NATIONAL OCCUPATIONAL STANDARD FOR WATER AND SANITATION ENGINEER

NOS.WSE.01
FIRST EDITION

APPROVING AUTHORITY

This National Occupational Standard (NOS) has been prepared and published under the authority of the Zambia Qualifications Authority Board on 16th May, 2024.

ZAMBIA QUALIFICATIONS AUTHORITY

The Zambia Qualifications Authority (ZAQA) Act No. 13 of 2011 was enacted by the Government of the Republic of Zambia to ***"provide for the development and implementation of a national qualifications framework; establish the Zambia Qualifications Authority; provide for the registration and accreditation of qualifications; provide measures to ensure that standards and registered qualifications are internationally comparable; and provide for matters connected with, or incidental to the foregoing".*** Among other functions, ZAQA is responsible for ***determining national standards for any occupation***, through the various sector specific National Occupational Standards Development Teams (NOSDTs).

REVISION OF NATIONAL OCCUPATIONAL STANDARDS

National Occupational Standards (NOS) shall be revised every 5 years, or whenever it is deemed necessary, by the issuance of either amendments or revised editions. It is important that users of the NOS ascertain that they are in possession of the latest amendments or editions.

NOS DEVELOPMENT TEAM RESPONSIBLE

This National Occupational Standard was prepared by the Water NOSDT, upon which the following organisations were represented:

1. The University of Zambia (UNZA)
2. Natural Resources Development College (NRDC)
3. The Copperbelt University (CBU)
4. Water Resources Management Authority (WARMA)
5. Technical Education Vocational and Entrepreneurship Training Authority (TEVETA) and Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) Thrive Project
6. Zambia Environmental Management Agency (ZEMA)
7. Living Water International (LWI)
8. WaterAid Zambia (WAZ)
9. National Water Supply and Sanitation Council (NWASCO) / Lusaka Water Security Initiative (LuWSI)
10. Habitat for Humanity Zambia (HHZ)
11. Ministry of Water Development and Sanitation (MWDS)

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FOREWORD

The Zambia Qualifications Authority (ZAQA) is a statutory body under the Ministry of Education established by ZAQA Act No. 13 of 2011 to ***"provide for the development and implementation of a national qualifications framework; provide measures to ensure that standards and registered qualifications are internationally comparable; and provide for matters connected with, or incidental to the foregoing"***.

Among other functions, ZAQA is responsible for ***"determining national standards for any occupation"***, through the various sector specific National Occupational Standards Development Teams (NOSDTs) with experts composed of representation from the appropriate authorities, government departments, consumer associations, regulators, industry, academia, and non-governmental organisations, etc.

This National Occupational Standard (NOS) has been developed by the Water National Occupational Standards Development Team in accordance with the laid down procedures and guidelines of ZAQA. All users should ensure that they have the latest edition of this publication as the NOS are revised from time to time.

This NOS shall be used by, among others, industry, employers, quality assurance bodies, awarding and professional bodies, and education and training institutions, as a benchmark to identify training needs, develop job profiles/descriptions, develop curricula, and learning programmes in various sectors where the occupation exists. In the Water sector, demonstration of competence against this NOS may be required in order to run a business or practice a craft or profession.

JUSTIFICATION

A Water and Sanitation Engineer (hereinafter referred to as a WS Engineer) is a professional who helps maintain public health by ensuring the safe handling and disposal of wastewater, and in addition, the conveyance of safe portable water. Their work largely focuses on water treatment and disease prevention, and they are knowledgeable about public health and health laws. A WS Engineer determines and develops solutions to water, environmental, and sanitary engineering problems. The development of this NOS will ensure relevance of the training to latest advancements in industry, resulting in adequately and appropriately skilled WS Engineers.

This NOS highlights the core knowledge, skills, competences, and personal attributes that WS Engineers must possess to be successful in their jobs.

ACRONYMS AND ABBREVIATIONS

ArcGIS	Aeronautical Reconnaissance Coverage Geographic Information System
CAD	Computer Aided Design
CMMS	Computerised Monitoring and Maintenance Systems
CS	Core Skills
K	Knowledge and Understanding
NOS	National Occupational Standard
NOSDT	National Occupational Standards Development Team
OK	Organisational Knowledge
OSHE	Occupational Safety, Health and Environment
PC	Performance Criteria
PS	Professional Skills
RPL	Recognition of Prior Learning
SOP	Standard Operating Procedure
TK	Technical Knowledge
WATSAN	Water and Sanitation
WSE	Water and Sanitation Engineer
ZAQA	Zambia Qualifications Authority
ZQF	Zambia Qualifications Framework

GLOSSARY OF TERMS

For the purposes of this NOS, the following terms and definitions shall apply:

Core Skills/Generic Skills: are a group of skills that are key to learning and working in today's world. These skills are typically needed in any work environment. In the context of the NOS, these include communication related skills that are applicable to most job roles.

Disability: is the physical or mental impairment that substantially limits one or more major life activities.

Function: is an activity necessary for achieving the key purpose of the sector, occupation or area of work, which can be carried out by a person or a group of persons. Functions are identified through functional analysis and form the basis of the NOS.

Job Title: defines a unique set of functions that together form a unique employment opportunity in an organisation.

Knowledge and Understanding: are statements, which together specify the technical, generic, professional, and organisational specific knowledge that an individual needs in order to perform to the required standard.

National Occupational Standards (NOS): are statements of the standards of performance individuals must achieve when carrying out functions in the workplace, together with specifications of the underpinning knowledge and understanding. They are precise descriptions of what an individual is expected to be able to do in his/her work role.

National Occupational Standards (NOS) Code: is a unique reference code that identifies a NOS.

National Occupational Standards Development Team (NOSDT): means an established group of national stakeholders/experts responsible for the development of National Occupational Standards within a specific economic sector or occupation.

Occupation: is a set of job roles, which perform similar/related set of functions in an industry.

Organisational Context: includes the way the organisation is structured and how it operates, including the extent of operative knowledge that managers have in their relevant areas of responsibility.

Performance Criteria: are statements that together specify the standard of performance required when carrying out a task.

Scope: is the set of statements specifying the range of variables that an individual may have to deal with in carrying out the function which have a critical impact on the quality of performance required.

Sector: is a conglomeration of different business operations having similar businesses and interests. It may also be defined as a distinct subset of the economy, whose components share similar characteristics and interests.

Sub Sector: is derived from a further breakdown based on the characteristics and interests of its components.

Technical Knowledge: is the specific knowledge needed to accomplish specific designated responsibilities.

Unit Title: gives a clear overall statement about what the incumbent should be able to do.

Elements: set out competences the incumbent should possess to carry out the day-to-day activities.

1. OVERVIEW

This is an introductory section providing a summary and specific information or commentary about the content of the NOS, the targeted sector and occupation to help the user judge whether it is relevant to them.

NOS Code	**NOS.WSE.01**
Occupation	Water and Sanitation Engineering
Job Title	Water and Sanitation Engineer
Job Description	A Water and Sanitation Engineer is a specialist in design, planning, establishing, expanding, constructing, operating, and maintaining water and sanitation facilities.
Job Purpose	To develop and implement water, environmental, and sanitary engineering solutions to ensure the well-being of the communities.
ZQF Level	7
Sector	Water
Sub sectors	● Water Supply and Sanitation ● Water Resource Development and Management
Other Economic Sector(s) in which the Occupation is Practiced	Agriculture, Construction, Mining, Manufacturing, Health, Education.
Other Similar Jobs that can be Performed in the Occupation	Civil Engineer, Environmental Engineer, Project Engineer, Research Engineer, Maintenance Engineer, Sales Engineer, Consultant.
Minimum Educational Job Entry Qualification(s)	B.Eng. Civil Engineering/Environmental Engineering/ Chemical Engineering/Water Engineering
Practicing License Requirements (if any)	Membership with the Engineering Institution of Zambia (EIZ)
Training/RPL (Suggested)	1. First Aid Training 2. National Occupational Safety and Health 3. Project Management 4. Leadership and Ethics 5. Water, Wastewater, and Sanitation guidelines and standards
Minimum Job Entry Age	23 years
Prior Experience (Recommended)	Should have at least six months traineeship working with a qualified registered Water and Sanitation Engineer.
Performance Criteria	As described in the Units under Section 4

2. SCOPE

This NOS specifies the fundamental knowledge and understanding, skills and competences, and personal attributes that Water and Sanitation Engineers must possess to be successful in their jobs.

3. PERSONAL ATTRIBUTES (VALUES, ETHICS AND ATTITUDES)

This job requires ability to plan and prioritise; ability to work in a team; physique to sustain strenuous conditions; attention to detail; high technological exposure to handle various software, equipment, tools, and materials; sensitivity towards safety for self, others, and work environment; be well versed with tasks, functions, standards, specifications, codes of practice, and safety norms applicable to operations; be accountable and results oriented, etc.

4. UNITS AND ELEMENTS

This National Occupational Standard is divided into 7 Units, representing the tasks that a jobholder should undertake in his/her day-to-day work. Each unit is further broken down into elements depicting the number of activities to be carried out for the successful execution of a particular task.

UNIT 1 [This Unit covers the skills and knowledge required by a WS Engineer in planning for water and sanitation systems]

Unit No.	**01**
Unit Title	**Planning for Water and Sanitation Systems**
Description	This Unit describes the skills and knowledge required by a WS Engineer to plan for water and sanitation systems.
Scope	This Unit covers the following: ● Project identification with intent to provide solutions. ● Feasibility study.
Performance Criteria (PC) with respect to the Scope	
Element	**Performance Criteria (PC)**
Project Identification with Intent to Provide Solutions	To be competent, the individual must be able to: PC1. Develop project objectives. PC2. Estimate market demand. PC3. Selection of alternatives (site location for different components of WATSAN systems and level of investment). PC4. Complete preliminary appraisals (technical, economic benefits, environmental assessment, social assessment and risk analysis).
Feasibility Study	To be competent, the individual must be able to: PC5. Develop study briefs and desk reviews of similar projects/systems. PC6. Perform site reconnaissance surveys. PC7. Undertake topographical surveys and geotechnical investigations. PC8. Engage key stakeholders. PC9. Develop outline designs, estimate demands, estimate costs and timelines. PC10. Appraisal impact on social, existing systems, and the environment. PC11. Assess risks and economic feasibility.
Knowledge and Understanding (K)	
A. Organisational Context (knowledge of the company/ organisation and its processes)	The individual on the job must demonstrate knowledge and understanding of company: OK1. Procurement procedures. OK2. Human resource structure and hierarchy; policies and procedures. OK3. Operational safety, health, and environmental management guidelines and policies. OK4. Service charter. OK5. Values and ethics. OK6. Production reporting procedures. OK7. Maintenance policies and procedures, OK8. Performance evaluation. OK9. Change order management.

B. Technical Knowledge	The individual on the job must demonstrate knowledge and understanding of: TK1. Local construction codes and mandatory standards. TK2. Relevant design codes and standards. TK3. Engineering design principles. TK4. Water and sanitation systems configurations (setups). TK5. Construction project management. TK6. Construction contract management. TK7. Draughting and detailing of technical drawing. TK8. Project costing; preparing bills of quantities. TK9. Planning tools, like Microsoft projects. TK10. National and international construction procurement processes and procurement guidelines. TK11. Industry construction technologies (tools, equipment, and software, like CAD, ArcGIS etc.) TK12. Basic risk management. TK13. Standard operating procedures for water and sanitation systems. TK14. Monitoring and maintenance systems.
C. Regulatory Context (Knowledge of rules and regulations)	The individual on the job must demonstrate knowledge and understanding of: RK1. Laws and regulations related to environment, water, public health, biosafety, and occupation health and safety.
Skills (S)	
A. Core Skills/ Generic Skills	**Writing Skills** The individual on the job must be able to: CS1. Prepare and provide concise reports, instructions, and drawings or sketches. **Reading Skills** The individual on the job must be able to: CS2. Read English and be able to, or have the means to, give simple instructions in the local language. CS3. Read and interpret sketches, drawings or instructions provided for the required work. **Oral Communication (Listening and Speaking skills)** The individual on the job must be able to: CS4. Convey information clearly and concisely to co-workers
B. Professional Skills	**Decision-Making** The individual on the job must be able to: PS1. Adhere to the organisation's decision-making policies. PS2. Make independent and sound decisions based on engineering judgement, and considering public safety and interest of other stakeholders. PS3. Make prompt decisions based on feedback from tender documentation evaluations.

	PS4. Demonstrate impartiality in deciding the responsive tenderer. PS5. Demonstrate high ethical standards.
	Plan and Organise
	The individual on the job should be able to: PS6. Plan work estimates, and organise required resources in coordination with team members.
	Customer Centricity
	The individual on the job should be able to: PS7. Manage expectations with stakeholders, with intent to complete required works/task with minimal downtime.
	Problem Solving
	The individual on the job should be able to: PS8. Resolve any conflicts within the team.
	Analytical Thinking
	The individual on the job should be able to: PS9. Identify risks and manage them. PS10. Apply methodical step-by-step approaches to thinking, and break down complex problems into smaller and manageable components.
	Critical Thinking
	The individual on the job should be able to: PS11. Assess and manage potential hazards associated with exposure to contaminants in the environment. PS12. Observe and predict opportunities, threats, and solutions.

UNIT 2 [This Unit covers the skills and knowledge required by a WS Engineer to design water and sanitation systems]

Unit No.	**02**
Unit Title	**Designing Water and Sanitation System**
Description	This Unit describes the skills and knowledge required by a WS Engineer to coordinate the design and installation of water and sanitation systems.
Scope	This Unit covers the following: ● Designing extraction, treatment, reservoir, distribution, and consumer point posts for water systems. ● Designing collection, treatment, conveyance of treatment, and discharge for sanitation systems.
Performance Criteria (PC) with respect to the Scope	
Element	**Performance Criteria (PC)**
Designing Extraction, Treatment, Reservoir, Distribution, and Consumer Point Posts for Water Systems	To be competent, the individual must be able to: PC1. Interpret process flow of water systems, and assess current demand and forecast future demand requirements. PC2. Interpret design standards, sub sector regulations, and Acts of Government (NWASCO, NCC, Euro-code, British standards, WARMA, ZEMA, etc.) PC3. Apply design criteria for intake, pump, collection chambers, treatment, conveyance of treatment, and discharge. PC4. Use design software tools, i.e., WaterCAD, AutoCAD, EPANET, ArcGIS, etc. PC5. Generate technical drawings. PC6. Prepare bills of quantities. PC7. Prepare technical specifications.
Designing Collection, Treatment, Conveyance of Treatment, and Discharge for Sanitation Systems	To be competent, the individual must be able to: PC8. Interpret process flow of sanitation systems. PC9. Assess current demands, and forecast future demand requirements using modelling/analytical methods. PC10. Interpret design sanitation standards as per national regulatory requirements. PC11. Apply design criteria for sewers, collection chambers, treatment, discharge, and reuse. PC12. Apply design criteria for non-sewered sanitation systems. PC13. Use design software tools, i.e., EPA-SWMM, SEWERCAD, AutoCAD, ArcGIS, etc. PC14. Generate technical drawings. PC15. Prepare bills of quantities. PC16. Prepare technical specifications. PC17. Interpret and predict urbanisation patterns.

Knowledge and Understanding (K)	
A. Organisational Context (knowledge of the company/ organisation and its processes)	The individual on the job must demonstrate knowledge and understanding of company: OK1. Procurement procedures. OK2. Human resource structure and hierarchy; policies and procedures. OK3. Operational safety, health, and environmental management guidelines and policies. OK4. Service charter. OK5. Values and ethics. OK6. Production reporting procedures. OK7. Maintenance policies and procedures. OK8. Performance evaluation. OK9. Change order management.
B. Technical Knowledge	The individual on the job must demonstrate knowledge and understanding of: TK1. Water and sanitation system design considerations, e.g. population demand, settlement patterns, runoff, topography etc. TK2. Construction drawings. TK3. Construction/engineering technologies. TK4. Construction standards referencing NCC standards. TK5. Computer-aided design software for modelling, analysis, and technical systems, such as AUTODESK Suite. TK6. Safety, health, and the environment. TK7. Drinking water standards (ZABS) and water treatment procedures.
C. Regulatory Content (knowledge of rules and regulation)	The individual on the job must demonstrate knowledge and understanding of: RK1. Laws and regulations related to environment, water, public health, biosafety, and occupation health and safety.
Skills (S)	
A. Core Skills/ Generic Skills	**Writing Skills** The individual on the job must be able to: CS1. Prepare concise technical reports and drawings/ sketches. **Reading Skills** The individual on the job must be able to: CS2. Read English and be able to, or have the means to, give simple instructions in the local language used at the site. CS3. Read and interpret sketches, drawings or instructions provided for the required work.

	Oral Communication (Listening and Speaking skills)
	The individual on the job must be able to: CS4. Speak in English (at least working level), and be able to, or have the means to, give simple instructions in the local language used at the site. CS5. Listen attentively and interpret communication/ instructions from the supervisor and other co-workers.
B. Professional Skills	**Decision-Making**
	The individual on the job must be able to: PS1. Identify design risks, challenges, and provide solutions/ action points with minimal or no supervision.
	Plan and Organise
	The individual on the job should be able to: PS2. Discuss continuous feedback from teams and stakeholders, and applying the reviews.
	Customer Centricity
	The individual on the job should be able to: PS3. Manage relationships with customers with intent to satisfying their project requirements.
	Problem Solving
	The individual on the job should be able to: PS4. Resolve any conflicts within the team.
	Analytical Thinking
	The individual on the job should be able to: PS5. Analyse and convey to the superior, and carry out remedial action.
	Critical Thinking
	The individual on the job should be able to: PS6. Identify and deal with potential design challenges in different sites.

UNIT 3 [This Unit covers the skills and knowledge required by a WS Engineer to undertake procurement of engineering services, goods, and works]

Unit No.	**03**
Unit Title	**Procurement of Engineering Services, Goods, and Works**
Description	This Unit describes the skills and knowledge required by a WS Engineer for procurement of engineering services, goods, and works in civil engineering.
Scope	This Unit covers the following: ● Need(s) for engineering services, goods, and works. ● Tender processes. ● Contract awarding.
Performance Criteria (PC) with respect to the Scope	
Element	**Performance Criteria (PC)**
Need(s) for Engineering Services, Goods, and Works	To be competent, the individual must be able to: PC1. Identify the need(s) for engineering services (consultancy), goods, and works. PC2. Identify the most appropriate methods to employ for procurement of services (consultancy), works or goods. PC3. Engage key stakeholders for input in the need(s). PC4. Formulate appropriate procurement plans. PC5. Identify the most appropriate methods of procurement.
Tender Processes	To be competent, the individual must be able to: PC6. Design solicitation documents (contract, bills of quantities, specifications, drawings, other schedules, technical reports, etc.) that respond to the identified need(s). PC7. Adhere to national and international procurement standards. PC8. Establish confidential cost estimates for budgetary purposes. PC9. Promulgation of the tender processes. PC10. Adjudicate tenders. PC11. Produce tender evaluation reports. PC12. Participate in tender negotiations. PC13. Prepare tender negations, minutes, and addenda. PC14. Compile and file contract documents.
Contract Awarding	To be competent, the individual must be able to: PC15. Facilitate receipt of acceptance letters from bidders to clients/owners. PC16. Assist in the awarding of contract(s).
Knowledge and Understanding (K)	
A. Organisational Context (knowledge of the company/ organisation	The individual on the job must demonstrate knowledge and understanding of: OK1. Relevant standards, procedures, and policies of the organisation relating to procurement.

and its processes)	OK2. Context of the organisation as determined by whether it is client/owner's body, consultancy or construction, as well as legal, financial, social, regulatory or cultural. OK3. Internal factors, organisation structure, governance, and resource capabilities. OK4. Roles and responsibilities. OK5. Risk management. OK6. Occupational health and safety, environmental, and quality management. OK7. Performance evaluation. OK8. Change order management.
B. Technical Knowledge	The individual on the job must demonstrate knowledge and understanding of, but not limited to the following: TK1. Technical knowledge regarding the identified need(s). TK2. Relevant design codes and standards. TK3. Technical drawings and Green design principles. TK4. Computer literacy. TK5. Procurement methods, such as Design-Bid-Build, Design and Build, PPP, etc. TK6. Contract documents and associated addenda. TK7. Relevant technical specifications for materials, performance, conformity, etc. TK8. Technical knowledge of various construction materials. TK9. Basic risk management. TK10. Staffing levels. TK11. Specialisations, like mechanical, electrical/electronics, geomatic engineers, quantity surveyors, etc. TK12. Queries requiring clarifications of tender documentation
C. Regulatory Content (knowledge of rules and regulation)	The individual on the job must demonstrate knowledge and understanding of: RK1. Laws and regulations related to environment, water, public health, biosafety, construction legislation, and occupation health and safety. RK2. Laws and regulations relating to urban and regional planning.
Skills (S)	
A. Core Skills/ Generic Skills	**Writing Skills**
	The individual on the job must be able to: CS1. Produce evaluation report(s). CS2. Prepare and provide clear and simple instructions, details, and sketches to co-workers/others. CS3. Develop/review standard particular specifications. CS4. Develop/review particular contract conditions. CS5. Communicate effectively through writing as appropriate for the needs of the audience. CS6. Use conversational communication methods, such as email, WhatsApp, etc. CS7. Demonstrate good command of the English language.

	Reading Skills
	The individual on the job must be able to: CS8. Read English and be able to, or have the means to, give simple instructions. CS9. Read and cross check that tender documentation is responsive to the requirements. CS10. Research, read, and interpret technical data from manuals, books, and any other relevant literature. CS11. Read and comprehend written information or communication.
	Oral Communication (Listening and Speaking skills)
	The individual on the job must be able to: CS12. Demonstrate active listening and interpret communication/instructions from the supervisor, co-workers and tenderers. CS13. Convey information clearly and concisely to co-workers and others. CS14. Illustrate ideas using presentation skills and applications, such as PowerPoint, etc. CS15. Manage pre-tender meetings and discussions. CS16. Manage tender evaluation and negotiations meetings. CS17. Provide feedback on technical works and reports.
B. Professional Skills	**Decision-Making**
	The individual on the job must be able to: PS1. Adhere to the organisation decision-making policies. PS2. Make independent and sound decisions based on engineering judgement, and considering public safety and interests of other stakeholders. PS3. Make prompt decisions on feedback of tender documentation evaluations. PS4. Demonstrate impartiality in deciding the responsive tenderer. PS5. Demonstrate high ethical standards.
	Plan and Organise
	The individual on the job should be able to: PS6. Plan, organise, lead, and control organisation activities in line with the applicable deadlines. PS7. Schedule tasks and complete them within time and budget. PS8. Work to achieve set goals. PS9. Evaluate tender documentation in line with the tender procurement plan.
	Customer Centricity
	The individual on the job should be able to: PS10. Manage relationships with customers with intent to satisfying their project requirements.

	Problem Solving
	The individual on the job should be able to: PS11. Demonstrate ability to identify problems, brainstorm, and analyse possible answers, with the view of implementing optimal solutions. PS12. Consult widely and identify possible remedies. PS13. Escalate when required in line with the organisation's procedures and protocols.
	Analytical Thinking
	The individual on the job should be able to: PS14. Apply domain knowledge, observations, and data to perform tasks related to the assignment. PS15. Apply methodical step-by-step approaches to thinking, and break down complex problems into smaller and manageable components. PS16. Demonstrate creativity, interpersonal, and organisational skills. PS17. Employ data analysis, logical thinking, and research and communication skills.
	Critical Thinking
	The individual on the job should be able to: PS18. Observe and predict opportunities, threats, and solutions. PS19. Collect, understand, and interpret data and other information. PS20. Demonstrate ability to draw inferences based on relevant data, and personal knowledge and experience. PS21. Communicate resulting information with others verbally, nonverbally, and in writing.

UNIT 4 [This Unit covers the skills and knowledge required by a WS Engineer to construct water and sanitation systems]

Unit No.	**04**
Unit Title	**Construction of Water and Sanitation Systems**
Description	This Unit describes the skills and knowledge required by a WS Engineer to construct water and sanitation systems.
Scope	This Unit covers the following: ● Project execution. ● Project management. ● Construction management. ● Contract management ● Testing and commissioning.
Performance Criteria (PC) with respect to the Scope	
Element	**Performance Criteria (PC)**
Project Execution	To be competent, the individual must be able to: PC1. Formulate tasks from the activities required to be executed according to the needs plan and designs for the construction of water and sanitation infrastructure. PC2. Create work schedules and adjust as needed to stay on schedule. PC3. Assign personnel, equipment, and resources to activities. PC4. Conduct/facilitate testing of water samples, materials, pipe pressure tests, etc. PC5. Introduce process and technical design changes to improve performance and efficiency. PC6. Maintain compliance with safety and regulatory requirements. PC7. Interpret designs, drawings, and bills of quantities formulated for the construction. PC8. Compile and present reports on the progress of construction.
Project Management	To be competent, the individual must be able to: PC9. Demonstrate knowledge of the project cycle (initiation, planning, execution, closure). PC10. Appreciate the work-breakdown structure. PC11. Budget tracking against cost estimates in the bills of quantities. PC12. Apply vendor management. PC13. Perform project scheduling (programme). PC14. Carry out quality control. PC15. Employ project controls for time, cost, scope, and risk. PC16. Undertake human resource management. PC17. Perform project communication management. PC18. Execute project records management. PC19. Oversee project design and construction. PC20. Make decisions and payments for works.

Construction Management	To be competent, the individual must be able to: PC21. Demonstrate knowledge of overall planning, coordination, and control of the construction process from start to finish. PC22. Organise and manage project budget. PC23. Set and track schedules, and ensure all tasks are completed on time. PC24. Oversee site safety and security. PC25. Ensure projects are completed on time, on budget, and to client specifications. PC26. Conduct change order management. PC27. Manage construction resources (human capital, plant and equipment, tools, materials, etc.). PC28. Perform quality control management. PC29. Draw up operation and maintenance plans. PC30. Manage key stakeholders. PC31. Facilitate safety, health, and environmental management systems. PC32. Conduct and manage site progress and technical meetings. PC33. Oversee communication and procurement management.
Contract Management	To be competent, the individual must be able to: PC34. Interpret and apply contract law. PC35. Demonstrate basic comprehension of a construction contract. PC36. Formulate a construction contract document. PC37. Demonstrate understanding of various standards and model forms of contracts. PC38. Manage contract execution. PC39. Carry out risk identification, allocation, management. PC40. Manage contract claims. PC41. Comprehend the roles, relationships, responsibilities of the parties to the contract. PC42. Implement project records management. PC43. Demonstrate understanding of remedies of breach of contract. PC44. Appreciate various types of contract securities (bonds, guarantees, and insurance). PC45. Facilitate dispute and conflict management.
Testing and Commissioning	To be competent, the individual must be able to: PC46. Conduct all requisite testing on the completed construction as specified to verify conformance to design and specifications. PC47. Perform on-site commission. PC48. Prepare testing and commissioning report.

Knowledge and Understanding (K)	
A. Organisational Context (knowledge of the company/ organisation and its processes)	The individual on the job must demonstrate knowledge and understanding of company: OK1. Production reporting procedures. OK2. Procurement procedures. OK3. Human resource structure and hierarchy. OK4. Human resource procedures and policies. OK5. Maintenance policies and procedures.
B. Technical Knowledge	The individual on the job must demonstrate knowledge and understanding of: TK1. Project, construction, and contract management. TK2. OSHE aspects relevant to codes and standards. TK3. Computer literacy skills. TK4. Contract documentation and associated OSHE components. TK5. Technical knowledge of various construction materials. TK6. Basic risk management. TK7. Drafting of the OSHE management plan. TK8. Quality control and testing. TK9. Water standards. TK10. Water treatment procedures. TK11. Design and operations of water supply plants and systems. TK12. Design and operation of water supply plants and systems. TK13. Construction standards. TK14. Catchment management and environmental protection. TK15. Stakeholder engagement. TK16. Drafting SOPs. TK17. Contract management.
C. Regulatory Content (knowledge of rules and regulation)	The individual on the job must demonstrate knowledge and understanding of: RK1. Laws and regulations related to environment, water, public health, biosafety, construction legislation, and occupation health and safety. RK2. Laws and regulations relating to urban and regional planning.
Skills (S)	
A. Core Skills/ Generic Skills	**Writing Skills** The individual on the job must be able to: CS1. Generate production reports. CS2. Prepare and provide clear and simple instructions, details, and sketches to co-workers.

	Reading Skills
	The individual on the job must be able to: CS3. Read English and be able to, or have the means to, give simple instructions in the local language used at the site. CS4. Read and interpret sketches, drawings or instructions provided for the required work. CS5. Read and interpret SOPs. CS6. Read and interpret process flow diagrams.
	Oral Communication (Listening and Speaking skills)
	The individual on the job must be able to: CS7. Speak in English and be able to, or have the means to, give simple instructions in the local language used at the site. CS8. Convey information clearly and concisely to co-workers CS9. Effectively communicate processes and equipment information to co-workers.
B. Professional Skills	**Decision-Making**
	The individual on the job must be able to: PS1. Identify and solve problems with minimum or no supervision. PS2. Handle processes/production variables, whilst maintaining desired production quality.
	Plan and Organise
	The individual on the job should be able to: PS3. Plan work and organise required resources in coordination with team members.
	Customer Centricity
	The individual on the job should be able to: PS4. Manage relationships with communities or any relevant stakeholders.
	Problem Solving
	The individual on the job should be able to: PS5. Identify and solve problems with minimum or no supervision. PS6. Handle processes/production variables, whilst maintaining desired production quality.
	Analytical Thinking
	The individual on the job should be able to: PS7. Analyse and convey to the superior and carry out remedial action.
	Critical Thinking
	The individual on the job should be able to: PS8. Identify and deal with or report violation of any safety norms which may lead to accidents.

UNIT 5 [This Unit covers the skills and knowledge required by a WS Engineer for operation and maintenance of water and sanitation systems]

Unit No.	**05**
Unit Title	**Operation and Maintenance of Water and Sanitation Systems**
Description	This Unit describes the skills and knowledge required by a WS Engineer in operating and maintaining water and sanitation systems.
Scope	This Unit covers the following: ● Effective operation of water and sanitation systems. ● Maintenance of water and sanitation systems for sustainability.
Performance Criteria (PC) with respect to the Scope	
Element	**Performance Criteria (PC)**
Effective Operation of Water and Sanitation Systems	To be competent, the individual must be able to: PC1. Inspect functionality of water and sanitation systems, such as water meters, recording water production, well pumps, motors, controls, etc. PC2. Formulate and implement operational manuals or SOPs for staff. PC3. Guide other employees on the safe operations of equipment/machinery, and apply them in SOPs. PC4. Assess risk and possible safety hazards of all aspects of the operations. PC5. Evaluate the performance of water and sanitation systems based on identified indicators.
Maintenance of Water and Sanitation Systems for Sustainability	To be competent, the individual must be able to: PC6. Identify, through troubleshooting, the bottlenecks and efficiency problems in the water and sanitation system networks and provide solutions. PC7. Generate maintenance manuals. PC8. Assess and flag condition of equipment operations in order to predict breakdowns, and carry out rapid repairs following failures.
Knowledge and Understanding (K)	
A. Organisational Context (knowledge of the company/ organisation and its processes)	The individual on the job must demonstrate knowledge and understanding of: OK1. Company policies on plant, machinery, and equipment operations and service charters. OK2. Company procedures and guidelines on safety, health, environment, and quality. OK3. Internal factors, organisation structure, governance, resource capabilities, etc. OK4. Roles and responsibilities of staff.

B. Technical Knowledge	The individual on the job must demonstrate knowledge and understanding of: TK1. Safety risk assessment. TK2. Technical knowledge regarding operations and maintenance. TK3. Software knowledge and computer literacy. TK4. Water quality standards. TK 5. FSM (faecal sludge management) operations and standards.
C. Regulatory Content (knowledge of rules and regulation)	The individual on the job must demonstrate knowledge and understanding of: RK1. Laws and regulations related to environment, water, public health, biosafety, construction legislation, and occupational safety and health. RK2. Laws and regulations relating to urban and regional planning.
Skills (S)	
A. Core Skills/ Generic Skills	**Writing Skills**
	The individual on the job must be able to: CS1. Prepare an Operations and Maintenance (O&M) manual.
	Reading Skills
	The individual on the job must be able to: CS2. Read and interpret internal/external documents related to the O&M manual on water supply and sanitation.
	Oral Communication (Listening and Speaking skills)
	The individual on the job must be able to: CS3. Effectively communicate O&M guidelines to subordinates and other stakeholders.
B. Professional Skills	**Decision-Making**
	The individual on the job must be able to: PS1. Plan and organise O&M meetings.
	Plan and Organise
	The individual on the job should be able to: PS2. Determine the implications of failure to comply with O&M guidelines of water and sanitation systems.
	Customer Centricity
	The individual on the job should be able to: PS3. Manage relationships with customers.
	Problem Solving
	The individual on the job should be able to: PS4. Identify and solve problems with minimal or no supervision. PS5. Make decisions during emergency situations.

	Analytical Thinking
	The individual on the job should be able to: PS6. Analyse and convey to the superior, and carry out remedial action.
	Critical Thinking
	The individual on the job should be able to: PS7. Identify and deal with or report violation of any safety norms which may lead to accidents. PS8. Identify and deal with or report any vandalism to the water and sanitation system.

UNIT 6 [This Unit covers the skills and knowledge required by a WS Engineer to demonstrate leadership and supervisory skills]

Unit No.	**06**
Unit Title	**Demonstration of Leadership and Supervisory Skills**
Description	This Unit describes the skills and knowledge required for by a WS Engineer in demonstrating leadership and supervisory skills of engineering works.
Scope	This Unit covers the following: ● Delegation of duties and responsibilities; supervision. ● Training, mentorship, and team building.
Performance Criteria (PC) with respect to the Scope	
Element	**Performance Criteria (PC)**
Delegation of Duties and Responsibilities; Supervision	To be competent, the individual must be able to: PC1. Demonstrate ability to explain clearly the tasks to be delegated to the subordinates. PC2. Delegate duties and responsibilities to the appropriate subordinates, at the right time, with the necessary resources, skills, and authority to complete supervision tasks effectively. PC3. Collaborate in setting clear and achievable performance criteria, monitor progress, and provide feedback.
Training, Mentorship, and Team Building	To be competent, the individual must be able to: PC4. Identify the skills gaps, and provide appropriate training and mentorship to the subordinates. PC5. Conduct team building to promote team spirit.
Knowledge and Understanding (K)	
A. Organisational Context (knowledge of the company/ organisation and its processes)	The individual on the job must demonstrate knowledge and understanding of: OK1. Relevant standards, procedures, and policies of the organisation. OK2. Organisational roles, responsibilities, accountabilities, and authorities. OK3. Organisational strategic goals and objectives.
B. Technical Knowledge	The individual on the job must demonstrate knowledge and understanding of: TK1. Planning, organising, directing, and controlling. TK2. Problem solving and decision-making. TK3. Conflict resolution management. TK4. Effective communication. TK5. Knowledge of required staffing levels. TK6. Performance management.

C. Regulatory Content (knowledge of rules and regulation)	The individual on the job must demonstrate knowledge and understanding of: RK1. Laws and regulations related to environment, water, public health, biosafety, construction legislation, and occupational health and safety.
Skills (S)	
A. Core Skills/ Generic Skills	**Writing Skills**
	The individual on the job must be able to: CS1. Produce training and mentorship manuals, performance evaluation reports, etc. CS2. Prepare and provide clear and simple instructions, details, and sketches to co-workers/others. CS3. Communicate effectively through writing as appropriate for the needs of the audience. CS4. Use conversational communication methods, such as email, WhatsApp, etc. CS5. Demonstrate good command of the English language.
	Reading Skills
	The individual on the job must be able to: CS6. Read English and be able to, or have the means to, give simple instructions. CS7. Research, read, and interpret technical data from manuals, books, and any other relevant literature. CS8. Read and comprehend written information or communication.
	Oral Communication (Listening and Speaking skills)
	The individual on the job must be able to: CS9. Demonstrate active listening and interpret communication/instructions from the supervisor, co-morkers. CS10. Convey information clearly and concisely to co-workers and others. CS11. Illustrate ideas using presentation skills and applications, such as PowerPoint, etc. CS12. Provide feedback on delegated tasks.
B. Professional Skills	**Decision-Making**
	The individual on the job must be able to: PS1. Adhere to the organisation's decision-making policies. PS2. Make independent and sound decisions based on engineering judgement, and considering public safety, subordinates, and interest of other stakeholders. PS3. Make prompt decisions on feedback on delegated tasks PS4. Demonstrate high ethical standards.

	Plan and Organise
	The individual on the job should be able to: PS5. Plan, organise, lead, and control organisation activities in line with the applicable deadlines. PS6. Schedule training tasks. PS7. Work to achieve set goals. PS8. Employ SWOT Analysis to evaluate the performance of the delegated tasks, training, mentorship, and team building activities.
	Customer Centricity
	The individual on the job should be able to: PS9. Provide leadership and supervision roles with the aim to enhance relationships with customers and satisfying their project requirements.
	Problem Solving
	The individual on the job should be able to: PS10. Demonstrate ability to identify problems, brainstorm, and analyse possible answers with the view of implementing optimal solutions. PS11. Consult widely and identify possible remedies. PS12. Escalate when required in line with the organisation's procedures and protocols.
	Analytical Thinking
	The individual on the job should be able to: PS13. Apply domain knowledge, observations, and data to perform tasks related to the assignment. PS14. Apply methodical step-by-step approaches to thinking and breaking down complex problems into smaller and manageable components. PS15. Demonstrate creativity, interpersonal and organisational skills. PS16. Employ data analysis, logical thinking, research, and communication skills.
	Critical Thinking
	The individual on the job should be able to: PS17. Demonstrate ability to observe and predict threats, opportunities, and solutions. PS18. Collect, understand, and interpret data and other information. PS19. Demonstrate ability to draw inferences based on relevant data, and personal knowledge and experience. PS20. Communicate resulting information with others verbally, nonverbally, and in writing

UNIT 7 [This Unit covers the skills and knowledge required by a WS Engineer to ensure safety, health, and environmental management]

Unit No.	**07**
Unit Title	**Ensure Safety, Health, and Environmental Management**
Description	This Unit describes the skills and knowledge required by a WS Engineer in maintaining safety, health, and environment in the work environment.
Scope	This Unit covers the following: ● Ensure safety and health regulations are followed by the jobholder as well as other employees. ● Ensure operations at the establishment conform to the requirements for environmental protection.
Performance Criteria (PC) with respect to the Scope	
Element	**Performance Criteria (PC)**
Ensure Safety and Health Regulations are Followed by the Jobholder as Well as Other Employees	To be competent, the individual must be able to: PC1. Implement organisational safety and health policies. PC2. Implement environmental policies of the organisation. PC3. Identify, through troubleshooting, the bottlenecks and efficiency problems in the distribution network. PC4. Assess risk and possible safety hazards of all aspects of operations. PC5. Guide other employees on the safe operation of machinery, tools, and equipment, and apply them in the formulation of standard operating procedures (SOPs).
Ensure Operations at the Establishment Conform to the Requirements for Environmental Protection	To be competent, the individual must be able to: PC6. Implement the overall environmental policies of the organisation and the country. PC7. Guide other employees on the safe operations of equipment/machinery, and apply them in formulation of SOPs.
Knowledge and Understanding (K)	
A. Organisational Context (knowledge of the company/ organisation and its processes)	The individual on the job must demonstrate knowledge and understanding of company: OK1. Policies on safety, health, and environmental protocols. OK2. Procedures and guidelines on safety, health, quality, and environment.
B. Technical Knowledge	The individual on the job must demonstrate knowledge and understanding of: TK1. Safety risk assessment. TK2. EIA processes. TK3. Toolbox talk. TK4. Material safety data sheets (MSDS).

C. Regulatory Content (knowledge of rules and regulation)	The individual on the job must demonstrate knowledge and understanding of: RK1. Laws and regulations related to environment, water, public health, biosafety, and occupational health and safety.
Skills (S)	
A. Core Skills/ Generic Skills	**Writing Skills**
	The individual on the job must be able to: CS1. Prepare health, safety, and environment SOPs.
	Reading Skills
	The individual on the job must be able to: CS2. Read and interpret internal/external documents related to health, safety, and environmental management.
	Oral Communication (Listening and Speaking skills)
	The individual on the job must be able to: CS3. Communicate health, safety, and environmental information to subordinates and other stakeholders.
B. Professional Skills	**Decision-Making**
	The individual on the job must be able to: PS1. Plan and organise departmental health, safety, and environment talks/meetings. PS2. Carry out departmental health, safety, and environmental risk assessment (in conjunction with the Safety Officer).
	Plan and Organise
	The individual on the job should be able to: PS3. Determine the implications of failure to comply with health, safety, and environmental regulations on the individual and the company.
	Customer Centricity
	The individual on the job should be able to: PS4. Manage relationships with customers on health, safety, and environment issues.
	Problem Solving
	The individual on the job should be able to: PS5. Identify and solve problems with minimal or no supervision. PS6. Make decisions during emergency situations.
	Analytical Thinking
	The individual on the job should be able to: PS7. Analyse and convey to the superior, and carry out remedial action.

	Critical Thinking
	The individual on the job should be able to: PS8. Identify and deal with or report violation of any safety norms which may lead to accidents.

5. EQUIPMENT, TOOLS AND CONSUMABLE MATERIALS

Equipment, tools, and consumable materials used by the jobholder include, but are not limited to:

EQUIPMENT:

Surveying equipment: Automatic level, Laser level, Total station, Handheld GPS, Measuring tape, Spirit level, square etc.

Electronic equipment: Computer and software, printer, etc.

TOOLS:

Hand Tools: Water dip meter, Water quality multi-meter (portable lab).
Measuring Instruments: Discharge measuring devices, Distance measuring device, etc.

CONSUMABLES AND GENERAL REQUIREMENTS:

Personal Protective Equipment: Steel capped boots, Safety helmet, Safety goggles, Reflective vest and work suit.

6. DILEMMAS/CHALLENGES AND COMPLEXITIES FOR A JOBHOLDER

Dilemmas associated with the job of a Water and Sanitation Engineer include: budgetary constraints; obsolete and/or inappropriate equipment and tools; bureaucracy in procurement procedures; lack of appreciation of preventive maintenance by non-engineering **management** staff; rapid change of technology and materials; lack of personal protective equipment; climate change, etc.

6.1 Alternative Choices (Solutions) to Dilemmas and Complexities

Solutions to dilemmas include: selecting and procuring appropriate equipment and tools for the job; supporting capacity building through training; identifying and utilising suitable adaptation and mitigation measures against the effects of climate change; include engineering professionals in management teams, deployment of automation where feasible; provision of personal protective equipment, etc.

7. WORKING CONDITIONS/ENVIRONMENT

Working conditions include: indoor and outdoor water sanitation facility sites, as well as workshops and factories; may also work in commercial buildings or private homes; confined spaces; working at heights; working in conditions that may be dirty and noisy; emergency call-outs; standing or squatting for long hours. In most cases, the job involves working normal hours, but in some instances, shift work and regular overtime may be required. The job also requires wearing suitable protective clothing, such as works suits, ear protectors, safety visors or goggles, gloves and hardhats, safety harnesses, etc.

8. PARTIES INVOLVED/INTERACTING WITH THE JOB HOLDER OR TRAINEE

8.1 Internal – Within the Organisation

Parties involved or interacting with the jobholder, who are internal to the organisation include: supervisors/superiors, subordinates, and other section members, occupational health and safety teams, other colleagues, etc.

8.2 External – Outside the Organisation

Parties involved or interacting with the jobholder, who are external to the organisation include: government regulators, trainers, clients, suppliers of equipment/tools/consumables, fellow Water and Sanitation Engineers from other companies, labour unions, occupational health and safety associations, students/interns, etc.

9. PHYSICAL DEMANDS ON THE BODY

- Physique to sustain strenuous conditions;
- Be able to walk and stand for long periods of time;
- Be able to sit for sustained period of time at the design desk;
- Bend, stretch, twist, or reach out;
- Be able to lift relatively heavy materials, tools, and equipment;
- Be able to use fingers, hands, and feet with ease to complete the assigned task (dexterity);
- Etc.

ANNEX A
Criteria for Assessments based on this NOS

A.1 Guidelines for Assessment

A.1.1 Criteria for assessment for curricula and learning programmes based on this NOS will be created by curricula and programme developers, and each Performance Criteria (PC) will be assigned marks proportional to its importance in the NOS. Curricula and programme developers will also lay down proportion of marks for theory and practical skills for each performance criteria, giving more weight to practical skills.

There shall be allocated 'Total Marks', which will be the sum of all marks in each Unit, distributed across the number of PCs in that particular Unit. The 'Out of' mark will be the mark allocated to each PC, which will be shared between theory and skills practical assessments.

A.1.2 Individual awarding/assessment bodies, or institutions and other users of the NOS, will create unique question papers for the theory part and evaluations for the skill practical part for their respective candidates.

ANNEX B
NOS Version Control

This Annex gives details necessary for the tracking of the NOS versions based on the number of revisions.

NOS Code	**NOS.WSE.01**		
ZQF Level	7	**Version Number**	01
Sector	Water	**Date of Approval**	May 2024
Sub Sectors	• Water Supply and Sanitation • Water Resources and Development	**Date of Last Review**	N/A
Occupation	Water and Sanitation Engineering	**Date of Next Review**	May 2029

"You learn,
We Standardise"

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