QUALIFICATION SPECIFICATION SECTION A							
QUALIFICATION DEVELOPER	Botswana International University of Science and Technology						
TITLE	Bachelor of Science in Ecosystem Science and Sustainability			**NCQF LEVEL**	7		
FIELD	Natural, Mathematical and Life Sciences		**SUB-FIELD**	Ecosystem Science and Sustainability			
New qualification	✓	Review of existing qualification					
SUB-FRAMEWORK	General Education		TVET		Higher Education	✓	
QUALIFICATION TYPE	Certificate		Diploma		Bachelor	✓	
	Bachelor Honours		Master		Doctor		
CREDIT VALUE					486		

RATIONALE AND PURPOSE OF THE QUALIFICATION

RATIONALE:

Botswana and most other countries in Africa are resource-based economy, wherein economic activity is highly dependent on the exploration and utilization of its natural resources particularly the mineral resources. Secondary to mining, Botswana also receive significant revenues from tourisms industry and agriculture particularly the cattle export (Lesego 2010; Modungwa 2018). With the current rate of mining activities and use of natural capital, it is foreseeable that significant impacts on environment is inevitable unless a holistic approach will be adopted to protect the other components of the natural resources. To attain sustainable development of the country and the elsewhere, there is a need to adapt a comprehensive strategy in managing natural resources towards sustained development and that Ecosystem approach is the best option. This approach is overly emphasized under the Botswana's National development Plan (NDP 11, 2017), wherein, all sectors of the society should adapt a sustainable strategy that would maximize productivity and conserve the natural resources for future generation. It is very clear in NDP 11 that efficient use of natural resources, protection of environmental degradation and preserving the well-being of the society are primary components to any developmental agenda in all sectors of society. Currently however, there is no specialized manpower in Botswana

that could tackle this enormous challenge. A new breed of professionals is needed that is to actively implement the country's National Framework on Sustainable Development in all sectors of the society (HRDC, Botswana). Therefore, there is a need to develop highly skilled manpower to play a major role for a sustainable development of the economy and society that can only be achieved with thorough sustainable management of natural resources.

This qualification, therefore, will meet the demands in Botswana, SADC and worldwide for high level skilled manpower necessary for natural resources and ecosystem management and sustainable development. The holder of this qualification should address the current challenges on strengthening human well-being and capabilities to understand fundamental requirements for sustainable development; avert environmental and social disaster; create and implement evidence-based instrument (scientific perspective) on decision making and policy formulation; and promote and secure the global environmental commons. Therefore, there is a need to produce highly skilled manpower to play a major role for a sustainable development of a diverse economy that can only be achieved with thorough sustainable management of natural and human resources.

PURPOSE:

The purpose of this qualification is to produce graduates with specialized knowledge, skills and competences of ecosystems science and sustainability, and are able to:

i) Integrate the latest science and high impact technologies into real-world decision making and public policy for managing resources – the air, water, land and biological diversity.
ii) Avert the challenges of the ever-changing environment to meet the demands of the current and future human generations.
iii) Analyse and process complex information on ecosystem interactions and develop sustainable for solutions for environmental challenges.
iv) Use various concepts in sustainability science, systems analysis, information management, natural resources ecology and measurements for enhancing perspectives of sustainability at different scales and geographic locations including sustainable urban development and green cities.

Successful degree holders of this qualification have enhanced capability in performing critical task in implementing sustainable development goal in a society through their capacity to analyse and integrate

the complex environmental system and processes; understand the necessary fundamental changes in the current patterns of development; initiate inclusive actions based on current issues; and apply scientific evidence in formulating policies and measuring their impact on society and environment through a systemic approach that helps identify and manage trade-offs while maximising co-benefits.
ENTRY REQUIREMENTS (including access and inclusion)
a) Minimum entry qualification: Certificate IV, NCQF Level 4 (General Education or TVET). b) Applicants who do not meet the above criteria may be considered through Recognition of Prior Learning (RPL) and Credit Accumulation and Transfer (CAT) policies for access. This consideration will be done following guidelines of the education and trainings providers (ETP) which are aligned with BQA/ National policies.

QUALIFICATION SPECIFICATION **SECTION B**	
GRADUATE PROFILE (LEARNING OUTCOMES)	**ASSESSMENT CRITERIA**
1. Demonstrate understanding of the current knowledge of the earth system pathways and their interactions in relation to resource utilization and environmental sustainability.	1.1. Explain to the stakeholders and environmental practitioners the importance of the five sphere of earth system pathways and their interactions in the efficient use and sustainability of natural resources; 1.2. Elucidate the relationship of the earth system pathways in planning developmental strategies; 1.3. Propose strategies for progressive development of society while preserving the environment;

	1.4. Utilize the knowledge on the interaction of earth system in the developing holistic and inclusive solutions of current environmental problems of the society.
2. Analyse the origin life, its evolution, preservation and diversity through time as the central entity in an ecosystem and as a natural capital.	2.1. Explain to stakeholders and clientele the importance of biodiversity preservation for sustainable and wholistic development in all sectors of the society; 2.2. Utilize the basic knowledge of life, the theories of origin and evolution of life and the current body of knowledge in the assessing biodiversity and ecosystem sustainability; 2.3. Evaluate the impact of human activities on biodiversity and the importance of biodiversity on sustaining ecosystem health and productivity. 2.4. Propose strategies to sustain biodiversity and ecosystem functions.
3. Demonstrate a specialized knowledge on ecosystem processes that support and enrich humankind including interactions among organisms and species.	3.1. Explain to the stakeholders and clientele the principles and interaction between the biophysical environment and different ecosystem process and its importance in providing resources to meet the demand of the current and future generations; 3.2. Illustrate and explain to stakeholders and clientele how human intervention influence ecosystem processes and the feedback mechanisms among the components of the ecosystems;

	3.3. Utilize the principles and interaction of different ecosystem process and how human intervention influence the availability of natural resources through time. 3.4. Incorporate the ecosystem interaction in providing recommendations and solutions to environmental problems and resource utilization.

4. Apply the various concept of sustainability science in the economic development at different scales and geographic locations.	4.1. Explain to the stakeholders and clientele the importance of incorporating sustainability in carrying out developmental projects and programs. 4.2. Inculcate a culture of appreciating the interaction between the biophysical environment and the society in structuring sustainable development plans at different organizational levels. 4.3. Illustrate to stakeholders and clientele how human intervention influence ecosystem processes. 4.4. Utilize the feedback mechanisms among the components of the ecosystems in the evaluation of projects and programs.
5. Integrate systems analysis, information management, natural resources audit and measurements for enhancing perspectives of sustainable development.	5.1. Conduct capability classification of the natural resources (land and water resources) for efficient and sustainable resource utilization. 5.2. Create resource suitability assessment and classification of available land resources to enhance efficiency and productivity with minimum production and environmental cost. 5.3. Provide guidance to project developers and planner on how to improve efficiency of resource utilization based on land evaluation.

6. Conduct research related to ecosystem and sustainable development in compliance with legislated & ethical research principles.	6.1. Identify problems related to ecosystems and sustainable development. 6.2. Implement sound research techniques in formulating hypotheses; objectives; methodologies for research and development programs in resource utilization, ecosystem maintenance and sustainable development. 6.3. Gather and interpret reliable data using appropriate scientific tools. 6.4. Formulate up to date and practical recommendations based on research results. 6.5. Prepare and package comprehensive report.
7. Evaluate the influence of the current economic development tract on ecosystem processes and sustainable resource utilization	7.1. Assess the impacts of different economic activities and natural resource utilization. 7.2. Propose strategies to manage and sustain ecosystems, societies and biosphere. 7.3. Implement the strategies that are sustainable and economically sound
8. Solve environmental problems using appropriate analysis tools, observational and model data; and make inferences and conclusions.	8.1. Identify and synthesis environmental problems. 8.2. Analyse the problems using appropriate scientific methods. 8.3. Draw conclusions and recommendations based on tangible data. 8.4. Prepare report and comprehensive presentation to stake holders.
9. Produce coherent information on environmental issues and communicate effectively, both orally and in writing	9.1. Identify and validate environmental issues. 9.2. Provide an analysis of the environmental issues based on verified and factual information.

	9.3. Prepare report using appropriate structure, style and language for a specific purpose and audience when giving feedback to clients. 9.4. Address communities on issues concerning the identified problems and issues in their locality and service areas.
10. Conduct audit on waste management, pollution status, and natural resource degradation	10.1. Conduct base-line analysis of the status of the environment. 10.2. Quantify the factors influencing the current environmental scenario. 10.3. Propose mitigation measures to alleviate current and future environmental problems. 10.4. Implement localized sustainable mitigation strategies.
11. Integrate the latest science into real-world decision-making and public policy for the realization of sustainable development	11.1. Apply the economics of pollution and management, and its implication to environmental policy and regulation. 11.2. Assess the environmental cost and benefits of economic development. 11.3. estimate the cost associated with compliance of environmental rules and provision and its associated environmental benefits.
12. Conduct environmental impact assessment for proposed projects	12.1. Plan a comprehensive EIA for proposed projects. 12.2. Identify different stages and work packages in the conduct of the EIA from identification of the process and coverage of the project, and zones of environmental impact, Screening of the project and its requirements, scoping and considerations alternatives, data collection.

	12.3. Collect baseline data by utilizing good laboratory/field practice according to local, national and international regulations. 12.4. Utilize appropriate specialist environmental modelling software applications. 12.5. Analyse the data, create impact prediction and formula tr mitigation plan. 12.6. Prepare scientific and referenced EIA reports.
13. Apply professional code of ethics their profession	13.1. Recognize the objectives and standards of Environmental Professionals 13.2. Apply the code of ethics in carrying out the professional duties. 13.3. Practice integrity in discharging duties for public welfare and interest. 13.4. Utilize the special knowledge, skills and competencies for the benefit of mankind and their environment.
14. Create business opportunities on services provision, consultancies and products in environmental related economic activities	14.1. Identify business opportunities on environment related economic activities. 14.2. Conduct feasibility studies on business opportunities related to services provision, consultancies and products in environmental related economic activities 14.3. Create business models and plan on business opportunities related to services provision, consultancies and products in environmental related economic activities 14.4. Validate the business models to suit for specific

QUALIFICATION STRUCTURE **SECTION C**			
FUNDAMENTAL COMPONENT Subjects / Units / Modules /Courses	**Title**	**Level**	**Credits**
	Principles of Biology I	**5**	**12**
	General Chemistry I	**5**	**12**
	Introduction to Computing	**5**	**12**
	Pre-Calculus I	**5**	**12**
	Introduction to Physics	**5**	**12**
	Introduction to Technical Writing & Academic Literacy I	**5**	**6**
	Principles of Biology II	**6**	**12**
	General Chemistry II	**6**	**12**
	Pre-Calculus II	**5**	**12**
	Introductory to Electricity and Magnetism	**5**	**12**
	Introduction to Calculus	**6**	**12**
	Technical Writing & Academic Literacy II (Writing Process)	**5**	**6**
	Introduction to Analytical Chemistry	**6**	**12**
	Calculus for Applied Sciences I	**6**	**12**
	Calculus for Applied Science II	**6**	**12**
CORE COMPONENT Subjects / Units / Modules /Courses	Earth and its Materials	**7**	**12**
	Introduction to Human Environments	**6**	**12**
	Physics for Earth and Environmental Sciences	**6**	**12**
	Ecology and Biodiversity	**7**	**12**

	Introduction to Inorganic Chemistry (Chemical bonding and periodicity	**6**	**12**
	Introduction to Biophysical Environment	**6**	**12**
	Environmental Microbiology	**7**	**12**
	Professional Communication (Technical and Professional Communication)	**6**	**6**
	Introduction to Entrepreneurship	**6**	**6**
	Fundamentals of Soil Science	**6**	**12**
	Atmospheric Physics and Chemistry	**7**	**12**
	Geographic Information Systems and Databases	**7**	**12**
	Statistics for Environmental and Earth Sciences	**6**	**12**
	Natural Resource Management	**7**	**12**
	Starting and Sustaining a Business	**6**	**6**
	Environmental Impact Assessment	**7**	**12**
	Natural Resource Economics	**7**	**12**
	Ecosystems Ecology	7	**12**
	Environmental Analytical Chemistry	7	**12**
	Field mapping and reporting/internship	**7**	**12**
	Environmental Law and Policy	**7**	**12**
	Pollution and Remediation	**7**	**12**
	Climate and Climate Change	**7**	**12**
	Principles of Hydrology	**7**	**12**
	Energy and Sustainability	**7**	**12**
	Internship	**7**	**36**

Rules of combinations, Credit distribution (where applicable):

The distribution of the credits at different levels is as follows:

NQCF Level 5 = 96 credits

NQCF Level 6 = 162 credits

NQCF Level 7 = 228 credits

Total Credits = 486 credits

ASSESSMENT AND MODERATION ARRANGEMENTS

ASSESSMENT

For the overall assessment, candidate for this qualification should comply the prescribe credits stipulated in the course structure for Bachelor of Science in Ecosystem Science and Sustainability. The formative and summative assessments leading/contributing to the award of credits or a qualification shall be based on learning outcomes and/or sub-outcomes.

Formative assessment

Formative assessment or continuous assessment (C.A.) contributing towards the award of credits should be based on course outcomes. This can include tests, assignments and projects as well as simulated and real work settings. The contribution of formative assessment to the final grade shall be **40%** of the final mark.

Summative assessment

Candidates may undergo assessment including written and practical and simulated projects. The final examination for each course contributes between **60%** of the final mark for that course. To pass a course, a candidate must achieve a minimum of **60%** of the combined score from FA and SA.

MODERATION

There will be internal and external moderation for the qualification. Assessors and internal moderators must be BQA registered and accredited. Both internal and external moderation will be done in-line with the moderation policy of the Institution.

RECOGNITION OF PRIOR LEARNING (RPL)

Candidates may submit evidence of prior learning and current competence and/or undergo appropriate forms of RPL assessment for the award of credits towards the qualification in accordance with applicable RPL policies and relevant national-level policy and legislative framework. Implementation of RPL shall also be consistent with requirements, if any, prescribed for the field or sub-field of study by relevant national, regional or international professional bodies.

PROGRESSION PATHWAYS (LEARNING AND EMPLOYMENT)

Horizontal Articulation

Bachelor's degree (NCQF Level 7)

- Bachelor of Science in Ecology
- Bachelor of Science in Soil Science
- Bachelor of Science in Environmental Chemistry
- Bachelor of Science in Environmental Planning and Sustainable Development
- Bachelor of Science in Atmospheric Sciences
- Bachelor of Science in Natural Resources Management and Conservation
- Bachelor of Science in Sustainable Development

Vertical articulation

Honours Degree (NCQF Level 8) in:

- Bachelor of Science (Honours) in Ecosystem Science and Sustainability
- Bachelor of Science (Honours) in Ecology
- Bachelor of Science (Honours) in Soil Science
- Bachelor of Science (Honours) in Environmental Chemistry
- Bachelor of Science (Honours) in Environmental Planning and Sustainable Development
- Bachelor of Science (Honours) in Atmospheric Sciences
- Bachelor of Science ()Honours in Natural Resources Management and Conservation

Post-Graduate Certificate (NCQF Level 8) in:

- Post-Graduate Certificate in GIS and remote sensing application
- Post-Graduate Certificate in Environmental Impact Assessment

- Post-Graduate Certificate in Environmental Compliance and Audit

Post-Graduate Diploma (NCQF Level 8) in:

- Post-Graduate Diploma in Environmental Planning and Sustainable Development
- Post-Graduate Diploma in Land use planning
- Post-Graduate Diploma in Ecohydrology
- Post-Graduate Diploma in Integrated Water-Resources Management
- Post-Graduate Diploma in Climate Change and Mitigation
- Post-Graduate Diploma in GIS and remote sensing of the environment
- Post-Graduate Diploma in Integrated Waste Management
- Post-Graduate Diploma in Environmental Safety and Health

Employment pathway

Graduates will be able to pursue careers in various sectors such, agriculture, as water resources, mining industry, energy, commerce, meteorology, health as well as in relevant government departments. Specific career paths include:

- Environmental Consultants
- Resource Valuation and Development Experts
- EIA practitioners
- Water Resource Planners
- Geo-Environmental Scientists and Researchers
- Specialist Environmental Advisors
- Technicians and Research Associates
- Natural resource specialist

QUALIFICATION AWARD AND CERTIFICATION

Qualification Award

To obtain the Bachelor of Science in Ecosystem Science and Sustainability the student must obtain a minimum of 486 credits and satisfy all the rules of combination as indicated above.

Certification - Candidates meeting prescribed requirements will be awarded a certificate.

REGIONAL AND INTERNATIONAL COMPARABILITY

Based on the bench marking for the BSc Ecosystem Science and Sustainability, there was no university locally and regionally that was found offering the degree. The qualifications bench-marked in the application are those offered by the Colorado State University in the USA and a related degree program on Bachelor of Science degree in Wildlife, Sustainability, & Ecosystem Sciences, Tarleton State University, USA. Although the qualifications examined generally follow similar structures and standards, there are differences, though not significant, in that the modules are not offered at identical levels of the degree, module credits are not the same from different universities and the duration of the qualifications does not match. The proposed qualification has, therefore, generally, compares well with all the qualifications studied since the exit outcomes cover similar scope and depth and are aligned to exit-level descriptors typical of this level and type of qualification as well as competencies required for registration and accreditation with professional bodies such as the Colorado Commission on Higher Education (CCHE) and the Southern Association of Colleges and Schools Commission on Colleges (SACSCOC).

The degree, Bachelor of Science Honours in Ecosystem Science and Sustainability will focus on the study of ecosystem and sustainability of resource use particularly applicable to Botswana and other African countries. The degree program will produce professionals that are capable integrate the latest science into real-world decision-making and public policy, with the ultimate goal of managing our planet's natural resources – the air, water, land and biological diversity upon which all life depends – sustainably into the future. They will be equipped to analyze and process complex information on the ecosystem interactions the effect of human societies on ecosystem processes and their long-term sustainability and solving the ever-growing environmental challenges.

The strengths of the proposed program are to produce professionals that could make a difference in the real world ready to address challenges of global change, environmental and resource conservation, and sustainability. This is possible because of the interdisciplinary science approach that will allow graduates to have specialized knowledge, skills and competencies.
REVIEW PERIOD
5 years in line with the NCQF.