating the users to apply the regulations of sanitation work, the industrial wastewater is improperly disposed in a way that affected the Sanitation net efficiency and blocked its pipelines.

- Partial work stops in Wad dafeea plant due to lack of some pumps and spare parts for maintenance and operation.
- Inefficiency of working in the treatment plants according to the capacity:

1. the amount of water entering Suba Station (OX Biological Treatment) is estimated with (40000−35000) square meters, according to the personal interview with the person in charge of the station, which means that the station is working over its capacity affecting its useful lifetime, In addition to the phenomenon of discharging industrial wastewater of various utilities and installations -not connected to the public net− directly in the anaerobic ponds. This is Due to no priority is given to the execution of the project for the rehabilitation of Soba Alpaolak plant.
2. Wad dafeea plant current actual working capacity is 6000 square meters daily with a percent 35% of its designed capacity. Percent 50% of untreated wastewater is transferred to the old surface basins outside the station to evaporate naturally which evaluates the water highest in it. The SBR (1) has stopped working since October 2017 due to lack of spare parts for operation.

- The required tests have not been done to ensure the proper treatment of wastewater:
- Suba Station; had not made the periodic required tests for quality of daily work during (2014-2018) according to standards, for these tests' results help the station to make the appropriate maintenance programs.
- Wad Dafeea plant although has a Lab., but it had not made any tests on toxics and non-dissolving substances, for example; heavy toxic elements like lead & mercury although most of the wastewater in the station is of industrial nature.This is due to the no completion of Wad Dafeea laboratory for industrial wastewater tests.
- There was lack of awareness programs to the Sanitation net Users during (2014-2018) due to The awareness responsibility is one of the role of the media & public relations section which is directly accountable to the general manager, but this section is inactive although a manger is assigned for it since 25/9/2018. In addition, there are no annual plans or performance reports for (2014/2018) the undefined roles of the section and not prioritizing the type of awareness.
- Training programs had not focused on the technical needs, for example; wastewater treatment techniques, planning, design and execution of sanitation projects. There is a need serious need for training of the technical staff at Wad Dafeea on operational maintenance since July 2017 and this was not satisfied until now. Despite the implementation. Percent 78% of the planned training programs for 5 years, but the courses were not specialized and general course, E.g.(English language, Personal skills...etc..), which do not suit the industrial needs of sanitation. That's due

to: Training courses are not considering the real staff needs for the lack of coordination between various administrations in the corporation with the training department.

- the KSSC was Relying on government funding and not granting investment opportunities in the field of sanitation to attract non-governmental funding was due to The investment department in the KSSC was established with one chemical engineer as a manager, and another one as a technical to join the department and both of them is not specialized in investment department. They have not been trained to conduct their assignments in this department properly. Also the roles of the investment department are not defined in job description. The investment department has not established any annual plans or either performance reports. Due to the non-compliance with the directives of the Ministry of Strategic Affairs and Information to establish Khartoum State's plans.

Recommendations:

The KSSC should:

1. Collect sufficient information on projects before their execution to seek accuracy when making estimations for cost, work load and time limit for the project's completion, thus having realistic budget estimations, Prioritizing the plans with completing the Master Plans and Making feasibility studies and necessary designs for sanitation projects to ensure their completion in due time.
2. Executing procedures of the new pumps.
3. Making feasibility studies and necessary designs for the sanitation pipeline project between Suba station and Suba agricultural project to ensure their completion in due time. And adjustment of the conflicts with landowners.
4. Set defined plans for preventive maintenance.
5. Impose strict control on compliance with sanitation laws through enhancing controls and periodical inspection of the Sanitation net users.
6. Respond to the maintenance requests submitted from the stations' managers to the top management of KSSC to ensure their (stations) full capacity operation.
7. Giving priority to Suba rehabilitation project (Suba Biolack) to reduce the pressure treatment station and providing spare parts in time for maintenance.
8. Providing Suba station with a laboratory for necessary tests of wastewater and the completion of Wad Dafeea Lab to make special analysis for industrial wastewater to ensure proper water treatment.
9. Define roles of the section and prioritizing the type of awareness. Coordination between the training department and the other departments when defining the training needs and share with them the programs setting, in addition of increasing specialized programs of sanitation industry to develop the KSSC especially during its growing stage.
10. Define clear terms of reference for investment management and provide them with qualified manpower in the field of investment section.

1.0 BACKGROUND TO THE AUDIT:

1.1 Introduction:

Sanitation is the hygiene methodology to enhance healthcare through prevention of human contact with waste dangers. It also cares about the healthy precautions through sanitation, e.g.; collection of waste, disposal of sewage water. Sanitation system includes the management of human waste and sewage water storage and transfers and treatment or reusing of it. Sewage water is the brackish water resulting from usage of water inside building and installation, either for human or industrial or commercial use for different purposes. Sewage water coming from houses and institutions that carries bodily waste (primary feces and urine), laundry water, food waste and other ordinary life waste is classified as domestic drainage or sanitary water. Liquide waste from stores and community service installations is called industrial waste. That could be added to sanitary of domestic drainage. The industrial wasted like production or manufacturing of goods is classified as industrial drainage not as sewage water.

Khartoum Sanitary Corporation is responsible for the provision, development, expansion and management the user of sanitation net in the state. Although Khartoum state has started sanitation services since1954, still the percentage of coverage does not exceed a percent 7% of the Statei. The shortage of covering the entire State with sewage sanitation resulted in the unhygienic sewage disposal by the citizens. The lack of proper treatment of Sewage water has a negative effect on the environment; on soil, water as well as human and animal health. Disposal of sewage water has become one of the most disturbing issues that concern the whole world; for it seriously endangers health and economy as well. This sort of contaminated water, contains a lot of dangerous contaminators, either organic or chemical (soap or chemical antiseptics) some species of microorganisms, like E.coli causes vomiting and diarrhea that causes dehydration especially for children, Leptospira that causes liver, kidney and nervous system infections. Not with standing, the heavy toxic metals and carbohydrates, that will be more dangerous in waters coming from hospitals and factories.

1.2 Motivation for the Audit:

The audit was motivated by the following factors:-

Ensure availability and sustainable management of water and sanitation for all. improve water quality by reducing pollution, eliminating dumping and minimizing release of hazards chemicals and materials, halving the proportion of untreated wastewater and sustainability increasing recycling and safe reuse globally according to SDGs goal no (6 target 6.3) (2015-2030).

Rehabilitation and construction of infrastructure and sanitation. According to the second strategic plan for the state of Khartoum (2012-2016).

Coverage of the state with a comprehensive and sophisticated sanitation system According to the second strategic plan for the state of Khartoum (2017-2030), goal no (6)discussed the deterioration of the sanitation service in the state for example:-

- Many areas and streets are soaked in sewage sludge for instance (Khartoum Stadium, Abdel Rahman Street, Abu Sin Street and others), and the emission of harmful odors amid the explosions of sewage pipelines Without the supervision of the responsible authority.[3]
- Sudan loses about $ 500 million yearly due to deterioration of Environmental conditions and sanitation utilities[4].
- Sanitation problems threaten the human life[5].
- The government admits the leakage of sewage in the neighborhoods of Khartoum. The "watery diarrhea" epidemic, which the government refuses to call "cholera", began in August 2017 in the capital, Khartoum. According to Health minister, the state Khartoum recorded 878 including 19 deaths. According to The newspapers, public opinion issues and social sanitation networking sites[6].

1.3 Design of the Audit:

1.3.1 Audit Objectives:

The main objective of the audit is assess whether the procedures and activities (planning, execution and follow-up of the sanitation net development and maintenance process taken by the Khartoum Sanitary Corporation;),are work efficiently, effectively and economically to ensure good sanitation service.

1.3.2 Scope of the Audit:

The audit has covered all planning, project execution, operation and maintenance of all sanitation utilities. Moreover, it covers the collection, pumping, lifting, treatment plants and all activities run by Khartoum Sanitary Corporation. The audit has focused on Khartoum State only for the non-existence of sewage system in other states of Sudan. The audit has covered the period from (2014 – 2018) so as to compare the performance through these years to land on audit findings.

1.3.3 Audit Questions:

The audit objective is further detailed by the four main audit questions as described below:

1. Were the KSSC has plan and implement the operations of expansion and development of the Sanitation net?
2. Has Khartoum Sanitary Corporation perform preventive and curative maintenance of pipes and Sanitation net stations (lifting and pumping / handling)?
3. To what extent the primary processing units for factories, tanneries are controlled effectively by Khartoum Sanitary Corporation?
4. Has the Khartoum Sanitary Corporation is drainage and treatment wastewater effectively and efficiently?

These questions were developed into sub questions as listed in Appendix (2) the answers to these questions supported the conclusion against the audit objective.

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[3] **Al-Watan Newspaper date 2/7/2018**
[4] **Almeghar Newspaper –Alnelin 30-3-2018**
[5] **Al Watan Newspaper- Sudan News Website date16-4-2017**
[6] **Sudanil Website date 6-6-2017**

1.3.4 Methods used in Gathering Audit Evidence:

The team used secondary data reviewing documents related to KSSC covering five years, the team also conducted interviews as well as physically inspected as sources of primary data to gather evidence. Methods below show that:

- **Documentary**: review of internal laws, decisions and regulations, organizational structures, strategies, annual plans, performance reports, and all documents related to the provision of sanitation services. For further details see appendix (3).
- **Interviews:** with the Director General of the Ministry of Infrastructure and Transport (Khartoum State), Director General of the (Khartoum State Sanitary Corporation) and the directors of departments of various sections in (Khartoum State Sanitary Corporation) plus all stakeholders who provide sanitation services. For further details see appendix (4).
- **Observation and actual verification:** The audit has made physical visits to sites all the stations, (18 lifting and pumping stations, 2 treatment plants in Khartoum and Khartoum Bahri), in addition to some sanitations net pipelines in public streets(hospital Street, Al Amarat Street No. 57) to ensure the creditability of data provided to the audit by the Khartoum Sanitary Corporation.

1.3.5 Assessment Criteria:

The audit assessed the provision of sanitation services against internal criteria drawn by Khartoum State Sanitary Corporation, including : laws and legislations, policies and strategic objectives, various administrations' roles and authorities within the organizational structure, annual plans plus the Sudanese standard 173/2008 imposed by the Sudanese Standards and Metrology Organization. Details on the audit criteria are provided in the description of the audit are and it is also in the findings chapter.

2. *DESCRIPTION OF THE AUDIT AREA*:

2.1 Legal Mandate:

Khartoum State Sanitary Corporation was established in accordance with the State Law No. (4) 2007. The Corporation is under direct supervision of the Minister of Infrastructure and Transport and his directives, also responsible for the performance of its work and the exercise of its jurisdiction in accordance with the presidential directives issued for the purpose of developing and upgrading sanitation services. By the mandate of law, the State Ministry determines the policy guidelines of the Corporation in accordance with the policies and plans of the State. The Corporation derives its executive powers according to the following:

- Firstly: State Law No (11), 2009(Law regulating corporation of the Khartoum state).
- Secondly: State Law No. (7) ,2007 (the law regulating sewage in Khartoum state), which regulates the sewage services within the geographical scope of the mandate and the conditions of use under the licenses granted by the corporation to provide sanitation services after meeting the conditions required by law. The Corporation also follows several regulations to carry out its activities in the sewerage service in Khartoum state.

2.2 Terms of Reference (TORs) of Khartoum State Sanitary Corporation according to the Sanitary Corporation Law (2007):

1. Putting plans, policies and systems for sanitation services at the state level, taking into account the balanced development to achieve the objectives of the environment in coordination with the local authorities.
2. Providing sanitary services systems and coordinating with the providers of such services (related parties) and monitoring their performance.
3. Issuing licenses to the private sector, either national or foreign, to establish and construct public and private sanitation nets in the State.
4. Coordinating with the responsible authorities with regard to the collection, importation and manufactured sewage equipment, and materials.
5. Putting an integrated system for collection, transport, treatment and disposal of Sewage water in line with modern methods to protect the State environment from pollution.
6. Setting the technical specifications and treatment of wastewater and its installations before discharge in the main Sanitation net.
7. Rehabilitation of companies operating in the field of sewerage services and supervising their work.
8. To carry out research and studies that help to develop sanitation services and to encourage scientific research in this field.
9. Establish, operate and manage Sanitation nets and stations with technical, administrative and economic efficiency in accordance with international standards.
10. Issue regulations and orders that regulate sanitation services.
11. Invest its surplus funds in any aspect of investment that consider appropriate in order to strengthen its financial position and increase its revenues.

2.2 Goals and objectives:

1. Upgrade, develop and increase the area of sanitation to cover all Khartoum state.
2. Create the appropriate climate for the promotion of sanitation and encourage investment in this field.
3. Securing and disseminating free competition and managing its business on the basis of covering operating costs and rehabilitation.

2.4 Vision:

Safe and Sustainable Sanitation.

2.5 Mission:

Provide an efficient, economic and advanced sanitation service and to preserve the environment according to master plan using the appropriate modern technologies.

2.6 Strategic Objectives:

Cover the State with comprehensive and sophisticated developed sewage system.

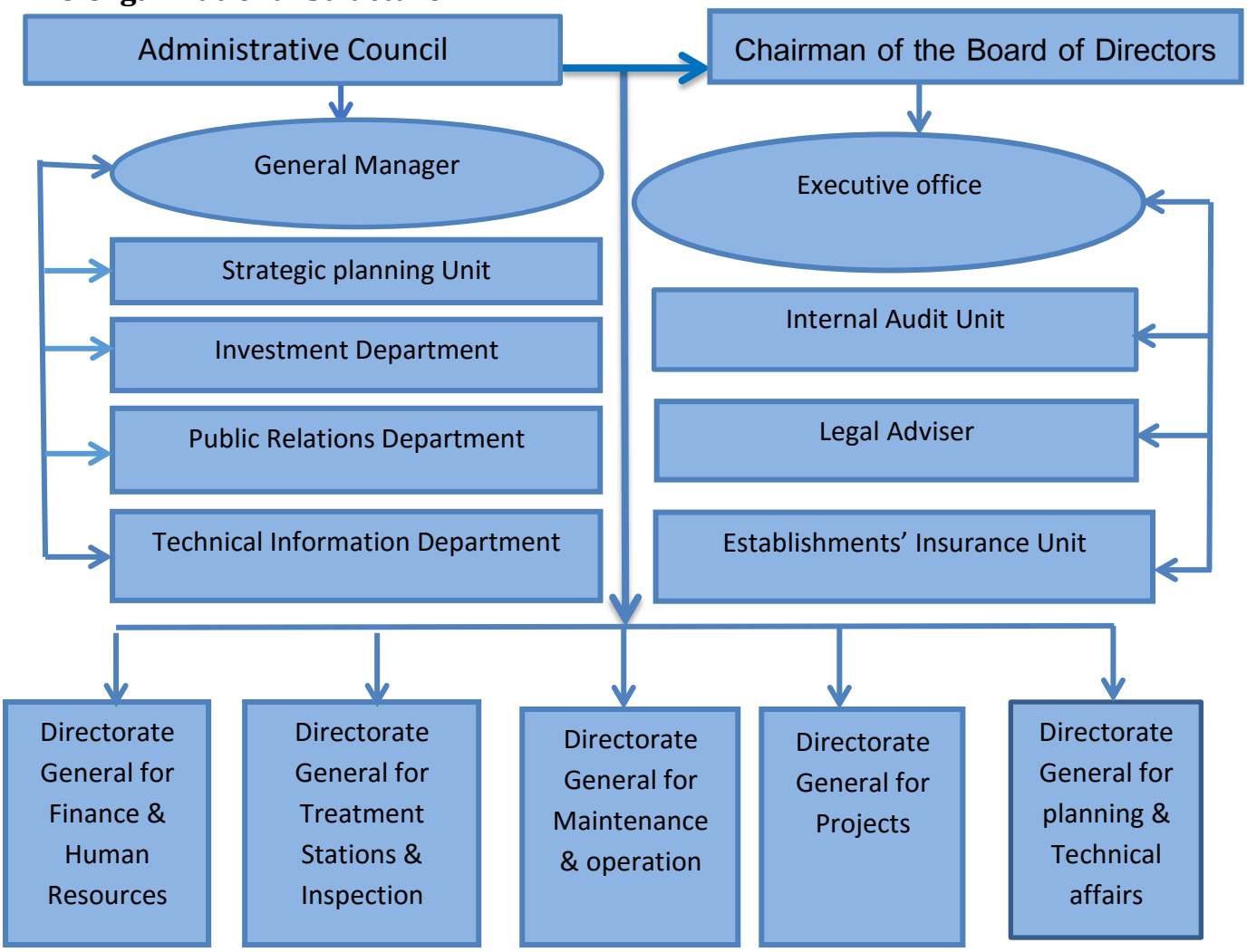
Sub-objectives:

- Development of the sewage system in the state.
- Use of decentralized sewage system.
- Development of operating, rehabilitation and maintenance system.

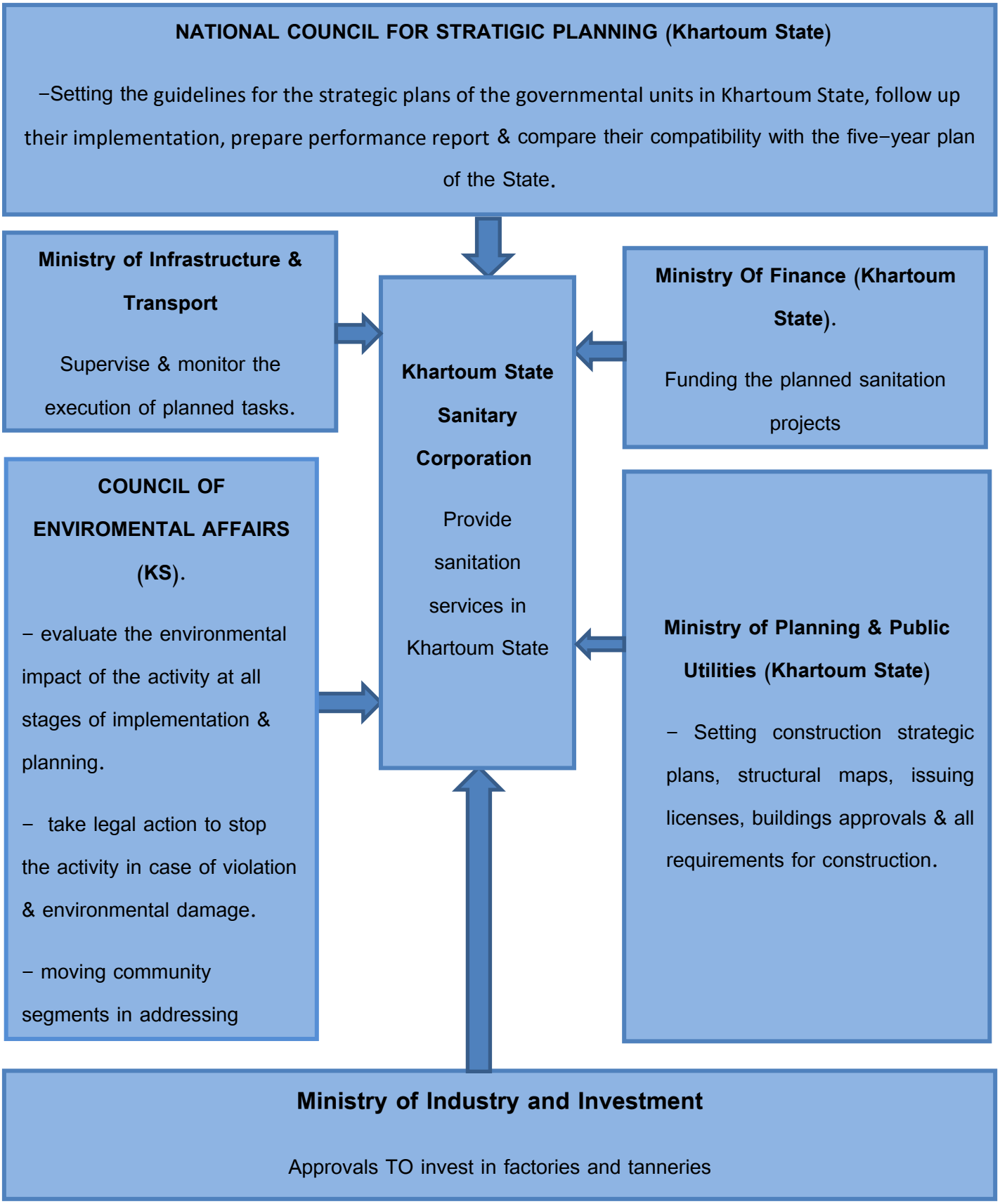
2.7 Sources of Funding:

Khartoum State Sanitary Corporation financial resources flow from the Ministry of Finance in Khartoum State as part of the approved budget, other source of revenues is the fees collected from providing the sanitary service. This funding is used in the construction and rehabilitation of sewerage lines and stations, purchase of assets and equipment in addition to the payment of wages and salaries of employees and management expenses.

2.8 Organizational Structure:



2.9 Stakeholders Role:



2.10 Process description of sanitation services:

1. Planning :(Directorate General for Technical and Administrative Affairs):

A. Preparing a feasibility study for sanitation utilities.

B. Preparing sanitation net designs.

C. Selecting contractors.

2. Executing :(Directorate General for Projects- Department of Inspection & Control):

A. Follow-up and monitoring projects in progress in Khartoum Sanitary Corporation executed by contractors.

B. Providing Service for Users (by Directorate General for Operation & Maintenance & Technical Department):

- Submit a request by users (citizens, companies, factories or hospitals) to K.S.C. for permission to make extension for new buildings, or renewal of connection in main Sanitation net.
- The service promotion office of the KSSC checks the following documents (valid ownership certificate – rent – copy of identity card & legal authorization).
- Fill in the application forms, attach all the required documents and submit it to the general manager.
- The form is transferred to the operation and maintenance department to prepare field visit by the sanitation net engineers.
- The form is then transferred to the technical department for work estimations by the competent engineer and approved by the director of the department, in case of factories, hospitals, and restaurants ….etc. the form will be transferred to the inspection for review by the Sanitation net operator.
- Approval of the form by the general manager, then the payment of the fees is made to the promotion office; the form will be transferred to the technical management for stamping. Eventually the form will be submitted to the Sanitation net operation development department for making the connection to the Sanitation net.

3. Operation & maintenance (Directorate for Operation & Maintenance)

A. Operation:

- Collection of sewage water through collection station.
- Transfer the sewage water by pumping, lifting station to

B. Maintenance:

- Receive reports at horizontal and vertical levels.
- Analyze and classify reports.
- Raise reports to different maintenance units.
- Maintenance execution process.

4. Treatment of Wastewater (Directorate General for Treatments Plants and Inspection):

A. Suba Treatment Plant (the design capacity is (31420 square meters) :

This station uses biological treatment of oxidation ponds which has three phases:

- The Anaerobic ponds in which the water settles down for three days.
- Facultative ponds in which the water settles down for four days.

- Maturation ponds in which the water settles down for fourteen days and after that it is drained directly to the outlet and then to the Nile.

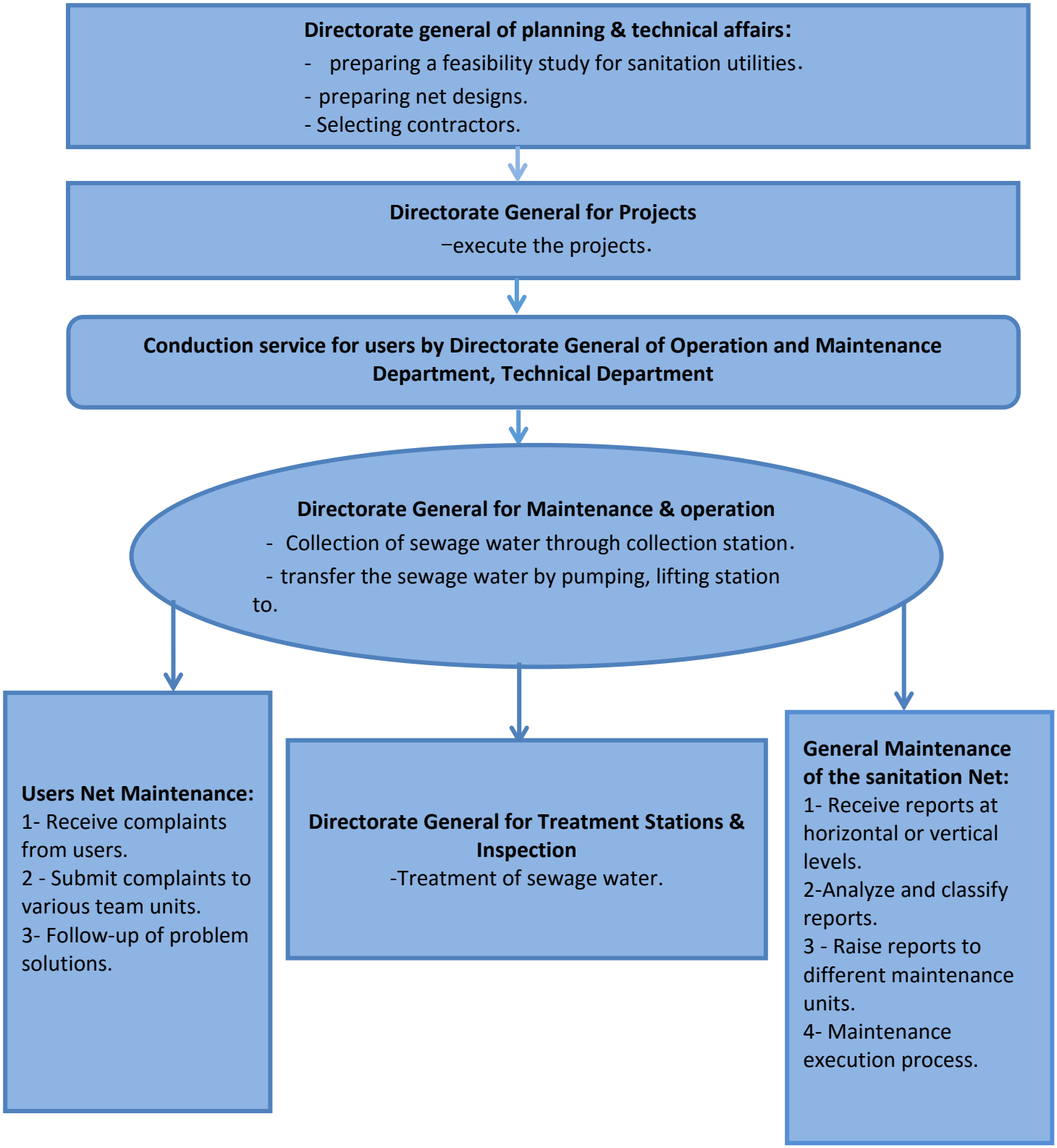
B. Alhag Yousif Treatment Plant (Wad Dafiaa) – (design capacity 17000square. meters daily)

This station uses the SBR technology. It goes through the phases below:

- The wastewater goes first into primary treatment (1st chamber), where the solid substances are retained. From there, the wastewater is fed into the SBR tank (2nd chamber).
- The actual biological cleaning by microorganisms now takes place in the SBR tank. Short aeration and rest phases alternate in a controlled cleaning process.
- The so-called activated sludge can now develop with millions of microorganisms and clean the water thoroughly.
- A rest phase now follows, during which the live sludge sinks to the bottom of the system. This allows a clarified water zone to form at the top of the SBR tank. After that the water is pumped and lifted to the tank and be used to forest irrigation.

The following Figure 2 describes the process Sanitation service in Khartoum Sanitary Corporation.

Figure 1: Process description:



2.11 Assessment Criteria:

Audit Question	Audit Criteria
1. Were the KSSC has plan and implement the operations of expansion and development of the Sanitation net?	- The five – year plan for Khartoum state during (2012-2016) strategic goal number 20: (Covering the state with a comprehensive and sophisticated sanitation services). - general objectives of KSSC (upgrade and develop an increase patch of sanitation services within the state) - Objectives of the sanitation net and assets improvement management: 1. Preparing necessary studies to develop the current sanitations net and its related assets to achieve the performance efficiency in providing services to citizen. 2.work on expansion of the Current sanitation services horizontally and vertically and increase efficiency according to the state's plan.
2. Has Khartoum Sanitary Corporation perform preventive and curative maintenance of pipes and Sanitation net stations (lifting and pumping / handling)?	- General objectives of operation & maintenance management: 1. Planning, implementing and developing the necessary programs for preventive, periodic and emergent maintenance for all sanitations net stations and to achieve the efficiency of performance and continuity. 2. Putting the necessary plans for continuous cleaning to the purification plants from weeds and solids. 3. Supervising the development of plans and programs necessary for maintenance of equipment, sewerage system, water tanks and pumps, generators, and discharge of exhaust gases according to the local and international standards.
3. To what extent the primary processing units for factories, tanneries are controlled effectively by Khartoum Sanitary Corporation?	- Term of references for inspection and control management - inspection factories department: (inspection to the Sanitation net subscribers to insure their commitment to provide all that would meet technical, legal, and administrative requirements). - according to the Sudanese standards no (173/2008) article (5) on pollutions with industrial wastes paragraph (105): (when disposal of industrial wastewater comes from facilities not connected to the Sanitation net, its necessary to construct an analysis tank or an internal treatment plant depending on the type of liquid industrial waste). - according to the Sudanese standards no (173/2008) article (3.2): (primary processing or an internal treatment plant is a series of processes that are subject to the liquid waste inside the factory before discharge to the public Sanitation net or disposal, which include filtering, sedimentation and chemical treatment).

4. Has the Khartoum Sanitary Corporation is drainage and treatment wastewater effectively and efficiently?	- Sanitary Corporation Law (2007): - Article (6/f): (Establishment of the Integrated System for the collection, transport, treatment and disposal of sewage water in line with modern methods of the State's environment protection from pollution).

sup Question	Audit criteria
1.1 To what extent have KSSC Establish, operate and manage sewage Sanitation nets and stations with technical, administrative and economic efficiency in accordance with international standards?	Objectives of the General Administration of Projects: (Supervise the execution of various projects to ensure quality of implementation and avoid any loss of resources in the time limit specified). Objectives of the General Administration of Projects: (Supervise the execution of various projects to ensure quality of implementation and avoid any loss of resources in the time limit specified).
1.2 Is the training courses for technical staff are effective?	- General objectives of human resources management: (implementation of the training plans & raising staff abilities). - General objectives of operation and maintenance management: (continuous training of staff and follow up the various developments in this area in coordination with organizations and counterpart units at home and abroad).
1.3 Are there any promotional plans to attract investors to invest in sewage projects?	- The duties of the Sanitary Corporation general director: (work to attract foreign and internal investment to qualified investors to work in this field in accordance with the recognized international standards and internal jurisdiction of the State). - based on the guidelines issued by the ministry of strategic affairs and information for Khartoum state 2018 in investment formation field : - encourage the community and private sector to contribute in implementing this strategy, and not solely rely on government funding. - strengthen controls and standards to attract financially and technically qualifies investors. - encouraging the role of the private sector in sanitation through the bot system.
2.1To what extent are the necessary operational and maintenance	-The objective of the pumping stations management is: (setting plans & programs necessary to provide materials and

materials provided in a timely manner?	equipment required for the operation of plants and laboratories in accordance with international standards). -The objective of the General Administration of Stores and Procurement items 5 & 6 is to: (review the position of the inventory and notify the responsible authorities to make purchases).
4.1 to what extent the wastewater used in the irrigation of forest(*HATTAB* district), or those flowing into the Nile (*SOBA* plant station) has been treated	- regulation of standards and specification to protect water environment from pollution- for Khartoum state 2011 article (6/a) : (Human, animal bodily wastes water should not be discharged to surface waters or dams unless treated according to the specific standards set).
4.2 have Khartoum Sanitary Corporation sensitized users to sanitation services to ensure that the waste and dirt that cause the blockage of pipes are not thrown in inspection rooms?	Best practice (Arab Republic of Egypt in sanitation example, a special department for sanitation service awareness, as part of the sanitation departments of the Sanitation Company of Cairo. The prior objective of this company is to raise the citizens' awareness in optimal use of sanitation net to maintain a neat, clean up-to-date environment.

3. Findings of the audit:

3.1 The Incompleteness of the overall integrated system for Bahri project has led to freezing the funds (about 87m.sdgs) in the unused or operated Projects:

According to the KSSC. Law 2007, article no.6.I TOR (establishing comprehensive system for collection, transfer, treatment and disposal of wastewater by using the modern methods that protect environment from pollution in Khartoum State).

Through documentary reviews 'of the annual plans and the performance reports of KSSC during (2014 – 2018) and from the interviews with specialized engineers, ***the audit has found: Uncompleted execution of the electromechanical works for Bahri main pumping station which was part of the annual plans since 2014, also the treatment station which assimilates the wastewaters for this project, was not listed in the annual plans of the KSSC as well***. The planning of Bahri Project first stage was partially executed since 2011 (which is the Sanitation net pipes, 4 lifting and main pumping stations) Instead of using the comprehensive system (collection, transfer, treatment and disposal of wastewater). This was due to not prioritizing the project plans. It is preferable, as to the specialist's opinion that, the treatment plant should be firstly established so as to get use of it in fixing the old pipelines that are transferred to the outlets in Wad Dafeea station without treatment till the completion of the project. This resulted in the freezing of 87m.SDG which was used in the partial execution of the Bahri Project which ought not to be used or benefited from till the whole completion of the system.

3.2 The Sanitary projects have been included in the annual plans and executed without preparing the necessary designs and feasibility studies for them:

According to article (18) section 1/c of the regulation of strategic and information activity in Khartoum State 2017, which states (the funds allocated for projects should be defined according to a scientific feasibility studies)

Based on the (TOR) of the Directorate General for Planning and Technical affairs (planning, contract and design department and design section) in the organizational Structure of the KSSC- planning which are as follows:

- Making designs and their drawings on request – especially for small projects.
- Reviewing designs before their implementation by the contractors.
- Studying the sanitation projects that are executed according to the strategic planning and preparing the needed designs for implementation plus the feasibility studies for them.

According to the documentary review for the projects records included in the annual plan in KSSC during the period (2014 – 2018), ***the audit has concluded that there were no feasibility studies or designs for the projects***. Table (1) below illustrates these projects.

Table (1) projects with no feasibility studies or designs:

project name	cost according to the plan by(M.SDG)	Percentage of project Cost to total projects Budget during the year	Year
The pumping line from Suba station to Suba agricultural project.16 Kilometers	100	50%	2014
Rehabilitation of Suba Station Biolack	80	21%	2017
Installation of pumpers to the pumping stations	10	3%	2017
Importing and installation of electro mechanics to the main pumping station- Bahri	49	24%	2014

Source: Audit Team Analysis for project record

This is due to the department plant to made projects without collecting sufficient information before the execution, which result in inaccuracy estimations cost, work load and time limits for the budgeted funds estimations were far from the actual funds. For example an amount of 100m.sdg was allocated for the carrying pumping line from Suba Station to "Agricultural Project with a length of 16 Kilometers and a width of 1000 Mm in 2014, but the contract was signed with the executing company by 50M, SDG. Less than percent 50% of the estimated cost of the year 2014, this resulted in the lack of benefit from the allocation of the difference in the planned amount in opportunities for other important projects. Also, the rehabilitation project of Suba Biolack was estimated By 80m, SDG in 2017 plan, it was not executed and was allocated for it in 2018 plan, with 187m, SDG Increasing. Percent 134% from 2017 plan. Actually In August 2018 a contract was signed with the executing company with an amount of 200.M SDG. Increasing percent 205% from 2017 plan.

3.3 Pumps with the amount of 20.m.SDG were not used:

According to the KSSC Law, 2007, TOR, article (6/O (establishment operation and management of Sanitation. Sanitation nets and wastewater stations with technical, administrative and economic efficiency according to the international standards (having spare pumps to address emergency Maintenance).

From the documentary review to the KSSC – Directorate for Maintenance and Operation and the physical field visits to 18 pumping and lifting stations in Khartoum sector and Khartoum Bahri, (percent 100% of the total number of stations) ***the audit found that There is no optimal use of resources, whereas 30 new pumps imported to stations for developments during 2015 with an amount of 20M, SDG. Only (8) were installed in stations – (21, 20, 9, and 6), the remain of the pumps were not installed despite the existence of (4) stations using (by pass) system (it is a system of pumping wastewater outside the main stream line without making the necessary treatment when it goes through the main stream line***. Table (2) below show that:

Table (2) the current status of the number of station:

Station	Sector	No of pumps needs according to design	Working pumps	Uninstalled Pumps
3	Khartoum	3	1	1
8	Khartoum	3	Nil	2
11	Khartoum- Bahri	3	1	2
16	Khartoum- Bahri	3	Nil	3

Source: performance report of Directorate for Maintenance and Operation

This was due to the slow executing procedures of the new pumps for Bureaucracy procedures, which resulted in getting no use of those pumps or achieving the objective for importing them. Moreover they didn't get use of the guarantee until its expiration.

3.4 Pipes had been imported to establish a pumping carrying line project between Suba station and Suba agricultural project with a cost of (50 M.SDG) and the line project is not executed:

According to the KSSC Law, 2007, TOR, article (6/O (establishment operation and management of Sanitation. sanitation nets and wastewater stations with technical, administrative and economic efficiency according to the international standards (having spare pumps to address emergency Maintenance)). From the documentary review to the projects files and the physical field visits to 18 pumping and lifting stations in Khartoum sector and Khartoum Bahri, ***the audit found that the pipes had been imported to establish a pumping carrying line project between Suba plant and Suba agricultural project. This project is of 16 Kilometers length and 1000 mm witch costs 50M, SDG which Equivalent to a percent 7% of the budget allocated to the Construction, rehabilitation of pipe lines, net &stations during the year 2017. An amount of 38M, SDG was paid (percent 77% of the total cost), these pipes are stored under the sun since 2017 and are not installed till the drafting of this report.*** Image (1) shows the pipes mentioned above.

Image (1) Pipes stored under the direct sun rays:

Source: The picture was taken by the audit team 23/10/2018

As a result there is no installation of pipe due to unprepared deigns and non-definition of the line stream and KSSC was not made adjustment to the conflicts with land owners, which was explained by executing company in its reports to the KSSC. The consequences of all this was; waste of money due to obsolete of pipe that store under the sun more pressure and deterioration on the current sanitation net, explosions of pipelines in addition to raise of the costs of the executing company due inflations of the local currency (costs are to be paid in local currency as per the signed contracts between the two parties).

3.5 The augmentation of malfunctions in the pipelines and stations for weakness of preventive maintenance:

Based on the roles of the Directorate General for Operation & maintenance (planning, executing and establishing the required programs for emergent and regular curative and preventive maintenance for all sanitation net station to realize sustainability and efficiency of Performance).Through the physical field visits and interviews with the all managing directors of (18 of pumping and lifting stations in Khartoum State. And according to the documentary audit for sanitation net users' complaints, for years (2016 & 2018)[7] ***the audit found that There was no preventive maintenance made to the stations, the maintenance was limited to curative whenever a problem or leakage occurred this due to unplanned preventive maintenance***. This resulted on frequent complaints occurred in many areas which assure the augmentation of problems in stations for lack of preventive maintenance.

Table (4) shows the audit collection of the total annual complaints for a number of areas during (2016-2018).

Table (3) shows the annual number of complaints in a number of Areas as per the audit.

Year	complaints in Khartoum(2 &3)	complaints in Aldum Al shrgia	complaints in Al Amarat	total annual complaints
2016	382	100	297	779
2018	473	111	342	926
Total	855	211	639	1705

Source: Audit Team Analysis for sanitation net users' complaints record

From the table it is notable that, complaints in Khartoum (2 &3) had reached 855 during (2016, 2017) i.e. percent 50 % of the total number whereas Alamarat area had reached 639 with a percent 37% of the total number also non preventive maintenance negatively affect the working machinery in the stations and resulted in the flood of sewage water on Khartoum State's streets Image (2) Shows floods of sewage water on streets of Khartoum Streets.

[8] **the audit is unable to check number of users' complaints lists for years (2014/2015 and 2018) due to the absence records.**

Image No (2) floods of sewage water on streets of Khartoum Streets.

Source: The picture was taken by the audit team

3.6 lack of control over the sanitation net users:

3.6.1 There are some factories in the sanitation net area, but still they have private sanitary wells:

According to the Sanitation Law in Khartoum State 2007, section,(2) article (5) which states:(wherever there is a sanitation net in a specified area, no individual, legal or public entity of the same service area has the right to transfer, collect, make treatment or dispose the brackish water unless through that sanitation net, this is according to the rules and regulations of this law.

From the audit review to the reports of the Directorate treatment, inspection and control stations for the years (2014-2018) ***the audit has come to There are some factories in the sanitation net area, but still they have private sanitary wells.*** Shown table no (6) shown the examples.

Table (4): Examples for factories with sanitation net area but have private sanitary wells:

Factory Name	Industry Type
Kobani Plastic	Plastic
Delta for Food stuffs	Food Stuffs packaging
Sarah Lilhagar	Ceramic

Source: audit team analysis of reports of the inspection and control stations for the years (2014-2018)

Due to the non-Impose strict control on compliance with sanitation laws through enhancing controls and periodical inspection of the Sanitation net users, as that the wastewater of those factories is not treated and the use of those private wells will contaminate the surface water.

3.6.2 No internal primary treatment unit is established:

According to the Sudanese metrology standard, no,(173/2008) article (3.2), this states: (the primary treatment is defined as the serial processes that the liquid waste inside the factory goes through before the disposal of this waste or draining it into the public sanitation net? It includes the filtering, resting and chemical balancing).

From the audit review to the reports of the Directorate treatment, inspection and control sanitations for the years (2014-2018) and the physical field visits to (10) factories[8] (also 5 tanneries out of 9 have been checked, and their treatment units have been inspected. ***The audit has come to no internal primary treatment unit is established for 5 numbers of factories out of 10 visited.*** Examples are shown on table (7) below.

Table (5): Examples of factories with no primary treatment units:

No	Factories inside the sanitation net
1	*Al Jawhara* factory for medical &; Cotton Products
2	Total Soap Co., Ltd
3	*Al Shorouk* Soap Factory
4	*JIA* Plastic Factory
5	National Company for Trade & Services

Source: audit team analysis of reports of the inspection and control stations for the years (2014-2018)

Due to not-obligating the users to apply the regulations of sanitation work, the industrial wastewater is improperly disposed in a way that affected the sanitation net efficiency and blocked its pipelines.

3.7 Failure to provide the maintenance and tools for appropriation and maintenance in timely and appropriate manner:

According to the goal of the Directorate General for maintenance and operation (pumping stations department), (establishing plans and required programs for provision of materials and equipment for the operation of the stations and laboratories in line with the international standards and according to the Directorate General for Stores and Procurements roles and responsibilities:

- Review of the inventory status and reporting to the responsible departments.
- Set stock storing plans for all items and materials to realize safety and validation requirements.
- Making procurements for the KSSC according to the prevailing Regulations.

From the documentary review for the performance reports and the field visits, to Wad dafeea plant the audit has noticed the partial work stop in the station due to lack of some pumps and spare parts

9 The audit has not obtained total number of these factories due to the lack of coordination between the KSSC and the Ministry of Industry which makes the authentications to establish factories and tanneries in Khartoum State.

for maintenance and operation. Table (5) shows the slow response in providing the required maintenance equipment:

Table (6): Slow response in providing the required maintenance equipment.

No	Date	Details
1	31-5-2017	Connecting the water in- line(4 inches) to Wad Dafeea
2	20-8-2015	Assigning a contractor to the pumps leakages in the station
3	29-10-2015	Spare parts for the Aero – pumps

Source: Performance reports of Wad Dafeea Station

No response is yet received as to the above requests till drafting this report; this is due to the slow procedures and delayed top management's response to the station's manager, the thing that resulted in work stop of some parts of the station and thus, not getting use of the full capacity of the treatment station of Wad Dafeea (17000 square meters). The operation percentage was between 37% and 50%(of the full station capacity according to the performance reports). As a result of that, the area is affected by the evaporating smells of the treated water and increase of citizens' complaints.

3.8 Inefficient operation of treatment plants according to capacity:

3.8.1 Suba plant (OX Biological Treatment):

According to the designed capacity for treatment stations: Suba station capacity is (31,420) cubic meters daily. From the physical visits to station of wastewater treatment (Suba) in Khartoum State, and the documentary review to performance reports of the station for (2017 – 2018) ***the audit has concluded that the amount of water entering Suba Station (OX Biological Treatment) is estimated with (35,000 -4,000) cubic meters, according to the personal interview with the person in charge of the station, which means that the station is working over its capacity affecting its useful lifetime, In addition to the phenomenon of discharging industrial wastewater(with different colors)of various utilities and installations -not connected to the public net – directly in the anaerobic ponds.*** See the image no (3).

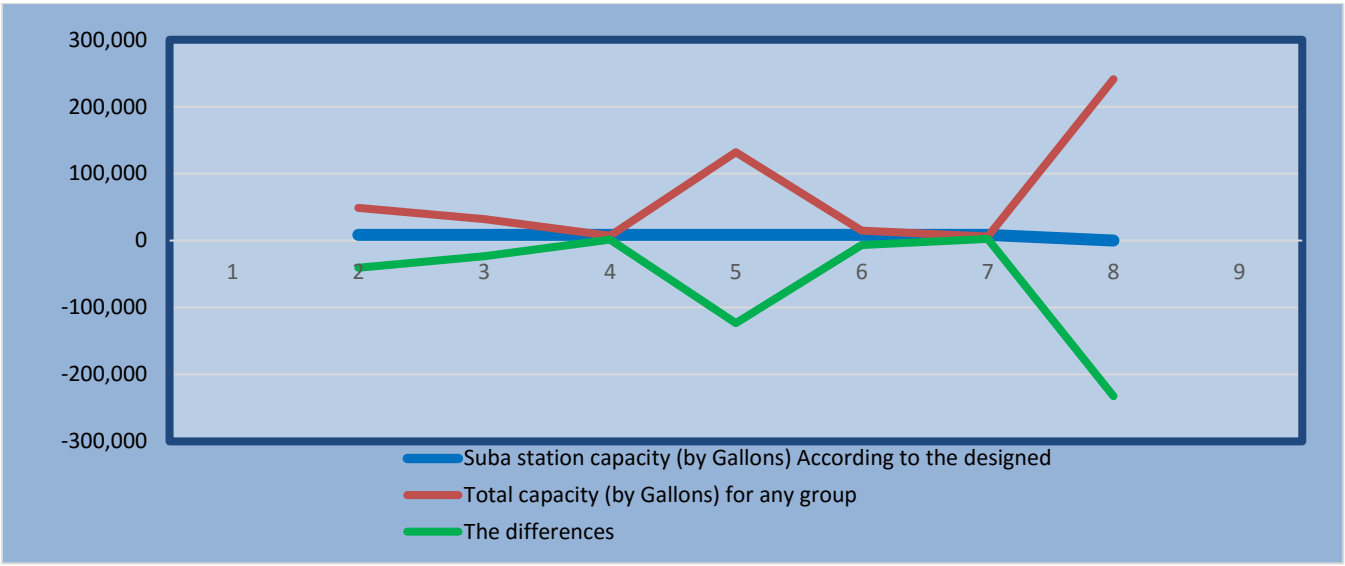
Image no (3) shows examples of wastewater tankers which are emptied in the anaerobic ponds:

Source: The picture was taken by the audit team 8/1/2019

Phenomenon of discharging industrial wastewater which estimated about (357,041 M^3) which deviation 10.36% over the operating capacity of the plant,

See Appendixes (6) @ (7). Figures (4) below show the Suba station capacity (by Gallons) compare with the total capacity of the Tankers groups.

Figure (2) the Suba station capacity (by Gallons) compare with the Total capacity Tankers groups



Source: Audit Team Analysis for Appendix (7)

This is Due to no priority is given to the execution of the project for the rehabilitation of Soba Alpaolak plant9; this led to the lack of treatment of wastewater destined for the Nile.

3.8.2 Wad Dafeea plant:

According to the designed for treatment plant (Wad Dafeea) capacity is 17,000 S. meters daily.

From the physical visits to stations of Hag Yousif in Khartoum State, and the documentary review to performance reports of the stations for (2017 – 2018) and the correspondences of executing contractor of the project dated (31/5-2017& 16 /2/2018) to the project administration. ***The audit has concluded that the station current actual working capacity is 6000 square meters daily with a percentage of 35% of its designed capacity. A percentage of 50% of untreated wastewater is transferred to the old surface basins outside the station to evaporate naturally which evaluates the water highest in it.***

The SBR (1) has stopped working since October 2017 due to lack of spare parts for operation. The sludge drying unit has stopped working due to water shortage used in machinery cleaning especially that the full capacity of dams is insufficient which resulted in its accumulation and making it very difficult to treat wastewater properly.

9 a biological treatment plant by active sludge, which implemented since 2004 with a design capacity of 40,000 cubic meters per day by a Turkish company, but the project did not work when the experiment was completed in 2009 for Technical errors at the time of implementation and has been placed in rehabilitation plans since 2014 to relieve the pressure on Soba station and has not been implemented so far.

Thus polluting the environment with evaporating bad smells around the neighboring areas and frequently citizens' complaints.

3.9 The required tests have not been done to ensure the proper treatment of wastewater:

According to the standards and regulations defined in the attached tables).Table (8) below shows some of the tests that should be made according to the Sudanese metrology standard no. (2013 /174), and the standard number of tests based on best practice. (The wastewater should go through decomposition stage to recognize the water specifications and to check whether they are aligned with the Sudanese metrology standard and to specify the treatment Process efficiency).

Table (7): Standard Number of Tests for Wastewater Decomposition:

Test type	Standard number of tests
(BOD)	Once a week
(COD)	twice a week
(T.S.S)	Daily
(N-NH3)	Daily
(Cl)	daily
(PH)	daily
(MPN)	at least once a week

Source: Sudanese metrology standard, no,(173/2008) article (3.2) & http://watertechexperts.com/vb/forum.php Source: Water Technology Experts Forum

From the physical field visit to Suba & Elhag Yousif treatment plants of Khartoum State, and the audit review of the performance reports of both stations, in addition to the interview with of the officials in the two plants***, the audit has come to:***

3.9.1 Suba Station:

Had not made the periodic required tests for quality of daily work during (2014-2018) according to standards, for these tests' results help the station to make the appropriate maintenance programs (There were only some requests for tests in Construction & Environmental Laboratories Limited Company, this was taken from the reply of the general manager of this company to the audit letter no. (NAC/SA /PA), addressing the related parties). The audit concluded that Suba Plant had made monthly contracts with the C& E. Laboratories Company to make tests, during the last 5 years, but tests had stopped since June 2013 as a result of cancelling those contracts.Table (9) below shows the total number of various excited requests for tests during (2014-2018).

Table (8): below shows the total number of various requests for tests(2014 2018)

YEAR	2014		2015		2016		2017		2018	
Test Type	Standard No Of Tests	Actual No of tests	Standard No Of Tests	Actual No of tests	Standard No of Tests	Actual No of tests	Standard No Of Tests	Actual No of tests	Standard No of Tests	Actual No of tests
BOD	52	5	52	5	52	4	52	1	52	1
COD	104	5	104	5	104	4	104	1	104	1
T.S.S	360	5	360	5	360	4	360	1	360	1
N-NH3	360	5	360	5	360	4	360	1	360	1
Cl	360	5	360	5	360	4	360	1	360	1
PH	360	5	360	5	360	4	360	1	360	1
MPN	52	5	52	5	52	4	52	1	52	1

Source: Audit Analysis for the Test results of the Establishing and environmental Labs during (2014-2018)

From the above table it is notable that there is no compliance with the standard number of tests; for example: (BOD) test should made once a week, i.e. 52 times a year, the actual number of tests done is only, 5 times during 2014 /2015, which percentage 10% of the standard number and 4 times during 2016 which percentage 8%, and once during 2017/2018 which percentage 2% of the Standard number, table(10) below show the deviation between the standard and actual number of tests.

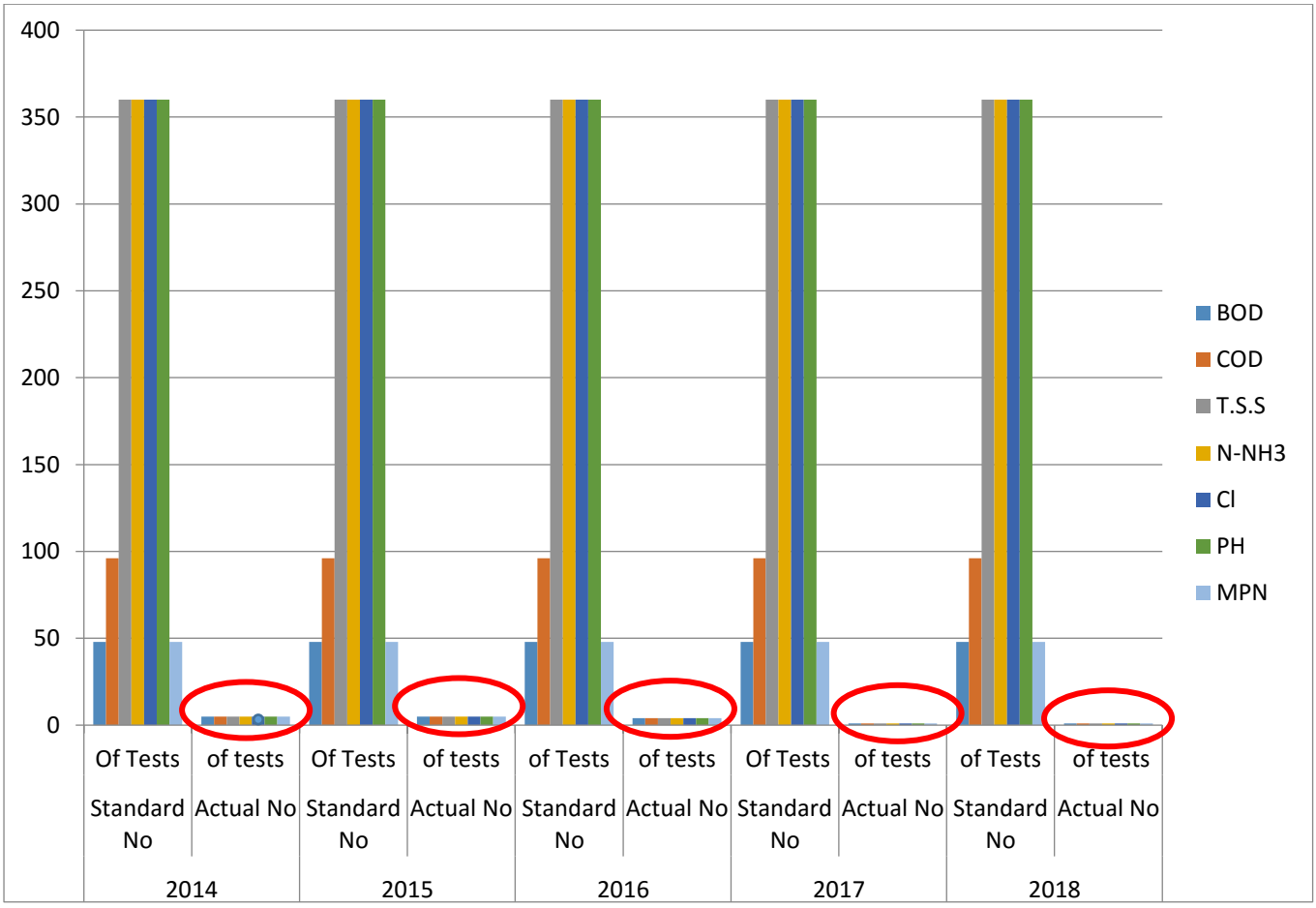
Table (9) the deviation between the standard and actual number of tests.

tests	Deviation between the standard and actual number of tests.				
	2014	2015	2016	2017	2018
BOD	90%	90%	92%	98%	98%
COD	95%	95%	96%	99%	99%
T.S.S	99%	99%	98%	99.9%	99.9%
N-NH3	99%	99%	98%	99.9%	99.9%
Cl	99%	99%	98%	99.9%	99.9%
PH	99%	99%	98%	99.9%	99.9%
MPN	90%	90%	92%	98%	98%

Source: Audit Analysis for the Test results of the Establishing and environmental Labs

The same situation is to be considered for the rest of test types. Figure (2) below show excited tests compare with the standard during (2014-2018).

Figure (3) excited tests compare with the standard



Source: Audit Analysis for the Test results of the Establishing and environmental Labs

The lack of a laboratory for the necessary tests in Suba station has resulted in the uncertainty of the quality degree of treated water going directly to the Nile.

3.9.2 Wad Dafeea plant:

Although this station has a Lab., but it had not made any tests on toxics and non-dissolving substances, for example; heavy toxic elements like lead & mercury although most of the wastewater in the station is of industrial nature.This is due to the no completion of Wad Dafeea laboratory for industrial wastewater tests. This resulted in the uncertainty of quality type of the treated water that goes for forest irrigation in Hatab area.

3.10 lack of awareness programs for the Net Users:

According to best practice (Arab Republic of Egypt in sanitation establishes, a special department for sanitation service awareness, as part of the sanitation departments of the Sanitation Company of Cairo. The prior objective of this company is to raise the citizens' awareness in optimal use of sanitation

net to maintain net, clean up-to-date environment. From the documentary audit to the organizational structure of the KSSC and the personal interview with the director of the public relations section of the Ministry of Infrastructure, the audit has found that there was lack of awareness programs to the Net Users during (2014-2018) due to the awareness responsibility is one of the role of the media & public relations section which is directly accountable to the general manager, but this section is inactive although a manger is assigned for it since 25/9/2018. Also there are no annual plans or performance reports for (2014/2018).

- The undefined roles of the section and not prioritizing the type of awareness.This resulted in the misuse of the Net by the citizens who dispose bodily waste that blocks the net pipelines.

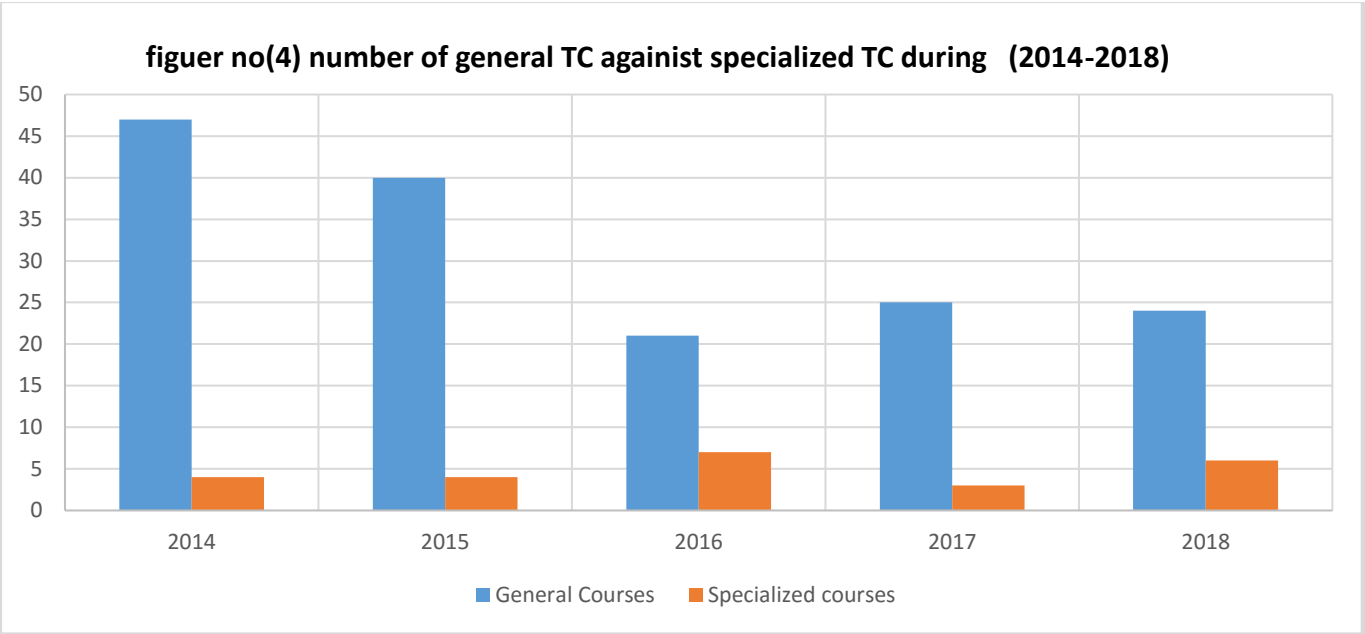
3.11 The training programs have not considered the technical needs of the KSSC:

According to strategic objectives of the Directorate General of Human Resources development/Training Department, for (2014 – 2018), this states Setting training plans, sustainable search for training courses that meets the corporation's requirements, keeping continuous developments, getting the best of the technology and modern systems of sanitation, develop, invest, and qualify human resources in this type of industry in and out KS. Through personal interview with the managing director of the training administration of the KSSC and the documentary review to the annual plans, performance reports, and training files analysis for the period (2014-2018) ***the audit found that Training programs had not focused on the technical needs, for*** example; wastewater treatment techniques, planning, design and execution of sanitation projects. There is a need serious need for training of the technical staff at Wad Dafeea on operational maintenance since July 2017 and this was not satisfied till now. Despite the implementation of a percentage 78% of the planned training programs for 5 years, but the courses were not specialized and general course, e.g. (English language, Personal skills...etc..), which do not suit the industrial needs of sanitation. This is shown in Table (4) and chart diagram No (2).

Table No (10) Execution of training courses for (2014-2018):

Year	Planned TC	Executed TC	Execution Percentage	Specialized TC	General TC
2014	55	51	92%	4	47
2015	53	44	83%	4	40
2016	29	28	96%	7	21
2017	29	28	96%	3	25
2018	34	30	88%	6	24
Total	200	181	90%	24	157

Source: Audit Team Analysis for Trainees' lists (2014 – 2018)



Source: Audit Team Analysis for Trainees' lists (2014 – 2018).

From the figure above it is notable that, the total number of specialized executed programs, The number of (24) TC is too little comparing to the general number of (157) TC over the years (2014 - 2018), the range of specialized TC is between (3-7), while it is about (21-47) for general TC. Also the average number of executed specialized TC was 4.8 and the average number of the executed general TC was 31.4 courses per year. This resulted in minimizing the development chances in the Corporation, especially in its current growing stage which requires high technical and engineering competencies. That's due to: Training courses are not considering the real staff needs for the lack of coordination between various administrations in the corporation with the training department.

3.12 Relying on government funding and not granting investment opportunities in the field of sanitation to attract non-governmental funding:

According to the directives from the Ministry of Strategic Affairs and Information in Khartoum State 2018 of establish investment environment:

1. Encouraging the society and private sector to contribute in the implementation of the strategy and not to rely on the public funding only.
2. Enhancing regulations and standards that guarantee qualified investors, either financially or technically.
3. Encourage the role of the private sector in sanitation through (B.O.T) system.

According to article no (b5) of the KSSC Law (providing a suitable climate for raising the sanitation service quality and encouraging investments in this industry.

Through the audit review to the annual plans and the director general of KSSC decisions, for (2014 - 2018) and from the personal interview with the investment director, it was clear for ***the audit found that the KSSC was Relying on government funding and not granting investment opportunities in the field of sanitation to attract non-governmental funding*** was due to The investment department in the KSSC was established with one chemical engineer as a manager, and another one as a technical to join the department and both of them is not specialized in promotion field. They have not been

trained to conduct their assignments in this department properly. Also the roles of the investment department are not defined in job description. The investment department has not established any annual plans or either performance reports. Due to the non- compliance with the directives of the Ministry of Strategic Affairs and Information to establish Khartoum State's plans, this led to inadequate circumstances for attracting non-governmental funding that increases revenues to be used in covering the Khartoum State with sanitation system which remained in the same situation since (1954) which has been percent 0%7 since its foundation.

4. Conclusion:

General Conclusion:

The audit general conclusion is that despite the efforts of the KSSC in expanding the Sanitation net with the Khartoum State. It has not succeeded in achieving its objectives because it doesn't set the comprehensive system of collecting, transporting, treatment and disposal of wastewater with compliance of the modern methods of environment protection form pollution in Khartoum State. This is due to mansions of planning, execution and follow-up of the Sanitation net development and maintenance process effectively to ensure good sanitation. And promoting and increasing sanitation service in Khartoum State. The percentage of covering does not exceed 7% of the State's area.

Specified Conclusion:

Based on the evidence shown in this report, the audit concluded that:

The weakness in sanitation service in Khartoum State is a result of deficiency in the processes of setting the comprehensive system in collecting, transferring, treating and disposing of wastewater to the following reasons:

- Uncompleted execution of the electromechanical works for Bahri main pumping station which was part of the annual plans since 2014, also the treatment plant which assimilates the wastewaters for this project, was not listed in the annual plans of the KSSC as well. The planning of Bahri Project first stage was partially executed since 2011 (which is the Sanitation net pipes, 4 lifting and main pumping stations) has led to freezing the funds (87M, SDG) in the unused or operated Projects Instead of using the comprehensive system (collection, transfer, treatment and disposal of wastewater) This was due to not prioritizing the project plans.
- There were no feasibility studies or designs for the projects this is due to the department plant to made projects without collecting sufficient information before the execution, which result in inaccuracy estimations cost, work load and time limits for the budgeted funds estimations were far from the actual funds.
- There is no optimal use of resources, whereas 30 new pumps imported to stations for developments during 2015 witch costs 20m.SDG which Equivalent to a percent 8% of the budget allocated to the Construction, rehabilitation of pipe lines, net &stations during the year 2015 see Appendix (3). Only (8) were installed in station (20, 21, 9 and 6), the remain of the pumps were not installed despite the existence of (4) stations using (by pass) system (it is a system of pumping wastewater outside the main stream line without making the necessary treatment when it goes through the main stream line. This was due to the slow executing procedures of the new pumps for Bureaucracy procedures.
- The pipes had been imported to establish a pumping carrying line project between Suba station and Suba agricultural project. This project is of 16 Kilometers length and 1000 mm witch costs 50 M, SDG which Equivalent to a percent 7% of the budget allocated to the Construction, rehabilitation of pipe lines, net &stations during the year 2017. An amount of 38M.SDG was paid (percent 77% of the total cost), these pipes are stored under the sun since 2017 and are not installed till the drafting of this report This was due to unprepared deigns and non-definition of the line stream and KSSC was not made adjustment to the conflicts with land owners, which was explained by executing company in its reports to the KSSC.

- No preventive maintenance made to the stations, the maintenance was limited to curative whenever a problem or leakage occurred this due to unplanned preventive maintenance. This resulted on frequent complaints occurred in many areas which assure the augmentation of problems in stations for lack of preventive maintenance.
- Lack of control over the Sanitation net users:
  1. There are some factories in the Sanitation net area, but still they have private sanitary wells Due to the non-Impose strict control on compliance with sanitation laws through enhancing controls and periodical inspection of the Sanitation net users, as that the wastewater of those factories is not treated and the use of those private wells will contaminate the surface water
  2. No Internal primary treatment unit established for five numbers of factories out of ten visited. Due to not- obligating the users to apply the regulations of sanitation work, the industrial wastewater is improperly disposed in a way that affected the Sanitation net efficiency and blocked its pipelines.
- Partial work stops in Wad dafeea plant due to lack of some pumps and spare parts for maintenance and operation.
- Inefficiency of working in the treatment plants according to the capacity:

  1. the amount of water entering Suba Station (OX Biological Treatment) is estimated with (35,000-40,000) square meters, according to the personal interview with the person in charge of the station, which means that the station is working over its capacity affecting its useful lifetime, In addition to the phenomenon of discharging industrial wastewater of various utilities and installations -not connected to the public net– directly in the anaerobic ponds. This is Due to no priority is given to the execution of the project for the rehabilitation of Soba Alpaolak plant.

  2. *Wad* dafeea plant current actual working capacity is 6000 square meters daily with a percent 35% of its designed capacity. Percent 50 % of untreated wastewater is transferred to the old surface basins outside the station to evaporate naturally which evaluates the water highest in it. The SBR (1) has stopped working since October 2017 due to lack of spare parts for operation.
- The required tests have not been done to ensure the proper treatment of wastewater:
  1. Suba Station; had not made the periodic required tests for quality of daily work during (2014-2018) according to standards, for these tests' results help the station to make the appropriate maintenance programs.
  2. Wad Dafeea plant although has a Lab., but it had not made any tests on toxics and non-dissolving substances, for example; heavy toxic elements like lead & mercury although most of the wastewater in the station is of industrial nature.This is due to the no completion of Wad Dafeea laboratory for industrial wastewater tests.
- There was lack of awareness programs to the Sanitation net Users during (2014-2018) due to The awareness responsibility is one of the role of the media & public relations section which is directly accountable to the general manager, but this section is inactive although a manger is assigned for it since 25/9/2018. In addition, there are no annual plans or performance reports for (2014-2018) the undefined roles of the section and not prioritizing the type of awareness.

- Training programs had not focused on the technical needs, for example; wastewater treatment techniques, planning, design and execution of sanitation projects. There is a need serious need for training of the technical staff at Wad Dafeea on operational maintenance since July 2017 and this was not satisfied until now. Despite the implementation. Percent 78% of the planned training programs for 5 years, but the courses were not specialized and general course, e.g.(English language, Personal skills...etc..), which do not suit the industrial needs of sanitation. That's due to: Training courses are not considering the real staff needs for the lack of coordination between various administrations in the corporation with the training department
- the KSSC was Relying on government funding and not granting investment opportunities in the field of sanitation to attract non-governmental funding was due to The investment department in the KSSC was established with one chemical engineer as a manager, and another one as a technical to join the department and both of them is not specialized in investment department. They have not been trained to conduct their assignments in this department properly. Also the roles of the investment department are not defined in job description. The investment department has not established any annual plans or either performance reports. Due to the non- compliance with the directives of the Ministry of Strategic Affairs and Information to establish Khartoum State's plans.

5.0 Recommendations:

The KSSC should:

1. Collecting sufficient information on projects before their execution to seek accuracy when making estimations for cost, work load and time limit for the project's completion, thus having realistic budget estimations, Prioritizing the plans with completing the Master Plans and Making feasibility studies and necessary designs for sanitation projects to ensure their completion in due time.
2. Executing procedures of the new pumps.
3. Making feasibility studies and necessary designs for the sanitation pipeline project between Suba station and Suba agricultural project to ensure their completion in due time. And adjustment of the conflicts with landowners.
4. Set defined plans for preventive maintenance.
5. Impose strict control on compliance with sanitation laws through enhancing controls and periodical inspection of the Sanitation net users.
6. Respond to the maintenance requests submitted from the stations' managers to the top management of KSSC to ensure their (stations) full capacity operation.
7. Giving priority to Suba rehabilitation project (Suba Biolack) to reduce the pressure on Suba treatment station and providing spare parts in time for maintenance.
8. Providing Suba station with a laboratory for necessary tests of wastewater and the completion of Wad Dafeea Lab to make special analysis for industrial wastewater to ensure proper water treatment.
9. Define roles of the section and prioritizing the type of awareness.
10. Coordination between the training department and the other departments when defining the training needs and share with them the programs setting, in addition of increasing specialized programs of sanitation industry to develop the KSSC especially during its growing stage
11. Define clear terms of reference for investment management and provide them with qualified manpower in the field of investment section.

Appendices:

Appendix (1): Responses from the KSSC management:

NO	Recommendation	the KSSC Comment(s)
1	Collect sufficient information on projects before their execution to seek accuracy when	We agree to what has been shown on the report and we have been taken serious measures to

	making estimations for cost, work load and time limit for the project's completion, thus having realistic budget estimations, Prioritizing the plans with completing the Master Plans and Making feasibility studies and necessary designs for sanitation projects to ensure their completion in due time.	complete the project and procure the pumps. We are targeting to start operating Bahri Sanitation net during the first half of next year.
2	Collecting sufficient information before the execution projects.	No response has been received from the management.
3	Executing procedures of the new pumps.	We attribute this to the lack of funding for the installation process and this issue has been amended; now all pumps are being installed except two which will be installed after coordination before the year end.
4	Making feasibility studies and necessary designs for the sanitation pipeline project between Suba station and Suba agricultural project to ensure their completion in due time. And adjustment of the conflicts with landowners.	This line installation requires the handling of the stream and high committee is formed to complete this procedure. The project will be raised as part of the 2020 plan.
5	Set defined plans for preventive maintenance.	We agree with you that, the sanitation net is deteriorated and getting old in addition to insufficient budgets, instability of exchange rates and the scarcity of foreign currency. We are seeking for allocation of stock in spare parts after the approval of the additional budget.
6	Impose strict control on compliance with sanitation laws through enhancing controls and periodical inspection of the Sanitation net users.	No response has been received from the management
7	Respond to the maintenance requests submitted from the stations' managers to the top management of KSSC to ensure their (stations) full capacity operation.	
8	Giving priority to Suba rehabilitation project (Suba Biolack) to reduce the pressure on Suba treatment station and providing spare parts in time for maintenance.	Suba Plant is working over its productivity capacity, hoping that the Biolack station should be rehabilitated to absorb the surplus of Suba plant. Wad Dafeea is working under its capacity for leakages in some of its parts, thus needing allocation of spare parts and additional financing to bring it back to its full capacity.

9	Providing Suba station with a laboratory for necessary tests of wastewater and the completion of Wad Dafeea Lab to make special analysis for industrial wastewater to ensure proper water treatment.	Despite the reasonable number of tests done in the station, still there will be contracts with the Environmental Laboratory Center, Environmental Center at the High council for Environment for periodic tests to ensure compliance with standards in addition to the periodic tests run by the KSSC
10	Define roles of the section and prioritizing the type of awareness.	We agree with you and We strive to tackle and prepare a comprehensive program with extensive media coverage.
11	Coordination between the training department and the other departments when defining the training needs and share with them the programs setting, in addition of increasing specialized programs of sanitation industry to develop the KSSC especially during its growing stage.	The management has conversely responded that the training courses are comprehensive and satisfying the technical training needs which were approved by its general administration. **Audit Comment to this response :** The different annual plans of the KSSC which Presented to the audit did not include its training needs.
12	Define clear terms of reference for investment management and provide them with qualified manpower in the field of investment section.	The observation is accurate, we do agree with it thoroughly, and we will start activating the Investment Administration procedures to attract investors. We also see that this sector needs to enter into partnerships and investment like, BOT (Build, Operate and transfer) PPP (Purchasing Power Parity) formulas with the private sector.

Appendix (2): Audit sub sustention:

1.1 To what extent have *KSSC* Establish, operate and manage Sanitation nets and stations with technical, administrative and economic efficiency in accordance with international standards?

1.2 Is the training courses for technical staff are effective?

1.3 Are there any promotional plans to attract investors to invest in sewage projects?

2.1 Are the necessary operational and maintenance materials provided in a timely manner?

4.1 To what extent does the KSSC conduct tests of treated water to ascertain its specifications prior to its use for the forestry irrigation in Hattab area or flow to the Nile from the treatment plant in Suba?
4.2 Has *Khartoum Sanitary Corporation* sensitized users to sanitation services to ensure that the waste and dirt that cause the blockage of pipes are not thrown in inspection rooms?

Appendix (3): Document Review:

NO	Document reviewed	Reasons for reviewing documents
1	Laws: - Law of Khartoum State Sanitary Corporation 2007. - The law of regulating companies and corporations for Khartoum state 2009. - Strategic and information law 2017. - Law establishing the center for environmental and construction laboratories - Law of Khartoum Water Corporation. - Law of Environmental Protection and Promotion 2008. - Evaluation of the environmental return of projects in Khartoum State 2011.	- To understand the legal mandate of KSSC, its responsibility, the relationship with related parties, and how it managed to plan to its projects. - To learn how the wastewater should be disposed in healthy manners without negative impact to the environment.
2	Regulations: - List of regulating sanitation services 2007. - List of standards and specifications of environmental protection against water pollution (SUDIA ARABIA). - List of regulating strategic and information work for Khartoum state 2017. - Organization structure for KSSC 2009. - The staff register of KSSC 2018.	To learn how sanitation services should be provided the best practice in some countries, and the distribution of staff within various departments.
3	- Strategic and annual plans, and performance reports for KSSC during the period (2014-2018).	To learn whether there is arrangement to the priorities in planning for sanitation projects, deviation in implementation, challenges facing KSSC, and measure the performance.
4	- The five – year plan for Khartoum state (2016-2020). - Sustainable development goals. - Reports about providing sanitation services in some countries (Egypt,)	To verify the extent of implementing KS plan, SDG goals, and measure the performance comparing with other countries.
5	- users' complaints record	To know the types of problems in Sanitation net pipe lines, frequency, and the efficient response to address it.

6	Standards and Specifications: - Sudanese standards NO (174/2013). - Sudanese standards NO (173/2008). - Technical specifications for primary processing units handled by KSSC. - Characteristics and standards of wastewater treatment. - Manual of performance indicators / the ministry of strategic affairs and information 2018. - Typical laboratory tests / center for environmental and structural laboratories.	To identify the types of standards tests, the legal limits allowed for organic and non-organic pollutants for industrial wastewater, the extent to which the corporation has the required laboratory tests.
7	Reviewing existing sanitation projects documents.	To measure the performance during the period (2014-2018).
8	Sample of Contracts with engineering companies, consultants, contractors, and others to implement sanitation projects.	To learn about basic requirements to implement projects, the responsible parts, and the causes of delaying projects or the deviation from which is expected to be done.
9	Subscriber's statements of the sanitation services.	To know the total number for factories, hospitals, restaurants, tanneries, and individuals who are receiving the sanitation services.
10	legal decisions: - Decision no (16/2018) to form management board for KSSC. - Decision no (34/2018) to report the performance of the ministry of infrastructure and transport for the purpose of urgent completion of ongoing sanitation projects. - Guidelines for preparing the year plan (2018) issued by ministry of strategic affairs and information - Decision no (37/2012) quality of wastewater treatment plants.	To learn about the extent of the compliance by KSSC to the decision and directives issued.
11	- Annual plans and performance reports for general directorate of KSSC during (2014-2018): - General directorate of planning and technical affairs. - General directorate of operation and maintenance. - General directorate of inspection, control, and treatment plants.	Measure the performance of different departments in the provision of sanitation serves according to the roles of each one.

	- General directorate of projects. - General directorate of investment. - General directorate of human and financial resources. - Media and public relation department.	
12	Other reports : - KSSC financial reports (2014-2018). - Technical reports for pumping, lifting, and treatment station (2014-2018). - Final report on the environmental impact of Nile water pollution / UNESCO November 2017. - Health and environment aspects for collect, treatment, disposal, or reuse of treated wastewater / Wikipedia. - Workshops and scientific papers carried out by KSSC.	To identify the types of problems that hinder the work of sanitation net pipelines and its station efficiently such as random in maintenance work, poor discharge, and blockage of pipes.

Appendix (4): Interviews:

NO	Interviewee	The purpose
1	General Director for Ministry Of Infrastructure and Transport.	To learn how to work with the main bodies and other stakeholders.
2	General Director Of Khartoum Sanitary Corporation.	To know the progress of various departments in the corporation.
3	Director Of The General Administration Of Operation and Maintenance.	To collect information on the performance of preventative and curative maintenance to the sanitation net pipe lines and sanitation net, respond to existing communications and challenges.
4	Director Of The General Administration Of Projects.	To Collect information on the causes of delaying current and future projects, prioritization, and challenges.
5	Director Of The General Administration Of Planning and Technical Affairs.	To Collect information on the administration, its function, its specialties, and how to develop annual and strategic plans in coordination with different departments of the corporation.
6	Director Of The General Administration Of Inspection, Control, and Treatment Plants.	Collect information on the specialties of the administration, its plans, implementation of the inspection boards on the sanitation net and its equipment.
7	Director Of Inspection and Control Management.	Identify the types of irregularities that are controlled by the management, collect information on

		wastewater discharge stations, and how to control the illegal connections inside or outside sanitation net pipe lines.
8	Director Of The General Administration Of Investment.	To know the functions, term of reference, the actions taken by the administration to attract investors (to invest in KSSC projects).
9	Secretary General of Supreme Council For Environment And Urban Promotion.	To know the importance of laboratory tests, effects of wastewater on the environment, and types of traditional and scientific methods used in treatment.
10	General Director Of Environmental and construction Laboratories Company.	Collect information about stakeholders, ensure whether KSSC periodically performs necessary laboratory tests, and learn how laboratory specifications could be meet.
11	Managers Of Pumping, Lifting, And Treatment Stations (20 stations).	Collect information on stations performance and the extent of compliance with standards, maintenance procedures required, materials required, general condition of machinery and equipment, and the current challenges.
12	Director Of Sanitation net Development	Knowledge management role in improving the efficiency of the Sanitation net performance.
13	General Director Of Training Management.	To know whether annual and strategic plans is suitable for training needs.
14	General Director Of Public Relations And Media Management	The extent to which the management implements awareness programs for citizen and Sanitation net users.

Appendix (5) Budget of Construction, rehabilitation of pipe lines, net &stations

Year	Budget of Construction, rehabilitation Of pipe lines, net &stations. (The amount by M.SDG)
2014	202
2015	196
2016	200
2017	382
2017	25

Appendix (6): Audit Team Analysis for the frequency of discharges in the plant daily by Gallons:

Number	Tanker number	Tanker capacity by Gallons	The frequency of discharges by day	Total capacity by Gallons

1	35729	3,000	4	12,000
2	35700	3,000	4	12,000
3	56002	2,500	2	5,000
4	5355	3,000	4	12,000
5	46947	3,000	7	21,000
6	386	4,000	3	12,000
7	9974	3,000	2	6,000
8	18580	4,000	3	12,000
9	28772	4,000	5	20,000
10	47096	3,000	6	30,000
11	833	3,000	7	21,000
12	35944	4,000	4	16,000
13	293	3,000	6	18,000
14	1959	3,000	5	15,000
15	35590	3,000	4	12,000
16	39622	3,000	3	9,000
17	38995	3,000	3	9,000
18	62514	3,000	4	12,000
19	3344	3,000	3	9,000
20	30445	3,000	2	6,000
21	2660	3,000	2	6,000
22	36300	3,000	4	12,000
23	433	3,000	3	9,000
24	1971	3,000	3	9,000
25	25827	4,000	3	12,000
26	5672	3,500	2	7,000
27	39706	3,000	4	12,000
28	2371	3,000	3	9,000
29	27194	3,000	2	6,000
30	23712	3,000	4	12,000
31	8345	3,000	3	9,000
32	2345	3,000	4	12,000
33	28108	3,000	3	9,000
34	44478	3,000	2	6,000
35	30831	3,500	3	10,500
36	2405	2,500	3	7,500
37	27130	3,000	3	9,000
38	8063	3,000	3	9,000
39	42930	3,000	4	12,000
40	8384	3,000	5	15,000
41	432	3,000	2	6,000
42	15090	3,000	3	9,000
43	39884	3,000	2	6,000
44	3068	3,000	4	12,000

45	2009	3,000	5	15,000
46	2421	7,000	6	42,000
47	8475	7,000	6	42,000
48	28282	3,000	6	18.000
49	653	3,000	4	12,000
50	46211	2,500	3	7,500
51	46112	3,000	4	12,000
52	24201	3,000	4	12,000
53	22258	2,500	3	7,500
54	30390	2,500	4	10,000
55	7284	7,000	4	28,000
56	41353	2,500	3	7,500
57	17205	2,500	4	10,000
58	31373	3,000	3	9,000
59	410900	3,000	4	12,000
60	42671	3,000	4	12,000
61	949	3,000	2	6,000
62	2075	7,000	4	28,000
63	2150	4,000	10	40,000
64	334	4,000	5	20,000
65	5758	2,000	5	10,000
66	239512	2,000	5	10,000
67	4226	2,000	4	8,000
68	2421	7,000	6	42,000
69	8286	7,000	5	35,000
70	8475	7,000	6	42,000
Total capacity by Gallons				1,163,000

Source: the number of Tankers entering the plant which calculated by The audit team during physical visits to the plant.

Convert (1,163,000 gallons) to liters **1,163,000*3.7 = 357,041,000 liters**

1 gallon=3.7 liter **(Source: https://www.youtube.com)**

Convert 357, 041,000 liters to cubic meters **357,041,000/1000 =357,041 M³**

1M³ =1000 liter **(Source: https://www.metric-conversions.org/volume/cubic-meters-to-liters.htm**)

Appendix (7): The differences between the Suba station capacity and Total capacity (by Gallons) of Tankers groups According to the capacity.

Suba station capacity (by Gallons) According to the designed	Total capacity (by Gallons) for any group.	The differences
8,492	49,000	-40,508
8,492	32,000	-23,508
8,492	7,000	1,492
8,492	132,000	-123,508
8,492	15,000	-6,508
8,492	6,000	2,492
Total	241,000	-232,508

Source: Audit Team Analysis for Appendix (6)

Convert Suba station capacity by Gallons from cubic meters to liter 31,420* 1000 =31,420,000 liter

Convert Suba station capacity by Gallons from liters to Gallons 31,420,000/3.7= 8,492 Gallons

[i] **www.moiat.gov.sd**