# Benchmarking System for the Wastewater Sector in Bahrain

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# Overview

**UNIFIED GCC WATER SECTOR STRATEGY**

By 2035 the GCC countries should reach **sustainable**, **efficient**, **equitable** and **secure** water resources management systems contributing to their sustainable socio-economic development

**WATER RESOURCES COUNCIL - BAHRAIN**

**TECHNICAL ADVISORY COMMITTEE**

**ARAB GULF UNIVERSITY**

**BENCHMARKING - SANITARY**

# Overview

- Sanitation services in Bahrain are provided to the public with free of charges.
- Presently sanitary utilities in Bahrain do not follow the best practices for benchmarking/quality assurance system for the wastewater utility management.
- Performance Indicators (PIs) are used to identify where organizational performance is meeting desired standards and where performance requires improvement.
- Survey has been conducted to gather information about current handling of wastewater system to identify the gaps.
- Further sanitary department identified PI's to measure and monitor the performance.

# Introduction

- A framework of performance indicators are developed to identify a reasonable set of environmental, social, economic and technical indicators for wastewater treatment.
- The **objective of this study** is to develop/adopt and implement a benchmarking system that is suitable to Bahrain Sanitation sector, and compare the findings with that from the best practices in the world.
- Within the framework and in line with the implementation plan of the GCC UWS, this will serve the 3rd policy of the 4th strategic objective aiming at “achieving the highest international standards of water and wastewater services” which calls for “adopting and implementing the highest benchmarking system for sanitation utilities in the GCC countries”.

# Methodological Approach

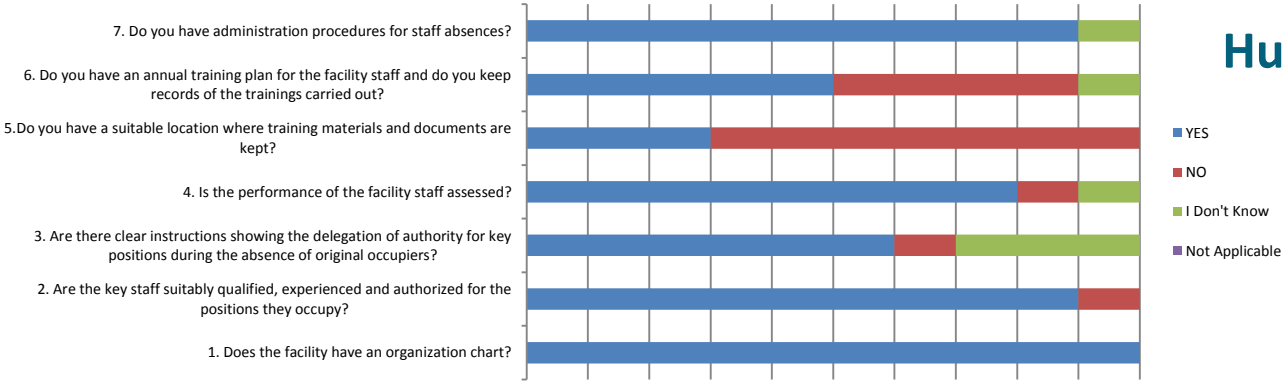
- The Development of a benchmarking system for the sanitation sector in Bahrain will involve the adoption of generally accepted procedures and methodologies.
- Presently there is no benchmarking/quality assurance system for the wastewater utility management in Bahrain.
- The approach of ACWUA (ACWUA, 2015) will be accomplished initially as a gap analysis exercise, this will represent Phase 1 of the study.
- Phase 2 of the study will utilize the literatures in determining the performance indicators using the IWA manual (Matos, et al., 2012) to analyze and select the most appropriate benchmark based on their relevance to the sanitation sector in Bahrain.

# Phase 1: Gap Analysis (ACWUA Survey)

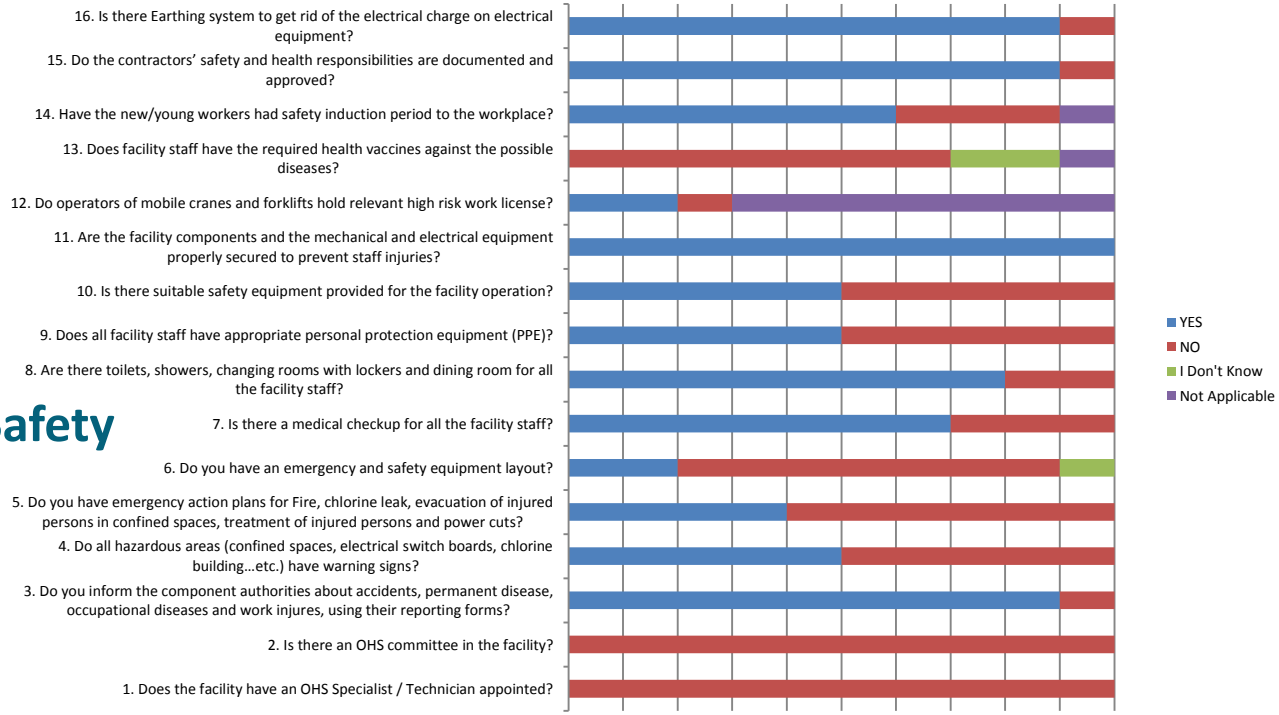
- A survey was launched by Ministry of Works, Municipalities Affairs and Urban Planning (MOWMAUP), Sanitary Engineering department to obtain the facility staff feedback regarding the performance management of the wastewater system in the Kingdom of Bahrain.
- The survey was based on the guidelines of Arab Countries Water Utilities Association (ACWUA, 2015).
- The survey questionnaires are grouped by the following categories: Human Resources; Occupational Health and Safety; Operation; Maintenance; Quality Assurance/Quality Control
- The targeted positions for the survey are Chiefs, Heads and potential senior engineers from Sanitary Engineering Operation & Maintenance Directorate (SEOMD) as a pilot survey.

# Results of Phase 1

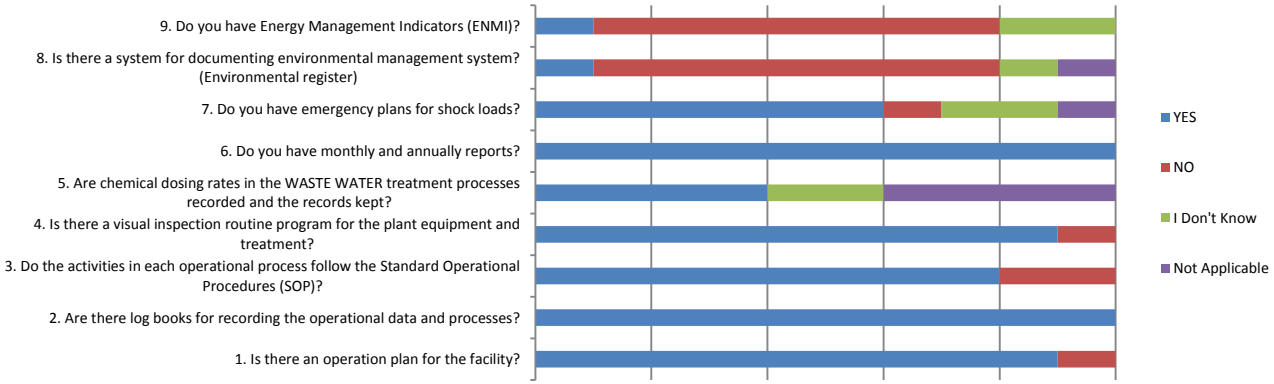
## Human resources



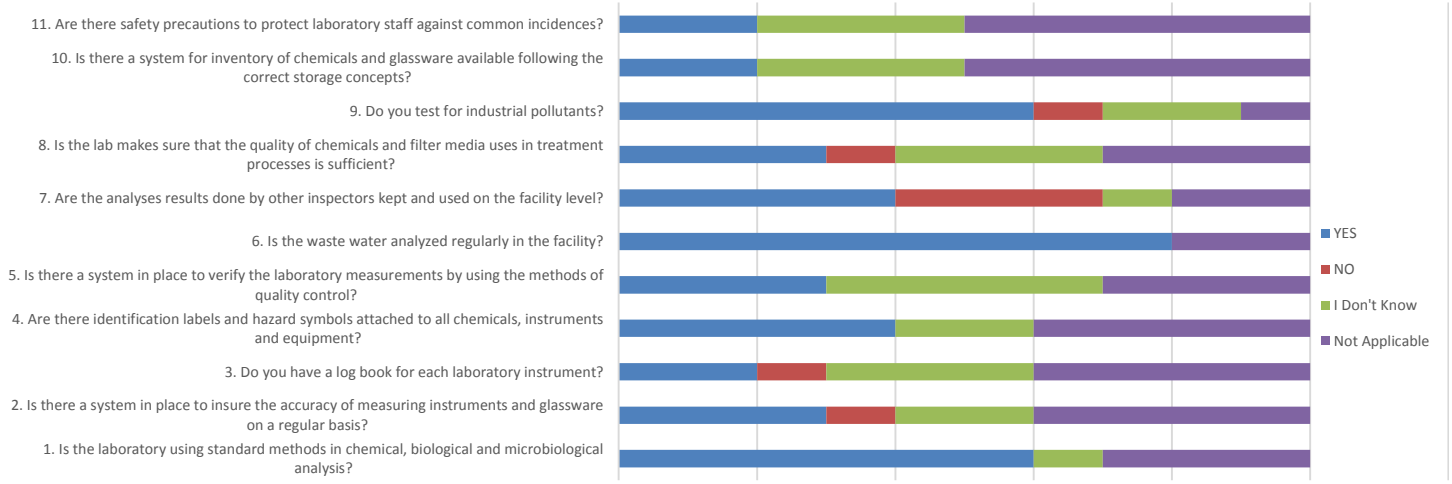

## Occupation Health and Safety



# Results of Phase 1




## Operation




## Quality Assurance and Quality Control

# Categories of identified gaps

| No. | GAPS | VALIDATION |
|---|---|---|
| | **HUMAN RESOURCES** | |
| 1 | Suitable location for training materials and documents. | Confirmed |
| | **OCCUPATION HEALTH AND SAFETY** | |
| 2 | OHS Specialist / Technician appointment in the facility | Confirmed |
| 3 | OHS committee in the facility | Confirmed |
| 4 | Emergency action plans for fire, chlorine leak, evacuation of injured persons in confined spaces, treatment of injured persons and power cuts | Confirmed |
| 5 | Emergency and safety equipment layout | Confirmed |
| 6 | Operators of mobile cranes and forklifts hold relevant high risk work license | Confirmed |
| 7 | Staff health vaccinations against the possible diseases. | Confirmed |
| | **OPERATION** | |
| 8 | Chemical dosing rates in the wastewater treatment processes records | Confirmed |
| 9 | System for documenting environmental management system (Environmental register) | Not confirmed |
| 10 | Energy Management Indicators (ENMI) | Confirmed |
| | **MAINTENANCE** | |
| 11 | Maintenance management system for civil structures and landscape. | Confirmed |
| | **QUALITY ASSURANCE / QUALITY CONTROL** | |
| 12 | Accuracy of measuring instruments and glassware. | Not confirmed |
| 13 | Log book for each laboratory instrument | Not confirmed |
| 14 | Identification labels and hazard symbols for all chemicals, instruments and equipment | Not confirmed |
| 15 | Verification of the laboratory measurements by using the methods of quality control. | Not confirmed |
| 16 | Record of the analyses results by other inspectors. | Not confirmed |
| 17 | Quality of chemicals and filter media in treatment processes | Not confirmed |
| 18 | System for inventory of chemicals and glassware available following the correct storage concepts | Confirmed |
| 19 | Safety precautions to protect laboratory staff against common incidences | Confirmed |

# Phase 2: Determining the Performance Indicators using the IWA Manual and Select the Appropriate Benchmark

- The performance was evaluated using performance indicators as per IWA.
- Performance indicators are measures of efficiency and effectiveness of the delivery of services by an undertaking that result from a combination of several variables.
- A performance indicator consists of a value which is a ratio between variables expressed in specific units. performance indicators can be analyzed interpreted and compared by taking into consideration context information and the quality of data for each utility.
- There are six categories with a total of 182 PI as per IWA manual (Matos et el., 2012): **Environmental Indicators (wEn); Personal Indicators (wPe); Physical Indicators (wPh); Operational Indicators (wOp); Quality of service Indicators (wQS); Economic and financial Indicators (wFi)**

# Results of Phase 2

- In fact, benchmarking procedures were useful tools to assess the performance of these facilities and help identify best practices.
- With the available data for 25 PI's for the year 2017, the data for benchmarking were used.
- In the future, the other related data shall be recorded to benchmark all the necessary requirements as per IWA manual of best practice for PI's for wastewater services.
- The availability of the data/information is a crucial factor in the metrics of benchmarking.
- Future additional data and information collection should be identified for the continuous implementation of the benchmarking system in Bahrain.

# Results of Phase 2

## Performance Indicators Categories

| No | Category | Total PI | PI - Data available |
|---|---|---|---|
| 1 | Environmental Indicators | 15 | 8 |
| 2 | Personal Indicators | 25 | 1 |
| 3 | Physical Indicators | 12 | 2 |
| 4 | Operational Indicators | 56 | 13 |
| 5 | Quality Of service Indicators | 29 | 1 |
| 6 | Economic and financial Indicators | 45 | 0 |
| TOTAL | | 182 | 25 |

# Results of Phase 2

## Performance Indicators Categories

| No. | PI | PI DESCRIPTION | UNIT | RESULT |
|---|---|---|---|---|
| 1 | wEn1 | WWTP compliance with discharge consents | %/year | 20.636 |
| 2* | wEn2 | Wastewater reuse | % | 29.933 |
| 3 | wEn6 | Sludge production WWTP | Kg DS/p.e/year | 3.963 |
| 4 | wEn7 | Sludge utilization | % | 0.000 |
| 5 | wEn8 | Sludge disposal | % | 100.000 |
| 6 | wEn9 | Sludge going to landfill | % | 100.000 |
| 7 | wEn10 | Sludge thermally processed | % | 76.785 |
| 8 | wEn11 | Other sludge disposal | % | 0.000 |
| 9 | wPe12 | Wastewater quality monitoring personnel | (No/(1000 tests/year)) | 0.228 |
| 10 | wPh1 | Preliminary treatment utilization | % | 176.911 |
| 11 | wPh3 | Secondary treatment utilization | % | 153.836 |
| 12** | wOp2 | Sewer cleaning | %/year | 25.261 |
| 13 | wOp34 | Sewer blockages | No/100km sewer/year | 249.351 |
| 14 | wOp37 | Flooding from sanitary sewers | No/100km sewer/year | 15.365 |
| 15 | wOp44 | Wastewater quality tests carried out | (-/year) | 0.995 |
| 16 | wOp45 | BOD tests | (-/year) | 0.992 |
| 17 | wOp46 | COD tests | (-/year) | 0.980 |
| 18 | wOp47 | TSS tests | (-/year) | 0.996 |
| 19 | wOp48 | Total phosphorus tests | (-/year) | 0.784 |
| 20 | wOp49 | Nitrogen tests | (-/year) | 0.988 |
| 21 | wOp50 | Fecal E.coli tests | (-/year) | 0.996 |
| 22 | wOp51 | Other tests | (-/year) | 0.999 |
| 23 | wOp52 | Sludge tests carried out | (-/year) | 0.622 |
| 24 | wOp53 | Industrial discharges tests carried out | (-/year) | 0.781 |
| 25* | wQS9 | Tertiary treatment | % | 36.697 |

# Captured lessons learned

- Insufficient data / information with the Engineers /Groups /Sections
- Old data not available - All data /information to be stored / archived
- Coordination to collect the data within the directorate is difficult
- Coordination to collect the data with other directorates
- The reply / response to the email is not effective
- Difficulty in initiating the benchmarking and for staff participation
- Delay in Decision Making / Approval

# Conclusion

- Performance assessment and benchmarking has developed as a key aspect of WWTP management.
- Benchmarking is a data-driven process, and can only be successful if careful consideration is given to data availability and accuracy.
- Without sufficient data, assessing the accuracy of the available data and identifying comparable WWTPs becomes increasingly complex.
- Improved data management practices can be achieved through WWTP benchmarking.
- With the available data for 25 PIs for the year 2017, the data for benchmarking were used.
- In the future, the other related data shall be recorded to benchmark all the necessary requirements as per IWA manual for PI's for wastewater services.

# Recommendations

The main recommendations of the study are:

- Gap analysis shall be conducted in detail for the non-confirmed gaps
- Continue with the 25 PI's measurement and to improve the performance wherever applicable
- Set action plan to collect data for remaining PI's
- Secure and archive the collected information for future use and analysis
- Use of SIGMA Lite professional software by IWA developed by ITA to enter the PI data and obtain the results with the following features:

  - Incorporation of the complete set of PIs from the IWA as a stand-alone PI evaluation system
  - Facility to export the results to MS-Excel spread sheet for further interpretation and processing
  - Easy to operate with automatic calculation of PIs