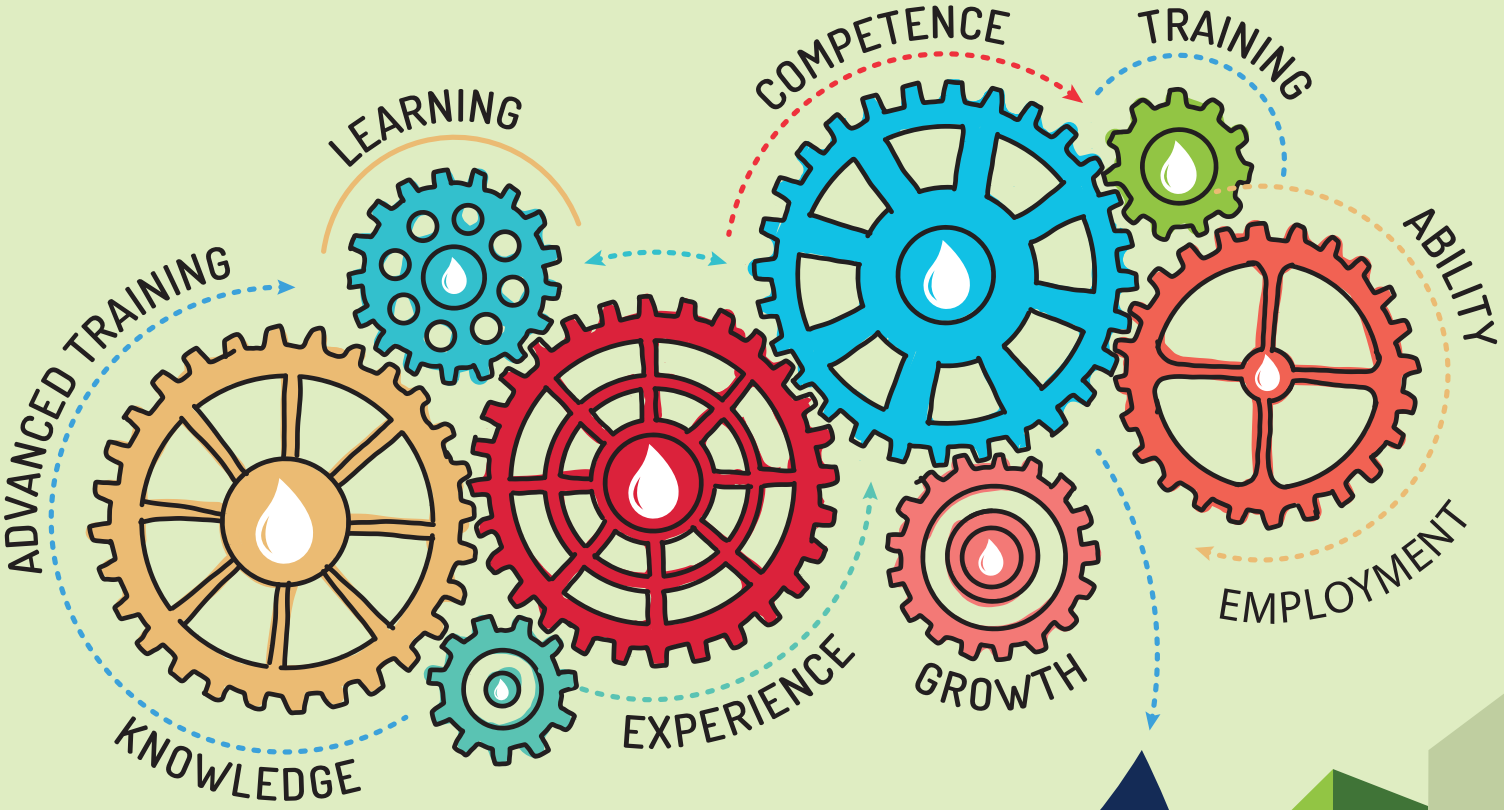
WATER RESEARCH DEVELOPMENT AND INNOVATION (RDI) ROADMAP SKILLS MAPPING STUDY

VOLUME 3: SHORT COURSE SKILLS MAPPING STUDY

N Nel, CD Swartz, N Moodley and MJ Jackson



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WATER RESEARCH DEVELOPMENT AND INNOVATION (RDI) ROADMAP SKILLS MAPPING STUDY

VOLUME 3: SHORT COURSE SKILLS MAPPING STUDY

Report to the
Water Research Commission

by

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The outputs of this research project are presented in four separate publications:

Volume I: Updated RDI Capability Study **(WRC Report No. TT 865/1/21)**
Volume II: Postgraduate short course mapping study **(WRC Report No. TT 865/2/21)**
Volume III: Short Course Mapping Study (**This report)**
Volume IIII: Demand Skills Study **(WRC Report No. TT 865/3/21)**

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EXECUTIVE SUMMARY

The Water Research, Development and Innovation (RDI) Roadmap is a high-level planning intervention that facilitates and guides the refocusing of research, reprioritisation of funds, synergising of existing initiatives and ring-fencing of the new resources to facilitate a more optimal water innovation system.

The objective of the water sector Short Course Mapping Study is to develop a high-level overview and map of available, quality-assured, RDI-relevant water-related short courses in South Africa. Further outcomes of this research study are to facilitate alignment of short courses offered by Higher Education Institutions (HEIs) and other institutions, and enable opportunities for more focused cooperation and partnerships in training and development between HEIs and water sector organisations.

The methodology adopted for this study included the identification of a targeted set of stakeholders within all of South Africa's 27 HEIs, professional bodies, and specialist research and innovation organisations to ensure high-quality engagements and feedback that would inform the research objectives. This was followed by data collection through a desktop study, literature review, an online questionnaire, semi-structured interviews, and data verification, as well as data analysis and reporting. A comprehensive gap analysis of the opportunities, overlaps, and gaps in available water sector-related short courses was then undertaken.

For the period from 2015 to 2020, a total of 134 unique short courses were identified through desktop study and questionnaire. These short courses were identified at 14 HEIs, five professional bodies, and seven research and innovation specialists. 54% of the identified short courses in the water sector are offered by HEIs, 28% by professional bodies and the remaining 19% by research and innovation specialists.

The following table is a summary of the short course offerings per institution (from 2015 to 2020) as identified through both the desktop study and the online questionnaire. Each short course was mapped to the Water RDI Roadmap clusters of needs and interventions.

The institutions with the most short course offerings include: Stellenbosch University (SU) (17), the Water Institute of South Africa (WISA) (15), the University of Pretoria (UP) (14) and the University of Cape Town (UCT) (13). HEIs identified as not offering any water-related short courses include: Central University of Technology (CUT), Limpopo University (LU), the Independent Institute of Education Monash SA (IIE MSA), Mangosuthu University of Technology (MUT), Sefako Makgatho Health Sciences University (SMU), Sol Plaatje University (SPU), Tshwane University of Technology (TUT), University of Fort Hare (UFH), University of Johannesburg (UJ), University of the Western Cape (UWC), University of Zululand (UNIZULU), Vaal University of Technology (VUT), and Walter Sisulu University (WSU); with the majority of these institutions classified as Historically Black HEIs (HBHEIs).

Short course offerings and cluster allocation as identified through the desktop study and online questionnaire

Institution		No. of short courses	Cluster 1	Cluster 2	Cluster 3	Cluster 4	Cluster 6	Cluster 7
HEIs	CPUT	6	1	5	0	0	0	0
	DUT	2	0	2	0	0	0	0
	NMMU	1	1	0	0	0	0	0
	NWU	4	0	2	1	0	0	1
	RU	4	0	4	0	0	0	0
	SU	17	1	5	11	0	0	0
	UCT	13	0	3	8	0	2	0
	UFS	3	0	0	3	0	0	0
	UKZN	1	0	1	0	0	0	0
	UMP	1	1	0	0	0	0	0
	UP	14	0	5	5	1	2	1
	UNISA	1	0	1	0	0	0	0
	UNIVEN	2	0	1	1	0	0	0
	WITS	3	0	3	0	0	0	0
Research and Innovation Specialists	ARC	6	3	0	3	0	0	0
	CAP-NET	7	1	6	0	0	0	0
	CSWUE	1	0	0	0	0	1	0
	Green Cape	1	1	0	0	0	0	0
	Gerald de Jager	3	0	3	0	0	0	0
	Water Academy	6	0	0	6	0	0	0
	Water Utilities Corporation	1	0	0	1	0	0	0
Professional Bodies	IMESA	8	2	2	3	0	1	0
	SAAMA	5	0	4	1	0	0	0
	SAIAE	2	0	1	1	0	0	0
	SAICE	7	0	4	3	0	0	0
	WISA	15	1	3	8	0	2	1
	Total	134	12 9%	55 41%	55 41%	1 1%	8 6%	3 2%

Professional bodies not offering water-related short courses include: the Association of the South African Quantity Surveyors (ASAQS), Consulting Engineers South Africa (CESA), Geological Society of South Africa (GSSA), Institute of Landscape Architecture of South Africa (ILASA), Institute of Plumbing South Africa (IOPSA), South African Council for the Landscape Architectural Profession (SACLAP), South African Council for Natural Scientific Professions (SACNASP), and Engineering Council of South Africa (ECSA). Of the Research and Innovation Specialists that were identified in this study, those not offering water-related short courses as per the methodological process include the

International Water Management Institute (IWMI), International Groundwater Resource Assessment Centre (IGRAC), South African Environmental Observation Network (SAEON), South African Network for Biosciences (SANBio), South African Institute for Advanced Material Chemistry (SAIAMC), World Wide Fund for Nature (WWF), and Southern African Science Service Centre for Climate Change and Adaptive Land Management (SASSCAL).

The mapping of the short course programme findings to the Water RDI Roadmap thematic clusters of needs and interventions relating to supply and demand for the water community, revealed that the majority of short course offerings are linked to Cluster 2 [*Governance, planning and management of supply and demand*] and Cluster 3 [*Adequacy and performance of supply infrastructure and operational performance (Built infrastructure/Ecological infrastructure/ecosystems*)]. The fewest number of short course offerings are linked to Cluster 4 [*Running the water sector as a smart business*] and Cluster 7 [*Monitoring and metering*]. The institutions offering short courses in the broadest range of clusters are UP and WISA.

In the Update of the RDI Capability Map Study (Volume 1) and Postgraduate Map (Volume 2) the strongest thematic clusters across the two research studies were Cluster 1 [*Increase ability to make use of more sources of water*], Cluster 6 [*Efficiency use of water (Agriculture, industry, and consumers*] and Cluster 2 [*Governance, planning, and management of supply and demand*]. Cluster 2 therefore emerges as the common strong thematic cluster across all the volumes.

Gaps in the water sector short course landscape have been identified as follows:

Operational Gaps:

- There are no short course offerings at the following HEIs: LU, IIE MSA, MUT, SMU, SPU, TUT, UFH, UJ, UWC, UNIZULU, VUT, and WSU. The majority of these institutions are HBHEIs.
- The lowest proportion of short courses are offered by research and innovation specialists.
- The professional bodies identified in this study as not offering water sector short courses include: ASAQS, CESA, GSSA, ILASA, IOPSA, SACLAP, SACNASP, and ECSA.
- None of the short courses as identified in this study are offered in the Northern Cape.
- 30% of the short courses identified through the online questionnaire are not accredited.
- There is a lack of consistent standardised descriptions for the target audience (titles, employment band) which may hamper potential participants from making informed decisions about enrolment.
- Less than 10% of the short courses identified in the questionnaire and desktop study have an online offering (particularly pre-COVID-19).

Strategic Gaps

- There is insufficient formal market research being undertaken by short course role-players to inform the design and development of short courses.
- There is an under-representation of short courses addressing certain clusters, particularly Cluster 1 and 6 as required by WRC targets set in the Water RDI Roadmap.
- There are few collaborations with HBHEIs in particular, and with international HEIs, industry, water sector organisations and Local Government for the pooling of resources and knowledge exchange.
- The following water-related audiences are not explicitly targeted in the water-related short course landscape:
    - Landscape Architects
    - Educators

    - Those involved in sustainability/climate change, social justice and the water-energy nexus.
- There is a shortfall in the optimisation of the following short course drivers:
    - Individuals and their expertise/research interests and willingness to disseminate knowledge
    - Stipulations in funding contract agreements
    - Broader audience over and above students to ensure financial viability.
    - Building capacity and awareness
    - National Government targets
    - Responding to the need for sustainable solutions to environmental problems
    - Student development
    - Student research
    - Demand from industry
- There is a lack of:
    - Streamlined and efficient processes for registration and accreditation of short courses.
    - Consistent funding.
    - Sufficient succession planning and retaining of experts in the field.
    - Differentiation between course creators/presenters and accreditors to avoid a conflict of interests.
- Barriers to learning such as internet and data accessibility exist and need to be reduced for online and time-efficient/ self-paced offerings to lower costs and increase accessibility.

Recommendations

To address the gaps identified in this study, and ultimately to improve coordination and awareness among the various stakeholders and role-players in the water-related short course training landscape, the following recommendations are made:

- Increase standardisation across the sector by organising water-related short course quality management on a regional scale, particularly in higher education. Draw on international best practice whereby HEIs follow guidelines to establish quality management of short courses despite having their own internal assurance mechanisms. The pooling of resources could empower those identified as not operating in the short course landscape, particularly HBHEIs, Landscape Architects and those involved in: sustainability/climate change, social justice, and the water-energy nexus. Nurturing and developing strong thematic clusters and stimulating additional short courses to address weaker thematic clusters are key strategic decisions that can be undertaken through shared expertise. Explore options to optimise the accreditation and registration processes for short courses to ensure greater user-friendliness and a less cumbersome and time-consuming process. Eliminate conflict of interest between short course creators and accrediting bodies by ensuring these bodies are not running in-house courses.
- Optimise and increase awareness of the short course drivers as identified, to ensure alignment with various water sector needs, retain knowledge, and increase access to funding.
- Foster and build collaborative programmes and synergy between professional practitioners, prospective students, water sector organisations, HEIs, research and innovation specialist agencies, Local Government, National Government, SMMEs, Sector Education Training Authorities, and professional bodies. Foster coordination between the various roleplayers by utilising and updating the summary tool created as part of this study.
- Where possible, increase the number of online short course offerings that can be completed at the delegates' own pace both in response to the COVID-19 pandemic, and to increase access and reduce costs of short courses. Barriers to entry of this format of teaching such as access of delegates to devices and data as well as large practical components will require further consideration.

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ABBREVIATIONS

ACEWater 2	African Centres of Excellence Human Capacity Development Programme
AMPLE	Asset Management Program Learning Environment
ARC	Agricultural Research Council
ARUA	African Universities Research Alliance
ASAQS	Association of the South African Quantity Surveyors
AU	African Union
BGCMA	Breede Gouritz Catchment Management Agency
BOCMA	Berg-Olifants Proto CMA
BREF	Best Available Techniques Reference
CESA	Consulting Engineers South Africa
CHE	Council on Higher Education
CHI	Computation Hydraulic International
CMA	Catchment Management Agencies
CPD	Continuing Professional Development
CPUT	Cape Peninsula University of Technology
CSIR	Council for Scientific and Industrial Research
CSWUE	Chris Swartz Water Utilities Engineers
CUT	Central University of Technology
DEA&DP	Department of Environmental Affairs and Development Planning
DHET	Department of Higher Education and Training
DSI	Department of Science and Innovation
DST	Department of Science and Technology
DWAF	Department of Water Affairs and Forestry
DWS	Department of Water and Sanitation
DUT	Durban University of Technology
ECSA	Engineering Council of South Africa
EWSETA	Energy and Water Sector Education and Training Authority
EWQ	Environmental water quality
FETWater	Framework programme for research, education and training in the water sector
GSSA	Geological Society of South Africa
HBHEI	Historically Black Higher Education Institution
HCD	Human Capacity Development
HEI	Higher Education Institution
HEQC	Higher Education Quality Committee
HEQSF	Higher Education Qualification Sub Framework
HRDS	Human Resource Development Strategy
IGRAC	International Groundwater Resource Assessment Centre
IIE MSA	Independent Institute of Education Monash SA
ILASA	Institute of Landscape Architecture of South Africa
IMESA	Institute of Municipal Engineering of Southern Africa
INR	Institute of Natural Resources
IOPSA	Institute of Plumbing South Africa
IUCMA	Inkomati-Usuthu CMA
IWMI	International Water Management Institute
IWP	Integrated Water Platform
IWRM	Integrated Water Resource Management
JPTL	Junior professional and technical level
LNWCMA	Limpopo-North West Proto CMA

LU	Limpopo University
MER	Monitoring-Evaluation-Reporting
MISA	Municipal Infrastructure Support Agency
MoU	Memorandum of Understanding
MTPCMA	Mzimvubu-Tsitsikamma Proto CMA
MUT	Mangosuthu University of Technology
NEPAD	New Partnership for Africa's Development
NICHE	Netherlands Initiative for Capacity Development in Higher Education
NMMU	Nelson Mandela Metropolitan University
NQF	National Qualifications Framework
NRF	National Research Fund
NSDP	National Skills Development Plan
NSF	National Skills Fund
NUFFIC	Netherlands Universities Foundation for International Cooperation
NWRS2	National Water Resource Strategy, second edition
NWU	North West University
OKP	Orange Knowledge Programme
PIRB	Plumbing Industry Registration Board
QCTO	Quality Council for Trades and Occupations
RDI	Research, Development and Innovation
RDD	Research, Deployment and Deployment
RDM	Resources Directed Measures
RDRM	Revised Desktop Reserve Model
RFA	Research Focus Area
RU	Rhodes University
SA	South Africa
SAAMA	Southern African Asset Management Association
SABI	South African Irrigation Institute
SACLAP	South African Council for the Landscape Architectural Profession
SACNASP	South African Council for Natural Scientific Professions
SADC	Southern African Development Community
SAEON	South African Environmental Observation Network
SAIAE	South African Institute of Agricultural Engineers
SAIAMC	South African Institute for Advanced Material Chemistry
SAICE	South African Institute of Civil Engineers
SALGA	South African Local Government Association
SANBIO	South African Network for Biosciences
SANWATCE	South African Network of Water Centres of Excellence
SANWATSE	Southern African Network of Water Centres of Excellence
SAQA	South African Qualifications Authority
SASAqS	Southern African Society of Aquatic Scientists
SASSCAL	Southern African Science Service Centre for Climate Change and Adaptive Land Management
SC	Short Course
SCE	School of Consulting Engineering
SDC	Source-directed-control
SETA	Sector Education and Training Authority
SIAM	Sustainable Infrastructure Asset Management
SMME	Small, Medium and Micro Enterprise
SMU	Sefako Makgatho Health Sciences University

SPL	School for Public Leadership
SPU	Sol Plaatjie University
SU	Stellenbosch University
SUWI	Stellenbosch University Water Institute
TMT	Tailor-Made Training
TUT	Tshwane University of Technology
TVET	Technical and Vocational Education and Training
UCT	University of Cape Town
UFH	University of Fort Hare
UFS	University of the Free State
UJ	University of Johannesburg
UKZN	University of KwaZulu-Natal
UMP	University of Mpumalanga
UNESCO	United Nations Educational Scientific and Cultural Organisation
UNISA	University of South Africa
UNIVEN	University of Venda
UNIZULU	University of Zululand
UP	University of Pretoria
UWC	University of the Western Cape
VUT	Vaal University of Technology
WISA	Water Institute of Southern Africa
WITS	University of the Witwatersrand
WP	Work Package
WRC	Water Research Commission
WRDM	Water-related Disaster Management
WRYM	Water Resources Yield Model
WSP	Water Services Provider
WSU	Walter Sisulu University
WUA	Water User Associations
WWF	World Wide Fund for Nature
YWP	Young Water Professionals

1 INTRODUCTION AND CONTEXT

1.1 Contextualisation

The Water Research, Development and Innovation (RDI) Roadmap is a high-level planning intervention that facilitates and guides refocusing of research, reprioritisation of funds, synergising of existing initiatives and ring-fencing of the new resources to facilitate a more optimal water innovation system. The Roadmap is run as a partnership by the Department of Science and Innovation (DSI), Department of Water and Sanitation (DWS) and the Water Research Commission (WRC) (WRC, 2015).

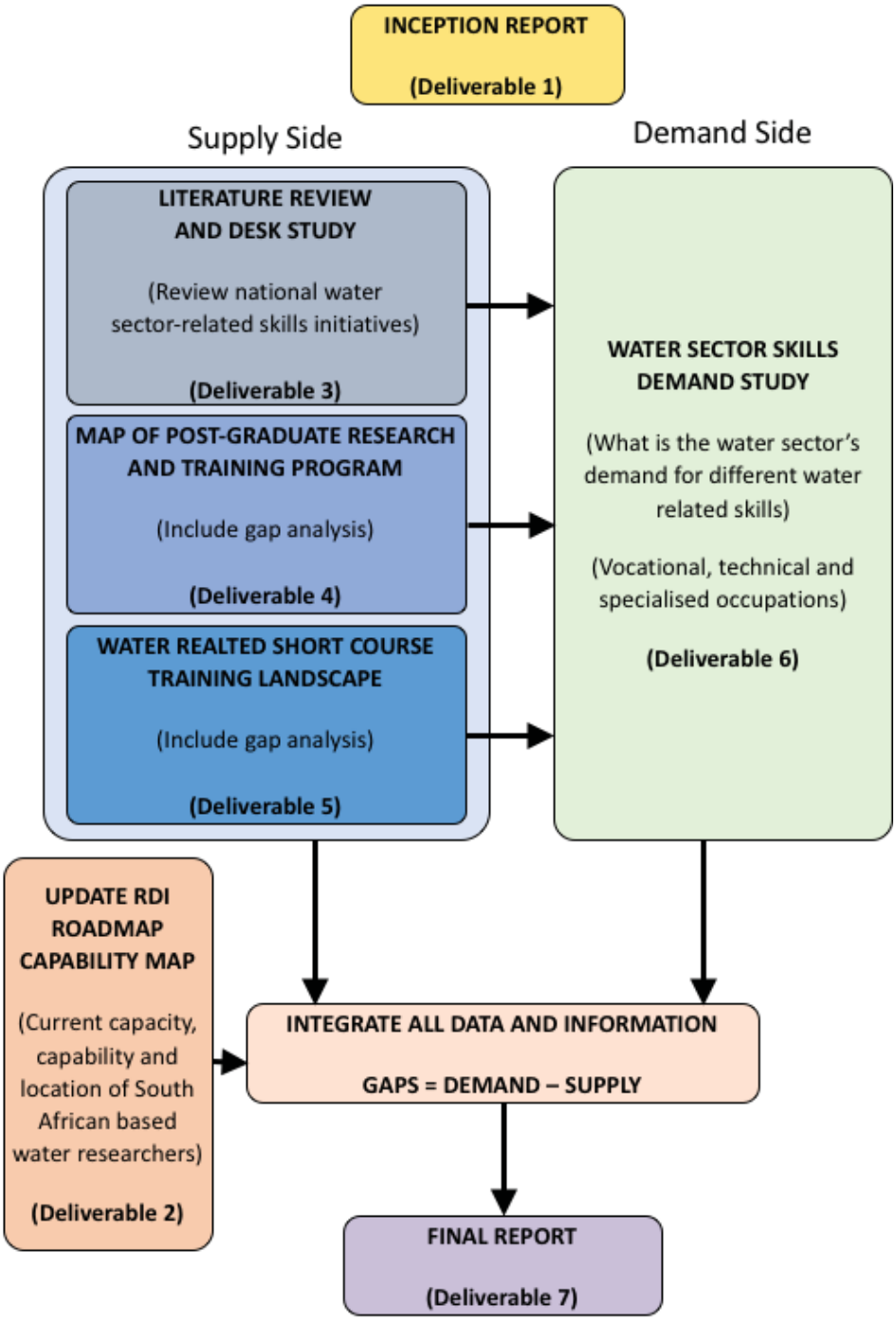
The vision of the Roadmap is that South Africa is a leader among middle-income countries in the development and deployment of water management practices and technologies.

One of the main pillars and focus areas of the Roadmap is to support high-end human capacity development for water RDI. Highly skilled individuals are key to enabling faster and more effective development and deployment of context-appropriate solutions to water sector challenges. Short course training is seen as a key aspect of driving the deployment of new knowledge and innovation into different implementation contexts.

An objective of the Water Roadmap Skills Mapping Study focuses on understanding water sector skills demand, mapping and analysing the water sector postgraduate training landscape, mapping the RDI-relevant short course training landscape, and updating the Water RDI Capability Map.

This study is the third volume of the Water RDI Roadmap Skills Mapping Study with the main objective being to develop a high-level overview and map of available, quality-assured water-related short courses in South Africa.

The context of Volume 3 (and the focus of this report) is depicted in Figure 1:



1.2 Background and Rationale

A specific water-related human capacity development opportunity, identified through the implementation of the RDI Roadmap, is that Higher Education Institutions (HEIs) and other public and private sector institutions are driving short course training as part of their service offering and business model.

According to the South African Qualifications Authority (SAQA, 2004) short courses are "particularly associated with 'just in time', and 'just enough' learning *to meet a specific need in workplace environments*" for purposes of Continuous Professional Development (CPD), or skills and knowledge 'upgrading'. Short course provisioning can occur in the following contexts (adapted from SAQA, 2004):

- In-service training programmes.
- Updating staff, for example, on changes to employment (HR) or health and safety legislation.
- Imparting 'new' knowledge "where this type of knowledge has not yet been included in a qualification".
- Refresher courses for professionals.

While SAQA (2004) recognises that short course provisioning is integral to the development of "meaningful career and learning pathways" it is acknowledged that "there is the real danger that this type of provisioning may result in disjointed and fragmented approaches".

With the above in mind, a key gap in this space is a need for improved coordination, awareness, and synergising between the various role-players and forms the rationale for this study (namely the development a high-level overview and map of the RDI water-related short courses in South Africa, that support the shift of new research and innovation into practice). The mapping of short courses will serve to facilitate improved coordination and synergising among practitioners and implementers.

1.3 Aims and objectives

To address the above-mentioned gap in improved coordination and awareness among the various role-players in the water-related short course training landscape, the main objective of this study is to develop a high-level overview and map of available, quality-assured, RDI-relevant water-related short courses in South Africa. Further outcomes of the volume are to:

- Facilitate alignment of short courses offered by HEIs and other institutions including those from the private sector;
- Enable opportunities for more focused cooperation and partnerships in training and development between HEIs and water sector organisations including Water Service Providers (WSPs), Local and National Government such as the Department of Water, and Sanitation (DWS), Small, Medium and Micro Enterprises (SMMEs) and Sector Education and Training Authorities (SETAs).

1.4 Scope and Approach

This study allows for the identification of gaps in the short course training landscape and facilitates improved coordination and synergising amongst practitioners and implementers.
This study is specifically delineated to include short courses that are:

- Defined according to *the South African Qualifications Authority (SAQA), Criteria and Guidelines for Short Courses and Skills Programs (2004):* "A short learning programme through which a learner may or may not be awarded [max 120] credits towards a qualification or a part-qualification, depending on the purpose of the programme" (NQF Standard Glossary of Terms, 2014) but need not be credit-bearing necessarily.
- Linked to knowledge sharing that is derived from research, innovation, new technologies, and commercial activities that allow for the opportunity to expose practitioners to emerging trends.
- Quality-assured *accredited* or CPD registered or have undergone *institutional review mechanisms/quality controls*) by the institutions that offer them. Based on the Council on Higher

Education (CHE) regulations and guidelines, NQF levels and credits should not be assigned or allocated to a short course that does not lead to a qualification on the Higher Education Qualification Sub-Framework (HEQSF).

- Offered at least on a semesterly, quarterly, or monthly basis dated throughout 2015 to 2020. Some short courses are offered on a more frequent basis or on demand, and these will also be included in the study.

The primary target audience of the volume is the various role-players in the short course training landscape. These role-players include:

- Short course developers (creators) and trainers,
- Staff in departments that fulfil an oversight and quality assurance function at HEIs,
- Professional bodies and associations,
- Specialist research and development organisations, in both the public and private sector,
- Employers and individuals who may want to source specific short course opportunities, and
- The WRC as an information source for the sector.

The secondary target audience includes organisations that fulfil a coordinating role related to skills development through RDI short courses, including the Sector Education and Training Authorities (SETAs), South African Local Government Association (SALGA), Municipal Infrastructure Support Agency (MISA), and the Institute of Municipal Engineering of South Africa (IMESA).

2 LITERATURE REVIEW

This chapter provides a review of short courses and/or short learning programmes on offer to postgraduate students or professionals in the water sector.

2.1 Introduction

Short courses, (or short learning programmes) are dynamic tools that play an integral role in education and training for optimal workplace functioning. The provision of short courses provides 'just enough' and 'just in time' learning to meet the needs of a specific workplace, and allows for the dissemination of research findings and new knowledge sharing for CPD and the provision of a targeted learning programme to upgrade the skills and knowledge of a learner (SAQA, 2004). Further to this, short courses increase employability, self-employment possibilities, workplace/sector mobility; and provide flexible access to learning opportunities towards nationally registered unit standards and qualifications (SAQA, 2004). The duration of a short course typically does not exceed a few months thereby ensuring that economically active people need not be removed from the workplace for extended periods to be re-trained and up-skilled (DHET, 2019).

It is important that the provisioning of short courses should be subject to the same accreditation and quality assurance processes already in place for full qualifications and where possible, that the credits achieved through short courses should be counted towards / articulated into registered qualifications and unit standards (SAQA, 2004). However, short course learning programmes that do not articulate into registered qualifications are not regulated by SAQA. Besides the short courses offered and accredited by HEIs, the sector has experienced a significant increase in the number of independent service providers offering water-related short courses, some of which are not accredited.

2.1.1 Organisational Learning Activities

The contribution of summer schools, workshops, coaching, mentoring or exchange initiatives to training or skills development of postgraduate students or professionals in the water sector may be noted, especially where it forms part of a larger initiative (e.g. Framework Programme for Research, Education and Training in the Water Sector – FETWater programme). However, these initiatives are not the primary focus of this study, since detailed information can only be obtained from interviewing stakeholders that are willing to share information and the outcomes are often not tangible or quantifiable. These learning activities, furthermore, do not form part of the other volumes.

2.2 Policy Framework and Context

Short course provisioning is instrumental in achieving the overall objective of the National Skills Development Plan 2030 (NSDP) and Human Resource Development Strategy (HRDS) 2017 which is to have a better educated workforce (NSDS booklet: April 2001).

Further to this, the following South African Acts, regulations, and policies create an enabling framework for cost-effective upskilling and multiskilling of the labour force:

- The South African Qualifications Act, (No. 58 of 1995), its NSB Regulations (No. R452 of 28 March 1998), and the ETQA Regulations (No. R1127 of 8 September 1998);

- The Skills Development Act (No. 97 of 20 October 1998), the Skills Development Levies Act (No. 9 of 1999), and the Skills Development Regulations and Guidelines (2001);
- The General and Further Education and Training Quality Assurance Act (No. 58 of 29 November 2001);
- The Further Education and Training Act (No. 98 of 2 November 1998);
- The Higher Education Act (No. 101 of 19 December 1997) and its amendments;
- The draft New Academic Policy (CHE, 2001);
- Guidelines for applying for accreditation as a private provider of higher education qualifications registered on the NQF (CHE, 2002);
- Criteria and Guidelines for Providers (SAQA, 2001);
- Quality Management Systems for Education and Training Providers (SAQA, 2001);
- National Development Plan 2030. National Planning Commission. (2012). The Presidency: Pretoria;
- Human Resource Development Strategy for South Africa (HRD-SA) 2010-2030. (2009). Department of Education: Pretoria.

HEIs are mandated by the Council on Higher Education (CHE)/Higher Education Quality Committee (HEQC), in compliance with SAQA regulations to align, standardise and maintain effective short course management systems and processes in order to undertake the accreditation of their short course presentations (SU, 2015).

SAQA oversees the implementation of the National Qualifications Framework (NQF). All education and training qualifications are integrated into the NQF to ensure quality, coordination, and to facilitate progression or articulation from one qualification to another as an individual's career path progresses. In addition to the registration of qualifications, SAQA is also mandated to recognise Professional Bodies and register Professional Designations. The purpose of this mandate is to protect and promote trust in professions while encouraging the adoption of international best practices, accountability, social responsibility, and the implementation of CPD.

Short courses have an important role to play in terms of research, learning, teaching, community interaction, and skills development (SU, 2015). As such, short courses are subject to the same accreditation and quality assurance processes already in place for full qualifications, and where possible, the credits achieved through short courses are counted towards / articulated into registered qualifications and unit standards (SAQA, 2004). However, a large increase in the number of independent service providers offering water-related short courses, some of whom are not accredited, has posed the risk of disjointed and fragmented approaches to short course provisioning (SAQA, 2004). Short learning programmes that do not articulate into registered qualifications are not regulated by SAQA.

A few water sector-related professional bodies and associations are registered with SAQA. Those related to the water sector include, among others, the Engineering Council of South Africa (ECSA), Southern African Asset Management Association (SAAMA), South African Council for Natural Scientific Professions (SACNASP), the Water Institute of Southern Africa (WISA), IMESA and the Institute of Plumbers South Africa (IOPSA). Other than being responsible for the Professional registration of practitioners, these bodies perform various functions aimed at regulating and coordinating the provision and quality of training programmes, especially when awarding CPD points. CPD became compulsory in 2006 for the renewal of professional practitioners' registration with professional bodies, and CPD activities may include attending conferences, workshops, lectures, seminars, short courses, and refresher courses. Voluntary associations (such as the South African Institute of Civil Engineering,

SAICE), as well HEIs, may obtain accreditation from professional bodies to facilitate CPD activities. One such example is-the University of Pretoria's Enterprises unit (Enterprises UP).

Specialist research and innovation specialist organisations that offer training in the landscape and in some cases have partnerships with HEIs, e.g. the International Water Management Institute (IWMI), the Institute of Natural Resources (INR), the International Groundwater Resource Assessment Centre (IGRAC), South African Environmental Observation Network (SAEON), UNESCO-IHE Institute for Water Education, South African Institute for Advanced Material Chemistry (SAIAMC), South African Network for Biosciences (SANBio), Southern African Science Service Centre for Climate Change and Adaptive Land Management (SASSCAL), WaterNET, and Southern African Network of Water Centres of Excellence (SANWATCE).

2.3 National Skills Development Initiatives

2.3.1 Framework programme for research, education and training in the water sector (FETWater)

FETWater, established in 2002, responded to a skills and capacity gap in the water sector. This gap originated due to the implementation of new legislation and policy (National Water Act 36 of 1998 and National Water Policy of 1997) based on the principles of Integrated Water Resource Management (IWRM). IWRM requires that local levels of government, such as CMAs, Water User Associations (WUAs) and district or local municipalities, be established and take responsibility for the management, protection, conservation and sustainable use and supply of water resources. However, the establishment of these institutions required skills that were not available at the time.

A 1998 audit, conducted by the Department of Water Affairs and Forestry (DWAF now DWS), the United Nations Educational Scientific and Cultural Organisation (UNESCO) and the World Meteorological Organisation determined the education and training needs of the water sector. In response to this audit, the first phase of FETWater was implemented in 2002 to provide institutional and financial support for the creation of training networks as a means to establish co-operation between government, universities, research institutions and the public and private sectors. Financial support was provided by the Flemish Government through the Flaanders UNESCO Science Trust Fund and the South African government through the WRC and the DWAF (now DWS).

The first FETWater phase ended in 2005, followed by Phase II (2007 and 2010) and Phase III (2014-2019).

Three cooperative networks were established during Phase I to assist in identifying education, training and capacity building needs/priorities for the environmental management of water resources:

1. Resources Directed Measures (RDM) Network,
2. Groundwater Training Network, and
3. Beneficial Use of Water Network.

The focus of Phase II was water resource governance and four additional networks were established:

4. Wetlands and Rivers Network,
5. Water-related Disaster Management Network,
6. Catchment Management Agency Expertise Development Network, and
7. Catchment Management Strategy Development Network.

In general, a two-fold approach was followed to build capacity during Phases I and II. In the short term, short / training courses were developed and implemented facilitate immediate training and up-skilling of water sector professionals, including DWS representatives. Longer-term initiatives involved the integration of material into undergraduate courses and the establishment of Masters-level programmes to provide training as part of formal qualifications.

During Phase I, the RDM Training Network partners collaborated on the development of a curriculum for a Masters Programme in Environmental Water Requirements. According to the FETWater Phase I Progress Report, an outline of the Curriculum was presented to the four participating HEIs (University of Zululand, Rhodes University (RU), Nelson Mandela Metropolitan University (NMMU) and University of Cape Town (UCT) and the DWS was providing funding for the development of the modules and phased implementation of the programme. However, no further mention of this programme was found in subsequent FETWater documentation. A 2-day training course in Estuary Management was developed and piloted in 2009 and 2010 during Phase II of the programme. This short course was registered as a short course at Nelson Mandela University.

The aims of the Wetlands and Rivers Network, established during Phase II, were to support capacity building in integrated water resource and biodiversity management while raising awareness of the importance of wetlands types and rivers, increasing capacity to manage and rehabilitate these ecosystem types, and ensuring an understanding of the complex interaction between terrestrial and aquatic environments. Network Partners collaborated in the development and SAQA registration of a Coursework-based Masters qualification (Masters of Science in Aquatic Health), which is offered by the University of Johannesburg. The Qualification consists of seven modules as well as a research project. The modules are also offered as SAQA-accredited Short Courses and are credit-baring towards the full Qualification. A certificate is issued upon the successful completion of each module.

The Catchment Management Strategy Development Network initially formed part of the CMA Expertise Development Network, but a decision was taken to from a separate network with the aim of ensuring that the CMAs established catchment management strategies (CMSs) in compliance with the National Water Act. A Training Course on the development of CMS was developed and piloted twice during Phase II. Representatives of the University of Witwatersrand (WITS), University of the Western Cape (UWC) as well as Cape Peninsula University of Technology were invited to attend these courses. The representative from WITS agreed to incorporate the material into undergraduate lectures as well as a new Masters level course on Natural Resource Management at the institution. The material was also integrated into postgraduate courses at the UWC.

The Water-related Disaster Management (WRDM) network focused on establishing links between national and international experts in the field and supporting education, training and research needs in WRDM. WRDM course material was packaged into an elective module (NQF level 8) for inclusion into the Disaster Management Masters Programme offered at the University of the Free State (UFS).

An impact assessment of Phases I and II concluded that the RDM Network contributed significantly to capacity building within the DWS, especially for the DWS representatives responsible for Reserve Determination and River Health Programmes at the regional and national level (Mjoli and Jonker, 2010 as reported in WRC (2018). The large number of individuals capacitated by the RDM and Groundwater Networks were likely due to the fact that these Networks were established during the first phase of the programme and training was based on the needs of the DWS.

A tracer study of FETWater alumni, commission by the WRC (2018), found that Phases I and II of the FETWater programme resulted in 47 products/outputs/interventions which created 1 651 opportunities

to impact individuals ('opportunities' only, since the same individual may have benefited from more than 1 training event). The 47 programme outputs were categorized as Short Courses, Symposia/Conferences, Training Courses, Training Workshops, Student Tours, Products, Field Testing and Master Programmes (WRC, 2018).

Due to poor record keeping, the study successfully traced only 205 of the alumni from the first two phases of the programme. The majority of the traced individuals had attended training courses (63,4%), followed by training workshops (31,7%) and a Master's Degree programme (2,4%). Of the 205 alumni asked to participate in a tracer survey, only 34 responded to survey questions (16,6% response rate). The majority of the respondents were employed at the time of participation in the FETWater programme, whereas 16,7% were students. The majority of the respondents attended the Risk Management of Aquifers Training Course (43%) and the Master's Programme offered by the Rivers and Wetlands Network (33%). Most of the respondents indicated that the first two phases of the FETWater programme contributed positively to their professional career (77%).

Despite the fact that Phases I and II were successful in developing capacity in the sector, the uptake of the developed courses was limited and the impact was not sustained beyond the duration of the programme. This is likely due to a combination of factors, including limited funding, as well as fact that the courses were developed without alignment with the market's needs, including practical and workplace training components. Lastly, since the SETAs, Quality Council for Trades and Occupations (QCTO) and SAQA were not directly involved during development; the majority of the developed course material was not registered and accredited.

The following interventions / improvements were recommended for Phase III of the FETWater Programme:

1. Better alignment / integration of FETWater initiatives with DWS capacity building strategies / programmes to encourage the participation of DWS officials.
2. The integration of DWS capacity gaps, such as Water Compliance Monitoring and Enforcement, Water Use Licencing and Water Resource Planning into FETWater networks.
3. Institutionalization of FETWater into Higher Education Institutions for the benefit of local communities – both in providing training for better local water management and to assist in solving local problems.

Based on these recommendations and the training and skills gaps identified by Chapter 15 of the National Water Resource Strategy, second edition (NWRS2), six new networks were proposed for FETWater Phase III (2014-2019):

1. Water Infrastructure Network,
2. Water Monitoring and Assessment Network,
3. Water Planning and Implementation Network,
4. Water Regulation Requirements Network,
5. Water Use, Service and Sanitation Network, and
6. Institutional Management and Governance Network.

To promote sustainability, the focus of the third phase of the FETWater programme was to develop Water Related Occupational Qualifications with defined knowledge, practical and work experience components. Each of the 6 networks was tasked with selecting and developing at least 1 qualification. To date, three of the Occupational Qualifications have been registered with SAQA (Water Reticulation Officer, Water Infrastructure Management Practitioner and Water Regulation Practitioner) whereas the remainder are in the process of verification and submission. Piloting and mainstreaming of the

qualifications were excluded from Phase III but may be carried out under a potential Phase IV programme, pending SETA appropriation funding.

2.3.2 African Centres of Excellence Human Capacity Development Programme (ACEWater 2)

The African Union (AU) and New Partnership for Africa's Development (NEPAD) Southern African Network of Water Centres of Excellence (AU/NEPAD-SANWATCE) was tasked with implementing the European Union-funded African Centres of Excellence (ACE) Water2 project (2016 to 2019). One component of the ACEWater2 project is a "*Human capacity development (HCD) programme for junior professional and technical level (JPTL) capacity challenges in the water sector*". Five of the NEPAD Centre of Excellence countries from Southern Africa namely, Botswana, Malawi, Mozambique, SA and Zambia, were each tasked with preparing such a framework for their countries.

The key outcomes of the South African ACEWater2 project presented in the Final Report (AU/NEPAD, 2019) is summarized below.

In South Africa, the UWC and the Council for Scientific and Industrial Research (CSIR) conducted a scoping study of national capacity building initiatives in the water sector, specifically related to human capacity development of JPTL personnel. 'Junior professionals' are defined as individuals with a university qualification, with little or no work experience, that are in the process of obtaining professional registration, or have already obtained it. Individuals at 'technical level' includes trainees and qualified artisans, technicians and technologists with expertise in a technical vocation and they possess relevant work experience. In some instances, these individuals may also be registered with professional bodies or associations.

Key findings of the scoping study conducted by the UWC and CSIR include the following:

1. The existence of various approaches, strategies and initiatives aimed at addressing skills and capacity building in the sector
2. No coordinated mechanism for planning, delivery and quality assurance of skills and capacity development
3. Numerous providers of skills/education programmes, but inability to deliver qualifications that meet the sector's needs
4. Long lag between graduation and obtaining professional registration (3-5 years)
5. Planning, classification and registration of new occupations is a challenging and cumbersome process, involving the NQF and QC.
6. Un-coordinated funding leads to under or over investment in critical areas.
7. A shortage of critical skills in various aspects of the water value chain, including environmental health, engineering and socio-economic aspects.

A national stakeholder workshop conducted in 2017 provided feedback on the scoping study and solicited stakeholder input into the formulation of the framework for HCD of JPTL personnel in the SA water sector. Stakeholders included the CSIR, AU/NEPAD SANWATCE Secretariat, Umgeni Water, Eskom, DWS, University of Pretoria (UP) and UWC. Discussions during the workshop confirmed the following findings from the scoping study:

1. No effective coordination among higher education and further education institutions and initiatives due to a lack of a comprehensive reporting system. Annual reporting, as outlined in the NWRS2 (Chapter 15), attempts to address this point, but it has not been implemented.
2. The existing occupational framework for the water and sanitation sector is poorly coordinated, with training programmes offered to several perceived priority occupations.

3. No formal monitoring, evaluation and reporting framework for HCD in the water sector exists, including the JPTL level.

Additional discussions of relevance:

1. The DWS noted its plans to implement capacity development, as outlined in Chapter 15 of the NWRS2. Amongst others, these include determining the role players, implementing a coordinated skills planning, funding and monitoring system, and re-enforcing the relationship between education and training institutions and work places. The Department's focus for 2016/17 included implementing the occupations framework developed for the water and sanitation sector during FETWater Phase III.
2. The occupational programmes developed during the FETWater programme should be the priority capacity development programmes provided to JPTL individuals.
3. Building the SETA's capacity to support newly developed occupational training programmes aimed at addressing priority or scarce skills shortages, such as the FETWater programme.
4. A shift in the traditional approach to training from testing of academic knowledge to training focussed on the ability to perform the tasks required by an occupation. FETWater Phase III provided the platform to align academic training material with practical skills and workplace requirements.
5. It was recommended that a framework be drafted to determine the progress achieved in monitoring, evaluation and reporting of HCD initiatives in the water sector. This framework would include capacity building priorities, an implementation strategy, as well as monitoring and evaluation steps.

A draft of this Water Sector National HCD Monitoring-Evaluation-Reporting (MER) Framework was subsequently tabled at a national validation workshop in 2018 to obtain input from stakeholders.
The following feedback was received during this workshop:

1. As the lead institution in the water sector, it is critical that the DWS endorses and accepts ownership of any framework to ensure its development and implementation. While the DWS appreciated the potential benefits of the MER framework and expressed a willingness to develop it, it considered the development of such a plan '*beyond the mandate of the NEPAD Centres of Excellence'*.
2. Several recommendations were made, which included (i) further investigation into the existing monitoring system to identify appropriate indicators for the proposed MER Framework, and (ii) not using the term 'junior' to describe individuals with a university degree as it was perceived to be demeaning.
3. The proposed MER plan was inadequate due to the absence of key elements. However, the DWS expressed a willingness to take responsibility for such a plan and the EWSETA expressed its willingness to fund future work to develop the plan. It was clear that the development of such a plan would require collaboration between the key role players in the sector, including the DWS, DHET as well as the EWSETA and LGSETA, to ensure its implementation.

2.3.3 The Netherlands Initiative for Capacity development in Higher Education (NICHE)

The Dutch Government supports efforts to strengthen the institutional capacity for sustainable post-secondary education and training in developing countries. The Netherlands Initiative for Capacity Development in Higher Education (NICHE) is one of the vehicles it uses to achieve this aim.

The NICHE programme provides grants that is administered by the Netherlands Organisation for International Cooperation in Higher Education (NUFFIC) and focuses on 4 policy priorities: food security, water, security and the rule of law, and women's rights and sexual and reproductive health

and rights. These grants aim to support capacity development in higher education and TVET systems in partner countries related to the policy priorities areas.

The first of two NICHE grants awarded to a SA institution was '*Capacity building for Integrated Water Resource Management in South Africa'* (NICHE-ZAF-016-062). The programme started in 2010 and was due for completion in 2014, but a no-cost extension was granted to 2018. The project supported capacity development activities at the Cape Peninsula University of Technology (CPUT) and the UWC to increase the number of individuals with expertise in IWRM.

The project consisted of 11 planned results, clustered into 4 Work Packages (WP). During WP1, CPUT and UWC capacity development was targeted by enrolling staff members in MSc and PhD programmes. WP2 was aimed at strengthening and ensuring the sustainability of IWRM Research Centres at CPUT and UWC, consisting of the Centre for Water and Sanitation Research (CPUT) and the Institute for Water Studies (UWC). Part of WP2 consisted of the development a number of CPD courses based on the outcomes of an IWRM skills assessment. The aim was to register the courses with the host institution, followed by obtaining EWSETA and SAQA accreditation, as well as implementation (piloting) of the courses.

The titles of the CPD courses were as follows:

1. Access to water in rural settings
2. Access to water in urban settings
3. Adaptive strategies for water use and demand management
4. Catchment management strategy implementation
5. Developing water quality monitoring and pollution control plans
6. Environmental remediation for water quality
7. Financial and economic aspects of WRM
8. Integrated risk assessment in catchments
9. Integrated water quality monitoring and assessment
10. Participatory approaches in water demand management
11. Principles of GIS
12. Principles of Remote Sensing
13. Water, gender and development in a South African context
14. Water governance and stakeholder participation
15. Water legislation and policy
16. Water resources planning
17. Web based approaches for participatory water monitoring and management

The third WP focussed on the development of a joint postgraduate IWRM curriculum and diploma programme (NQF 8). This curriculum was based on existing UWC postgraduate diploma programmes and the CPD course material developed in WP2. The fourth WP focussed on developing a cross-cutting strategy for research and training at CPUT and UWC integrated with a learning organization and an equity strategy.

The second NICHE grant was awarded to the Department of Environmental, Water and Earth Sciences at Tshwane University of Technology (TUT) in 2010. The title of the project was '*Enhancing institutional capacity in water and wastewater treatment'* (NICHE-ZAF-009). The aims of project, relevant to this review, were as follows:

1. Revision of existing qualifications at TUT:
    a. National Diploma: Water Care (NQF level 6), including the development of an experiential training component

   b. B Tech: Water Care (NQF level 7)
2. Development of new qualifications, with quality-assurance by the CHE
   a. Postgraduate Diploma in Water Services Management (NQF level 8)
   b. Advanced Certificate in Water/Wastewater Treatment Technology (NQF level 6)
3. Development of four short courses, based on the new and revised qualifications (developed under Aims 1 and 2), for the training of municipal staff. The focus will be on water regulation, operation and maintenance of water/wastewater treatment plants, advanced water/wastewater treatment technologies and the asset management of water networks. On-line versions of these courses will also be developed. However no water-relevant short learning programmes at TUT could be detected during desktop studies by the current research team.
4. The design and implementation of a training programme for DWS trainers on technical and managerial aspects related to water and sanitation, including didactics training.

2.3.4 Orange Knowledge Programme (OKP)

The Orange Knowledge Programme (OKP) is the successor to both NICHE and the Netherlands Fellowship Programmes and is administered by NUFFIC. The main objective of the OKP programme is to contribute to sustainable and inclusive development by developing capacity in TVET and HE institutions. The programmes will provide funding for individual scholarships, group training and institutional projects aimed at capacity building.

Two national water sector-related projects have been awarded OKP funding in the present call for a period of 3 years (2019-2021). The first project '*Strengthening the skills of TVET staff and students to optimise water usage and climate smart agriculture in SA*' (OKP-ZAF-10023) was awarded to the Stellenbosch University's (SU) Faculty of Agriculture and Water Institute and the Maastricht School of Management (lead Dutch partner). The project aims to develop a new national occupational qualification that integrates sustainable and equitable water use with agriculture. To ensure the employability of TVET graduates, the curriculum content will be aligned with the needs of the water and agriculture labour markets and six TVET Colleges will be capacitated to implement the qualification.

The second project '*Bridging the water: co-create to learn and experience sustainable strengthening the South African Water Education and Training Capacity'* (OKP-ZAF-10002) was awarded to the Durban University of Technology (DUT) as lead SA partner, in collaboration with the World Water Academy (Netherlands). The aim of the 3-year project is to implement effective and innovative training methods to bridge the gap between theory and practice in the water sector. This will enable key players in the water value chain to improve water/wastewater management, water services and ultimately the livelihood of citizens. South African project partners include UCT, as well as the City of Cape Town, City of eThekwini, and the SALGA. On-the-job training will be provided to municipal staff in water and wastewater treatment and operation, and municipal staff as well as students at the education institutions (UCT and DUT) will receive formal training via courses on water and wastewater treatment. Alumni of DUT and UCT will receive practical training at living labs.

2.3.5 Kingfisher Programme

The Kingfisher programme is a collaboration between the Netherlands Association of Regional Water Authorities, VNG International (the International Cooperation Agency of the Association of Netherlands Municipalities) and the DWS. The programme was initiated in 2012 in response to a request from the DWS for assistance in the establishment of new CMAs. In practice, this entailed supporting the

establishment, policy development, operationalization, monitoring and evaluation and stakeholder engagement of nine CMAs by the end of 2016. In this programme, SA and Dutch regional water authorities collaborated to exchange information, skills and expertise in joint areas of interest.

The Kingfisher Programme contributed to improved stakeholder engagement and communication at the Berg-Olifants Proto CMA (BOCMA) by providing training in the Mutual Gains Approach. The tool was introduced to BOCMA by the Dutch Water Authority of Delfland during a 3-day workshop. One of the outcomes of this collaboration is the development of an Integrated Water Platform (IWP) for the Berg river to support water management stakeholder decision making.

In collaboration with UNESCO-IHO, the Dutch Water Authority of Delfland facilitated a hydrological monitoring course for employees of the Breede-Gouritz CMA. Staff members were trained on ensuring water balance, monitoring water resources, processing water user license applications, protecting water resources, managing pollution and sampling, thereby enabling better execution of water use management functions. This training has since been extended to other CMAs. Additional training was provided through the introduction of the Best Available Techniques Reference (BREF), which outlines the best existing techniques for wastewater treatment. The material was used to develop a collaborative methodology for the CMA, Municipal authority and industry to ensure proper remediation of industrial wastewater.

The capacity of the Inkomati-Usuthu CMA (IUCMA) staff in the areas of municipal engagement, governance and transboundary water management was strengthened by international staff exchange initiatives and participation in the CEO Forum, facilitated by the Kingfisher programme. The use of HydroNET was piloted at the IUCMA and will be rolled out to all of the CMAs. HydroNET is an online system which links and combines information regarding real-time situations into a personalised dashboard. It allows better decisions to be made for sustainable water resource management by the CMAs.

The Kingfisher programme facilitated a workshop at the Limpopo-North West Proto CMA (LNWCMA) to improve stakeholder engagement, specifically as it relates to municipalities. This led to the further professionalization of its existing Catchment Management Forums where stakeholders meet on a quarterly basis to discuss water-related issues.

A workshop on compliance was held at the Mzimvubu-Tsitsikamma Proto CMA (MTCMA), which enabled the CMA to better understand its role and responsibilities relating to monitoring and enforcing sustainable water use. The MTCMA also highlighted the utility of the CEO Forum as a learning and advisory platform. At the Olifants Proto CMA, a workshop was held to capacitate staff in the management of stakeholder involvement. This has resulted in significant improvements in stakeholder forum participation.

The programme was extended to Phase II, which is due to end in 2020. The aims of the second phase are to improve collaborative governance between local, regional and national government and to engage with relevant sectors such as agriculture and mining, and to increase the capacity of CMAs to deliver on their water regulatory role. Phase II of the Kingfisher Programme may be succeeded by a proposed “Blue Deal” (NUFFIC, 2018).

2.3.6 WaterNet

WaterNet is a subsidiary institution of the Southern African Development Community (SADC) established in 2000 and it consists of a network of higher education, research and training institutions

located in Southern and East Africa that specialise in water. The aim of this network is to establish and develop the technical and institutional capacity in Integrated Water Resource Management (IWRM) through training, education and research. A regional IWRM Masters Degree, introduced in 2002, has become the flagship skills initiative of WaterNet. The Programme is a joint offering by various universities, allowing the students to benefit from specialists in various aspects and introducing a common understanding of core principles of IWRM.

The academic section of the programme consists of 11 modules, subdivided into 3 categories:

1. Preparatory module
2. Core module
3. Specialisation Modules

All three modules are offered by the Universities of Dar es Salaam and Zimbabwe and students may choose to attend specialised modules offered by the Universities of Botswana, KwaZulu-Natal (UKZN), Malawi, Western Cape (UWC) and the Polytechnic of Namibia. It is estimated that more than 400 regional water managers have been capacitated by the various Masters degrees offered by WaterNet and in excess of 600 have attended short professional training courses.

2.3.7 SALGA – South African Local Government Association (SALGA)

SALGA aims to represent, promote and protect the interest of local government / municipalities by supporting its transformation. The association is not a training provider, but outsources these functions to external providers. Recent capacity building initiatives related to the water sector included 1 to 2-day workshops for municipal officials (Blue drop and Green drop water quality requirements as well as Monitoring, regulation and compliance) and municipal councillors (water governance – monitoring and oversight).

SALGA has partnered with the EWSETA and is awaiting the outcome of a 2019/20 Local Government Capacity building plan and funding request for 3 capacity building programmes; Capacity Building Initiatives for Municipal Councillors and Leadership, Capacity Building Initiatives for Graduates or Youth, and an Annual Local Government Water Technology Seminar.

2.3.8 Water Institute of Southern Africa (WISA)

WISA is a voluntary professional body for members of the water community. WISA hosts or co-hosts a number of capacity building initiatives every year, including seminars/symposia, conferences, and site visits or branch/provincial events. The attendance of some of these events can contribute to CPD points for Professionals.

WISA gained official SAQA recognition as a professional body in 2013 and the first SAQA-registered professional designation awarded by WISA was that of Professional Process Controller (2014). The requirements for awarding this designation are as follows:

1. Minimum academic qualification in an appropriate discipline of NQF 6
2. Minimum of 5 years post-graduation work experience in the field of Process Control
3. Has demonstrated competence in a list of occupational tasks

Capacity building initiatives specifically dedicated to the Process Controllers are hosted on an annual basis, including workshops or open days.

The Young Water Professionals (YWP) is a division of WISA for professionals or students under the age of 35. Membership entitles access to various skills development events including conferences, seminars, publication and entrepreneurship workshops and outreach activities.

2.3.9 Institute of Municipal Engineering of South Africa (IMESA)

IMESA promotes the interests of municipal engineers and their profession and aims to expand the knowledge and best practices in all Local Government Municipalities. IMESA offers capacity building short courses as well as an online training option for Municipal Engineers and Engineering Staff including:

1. Sustainable Infrastructure Asset Management (SIAM), which uses the web-based knowledge management system Asset Management Program Learning Environment (AMPLE). The use of AMPLE and associated training programmes was made possible by the contribution of GHD's Global Asset Management Group.
2. Design Guidelines for Small Coastal Stormwater Outlets. This 1-day course is based on guidelines formulated by IMESA and SU and intended to capacitate employees of municipal engineering departments.
3. Capacity Building in Urban and Regional Planning. IMESA and NWU collaborated to produce guidelines underpinning the Planning Profession. The material for this 1-day course was extracted from these guidelines. The aim of the course is to capacitate municipal engineers and engineering staff to engage with planning specialists and planning-related applications by providing a basic understanding of theory, concepts, practices and procedures.
4. New Developments in Water and Wastewater Treatment for Municipal Engineering Personnel. This 3-day short course exposed municipal engineering staff to updated information pertaining to wastewater treatment, as well as sustainable water management topics including water treatment, quality, demand management, disinfection, reclamation and re-use.

2.3.10 SAICE – South African Institute of Civil Engineering

SAICE is a voluntary association with the aim of '*advancing professional knowledge and improving the practice of civil engineering*'. One of the functions of SAICE is to provide members with continuing education in technical, managerial and communication skills and formed the Civils Masakheni organisation to promote skills development for civil engineers, civil engineering technologists and technicians.

SAICE has ECSA approval to accredit and/or offer CPD activities, and the responsibility of validation lies with the SAICE Education, and Training panel. A range of SAICE-approved CPD courses relevant to the water sector are on offer.

2.3.11 Consulting Engineers South Africa (CESA)

The School of Consulting Engineering (SCE) offers CPD-accredited short courses and accredits external service providers' training activities, including seminars, courses and workshops. Topics of these courses include Contracts, Procurement and Supply Chain Management, Quality and Risk Management, Occupational Health and Safety, Professional Registration, Management, Leadership and Finance, and Project Management, etc.

2.3.12 North West University (NWU)

The Centre for Environmental Management at NWU has offered a number of short learning programmes over the last 2 decades. Three of these courses, relevant to the water sector, are as follows:

1. Environmental law (Proposed NQF-level of 7) aimed at providing training regarding the legal aspects / requirements of environmental management to operational and management personnel. This 5-day course is registered with ECSA and SACNASP for CPD accreditation.
2. Environmental law – integrated water resource management (Proposed NQF-level of 6) provides training in the principles of national water and water-related legislation as well as practical guidance on workplace implementation of the legislation. This 5-day course is registered with ECSA and SACNASP for CPD accreditation.
3. Water quality monitoring (Proposed NQF-level of 6) course, which assists environmental managers in understanding the principles, methodology and application of chemical, hydrological, and microbiological water quality monitoring. It furthermore aids in the development of water quality monitoring programmes and translation of monitoring data into effective decision-making / management information. This 3-day course is registered with ECSA and SACNASP for CPD accreditation.

2.3.13 Rhodes University (RU)

The Institute for Water Research at RU offers a Learning Programme in Operationalising Integrated Water Resource Management (IWRM) to individuals in government or private institutions. The targeted beneficiaries include employees of Catchment Management Agencies, water use authorities, those responsible for water quality or development of water policy.

The learning programme consists of six modules, ranging in duration from 4 to 5 days each, with a RU certificate of competence awarded upon successful completion of each module and an associated assignment.

Applicants can apply for one or more of the following six modules:

1. Adaptive IWRM: the key to effective operations
2. Environmental water quality (EWQ)
3. Eco-classification and environmental water requirement
4. Linking resource-directed-measures (RDM) and source-directed-control (SDC) to water policy and strategy
5. Hydrological modelling using SPATSIM and modified Pitman model
6. Modelling the ecological reserve using Revised Desktop Reserve Model (RDRM)

The Environmental Learning and Research Centre of RU was the lead partner in the Green Skills Project, which ended in 2018. The project was initiated by the Environmental Skills Planning Forum chaired by the Department of Environmental Affairs. WITS, UCT, UWC, the Centre for Researching Education and Labour, the African Climate and Development Initiative and WWF-South Africa were key implementation partners, while the DBS) and the National Research Foundation (NRF) providing funding. The aim of this initiative was '*to build national capacity to better integrate and plan for green skills development, with a particular focus on post-school skills development*'.

2.3.14 Stellenbosch University Water Institute (SUWI) – EWSETA Collaboration

The collaboration between EWSETA and the Stellenbosch University Water Institute (SUWI) to '*create synergy to address skills mismatch, shortage and upgrade in the Energy and Water Sector*' is the result of a Memorandum of Understanding (MoU) between the two institutions. The intent of the MoU is to conduct focused skills planning research to:

1. Ensure high quality programme delivery
2. Equip students with experiential workplace learning to enhance their employability
3. Facilitate community outreach programmes
4. Submit joint proposals to the National Skills Fund (NSF) addressing unemployed graduates, and
5. Share best practices

During the first phase of the collaboration (2013-2014), SUWI analysed the educational needs of TVET College lecturers in response to the recognised gap in intermediate and artisanal skills in the water sector. The focus of the analysis was limited to Process Controllers since this qualification spans across various sectors and skills sets in the water and wastewater industry.

The key findings of the first phase of the project were as follows:

1. A lack of sector-appropriate courses offered by TVET colleges; specifically related to water and wastewater treatment, process plant operations and chemical plant operations,
2. A mismatch in the emphasis placed on the same skills by TVET college lecturers in the classroom and those required by employers (such as Water Services Providers) in the workplace, and
3. A deficiency in appropriate qualifications or practical experience of TVET college lecturers as it relates to the course material.

These factors contributed to employers providing non-accredited, in-house training with often poor articulation possibilities (SUWI-EWSETA, 2014).

The key recommendations emanating from this report were the following:

1. Up-skilling and re-skilling of TVET College lecturers by developing and implementing Short Courses and CPD initiatives.
2. Developing a new qualification to ensure the long-term, sustained output of qualified TVET College lecturers as well as providing Process Controllers an alternate path for articulation.
3. Supporting the development of learning materials and investment in infrastructure for improved course delivery at TVET Colleges.
4. Assisting TVET Colleges in building long-term relationships with municipalities or private industry to support practical or workplace training opportunities.
5. Communicating the need for skilled TVET lecturers to senior local government officials by developing and implementing a Short Course on good water governance (SUWI-EWSETA, 2014).

During the second phase of the EWSETA-SUWI collaboration (2016-2019), the TVET College Lecturers Capacity Building Programme was initiated. This involved the development and implementation of Short Courses to up-skill or re-skill TVET College Lecturers and Municipal Process Controllers, as well as the development and registration of a new Occupational Qualification: Water Works Management Practitioner. The main functions of a Water Process Management Practitioner is to manage, operate, maintain, control, assess and monitor the unit processes at water service works to produce potable water and treat wastewater, as well as managing the associated waste streams under the authority of

water service institutions. Following several workshops with a community of expert practitioners, the Occupational Qualification Water Works Management Practitioner (NQF level 6) was submitted to the QCTO in March 2018 for review, placement for public comment and submission to SAQA. The qualification was subsequently submitted to SAQA for registration in June 2019.

The three Short Courses were registered with the SU Short Course Division. The SU School for Public Leadership (SPL) was involved in development and facilitation of the Water Governance for Water Leaders Short Course. The topics covered by the Short Courses are aligned with the curriculum content of the Occupational Qualification, but due to the policies of the Short Course Division at SU, the credits cannot be transferred to an external qualification.

2.3.15 Stellenbosch University (SU)

The SU short course division offers a number of water sector relevant short courses. These courses are developed and facilitated by various Departments within SU, including the Departments of Civil Engineering and Genetics, including those developed by SUWI in collaboration with EWSETA. Of specific relevance are the following Short Courses offered by the Department of Civil Engineering:

2.3.16 University of the Free State (UFS)

The Centre for Environmental Management at the UFS recently collaborated with the Technische Universität Dresden (Germany) in presenting a Summer School on aquatic monitoring to industry or government professionals as well as postgraduate students. The title of the Summer School was Monitoring surface water quality: General framework, methods, tools and strategies and took place in Bloemfontein from 24 to 29 March 2019. The VolkswagenStiftung provided funding, including 25 bursaries to full time postgraduate students and subsidized registration to government or industry participants.

2.3.17 University of the Western Cape (UWC)

Besides the involvement of UWC in key sector initiatives, including FETWATER, ACEWater2 and NICHE projects, the Institute for Water Studies is involved in a number of research projects with associated opportunities for building capacity amongst postgraduate students. An example is the Heuningnes Catchment Research Project, which funded the installation of hydrological monitoring sites/living research laboratories. In total, 38 postgraduate students (14 Honours, 23 Masters and 1 Doctoral) benefited from access to these sites and two technical officers were trained in equipment installation and monitoring.

2.4 Short Course Targets

As part of the road mapping process, investment requirements to carry out Research Development and Deployment (RDD) programme per year is presented in WRC (2015) and is mapped against seven clusters of needs and interventions relating to supply and demand for the water community. The greatest investment requirements as depicted in Figure 2 are in Cluster 1 (Increase ability to make use of more sources of water, including alternatives) and Cluster 6 (Reduce losses and increase efficiency of productive use).

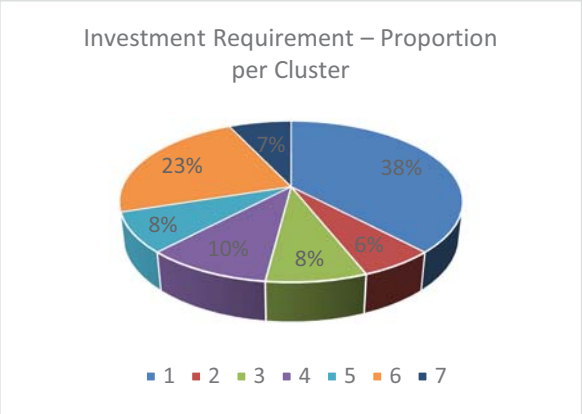


Figure 2: Investment requirement – proportion per cluster (WRC, 2015)

2.5 Short Course Good Practice

The CHE (2016) state that, by and large, countries with similar education systems to South Africa (including Australia, the United Kingdom, and Belgium) follow a dual approach to the quality assurance of short courses. On the one hand, these countries have accrediting bodies that regulate the provision of short courses by training providers that are not HEIs. In South Africa, this role is undertaken by the various SETAs. On the other hand, HEIs have their own internal quality assurance mechanisms, but the frameworks and guiding documents for implementation are provided by the external quality assurance body.

The CHE (2016) provides guidance for HEIs offering short courses with the following minimum requirements:

- Institutional policy framework;
- Effective short course coordination and governance structures;
- Processes and procedures for course design and development;
- Systems for course approval and registration;
- Rules and regulations pertaining to course marketing, recruitment and registration of participants;
- Adequate teaching and learning resources, and appropriate processes;
- Assessment strategy and procedures;
- Certification arrangements;
- A system of records management; and
- A system for monitoring and review as a basis for continuous improvement.

3 METHODOLOGY

3.1 Database and Stakeholder Consolidation

The first step of the study was the identification of a targeted set of stakeholders to ensure high-quality engagement and feedback could be obtained and used to inform the research objectives.

The stakeholder database was filtered for two sets of engagements namely: a) obtaining advice and input on the desktop review and questionnaire development (outlined below) and b) research and innovation-related short course data collection.

The database for the initial engagements seeking advice and input included two selections of stakeholders; one group that offer short courses, and another group who pay for staff to attend short courses. Stakeholders such as Human Resource Managers or Skills Development Facilitators that coordinate staff to attend short courses from organisations such as Water Service Providers (WSPs), DWS, Department of Environmental Affairs and Development Planning (DEA&DP), Catchment Management Agencies (CMAs), and Water Boards were considered.

The larger database for short course data collection, which was shared with the Reference Group for input and review, consisted of key organisations and relevant staff within these organisations including:

- HEIs that offer short courses as part of their business model, as well as short courses derived from research activities and as outputs of externally funded programs (e.g. Netherlands Universities Foundation for International Cooperation (NUFFIC), Netherlands Initiative for Capacity Development in Higher Education (NICHE), Orange Knowledge Program (OKP), and Tailor-Made Training (TMT)).
- Professional bodies and associations, for example, the SAICE, WISA, IMESA, and the IOPSA, are involved in short courses for the professionalisation of practitioners.
- Research and innovation specialist organisations who offer training in the water and RDI landscape and who, in some cases, have partnerships with HEIs. For example: the International Water Management Institute (IWMI), the International Groundwater Resource Assessment Centre (IGRAC), South African Environmental Observation Network (SAEON), UNESCO-IHE Institute for Water Education, South African Institute for Advanced Material Chemistry (SAIAMC), South African Network for Biosciences (SANBio), Southern African Science Service Centre for Climate Change and Adaptive Land Management (SASSCAL), WaterNET, and NEPAD Water Centre of Excellence.

The organisations in the water sector identified for this study are listed in Table 1.

Table 1: HEIs, Professional Bodies, and Research and Innovation Specialists in the South African Water Sector Identified in this Study

	Institution
	HEIs
1	Cape Peninsula University of Technology (CPUT)
2	Central University of Technology (CUT)
3	Durban University of Technology (DUT)
4	The Independent Institute of Education (IIE MSA) (Previously Monash SA)
5	Limpopo University (LU)
6	Mangosuthu University of Technology (MUT)
7	Nelson Mandela Metropolitan University (NMMU)
8	North West University (NWU)
9	Rhodes University (RU)
10	Sefako Makgatho Health Science University (SMU)
11	Sol Plaatje University (SPU)
12	Stellenbosch University (SU)
13	Tshwane University of Technology (TUT)
14	University of Cape Town (UCT)
15	University of Free State (UFS)
16	University of Fort Hare (UFH)
17	University of Johannesburg (UJ)
18	University of KwaZulu-Natal (UKZN)
19	University of Mpumalanga (UMP)
20	University of Pretoria (UP)
21	University of South Africa (UNISA)
22	University of Venda (UNIVEN)
23	University of Witwatersrand (WITS)
24	University of the Western Cape (UWC)
25	University of Zululand (UNIZULU)
26	Vaal University of Technology (VUT)
27	Walter Sisulu University (WSU)
	Professional Bodies
1	Association of South African Quantity Surveyors (ASAQS)
2	Engineering Council of South Africa (ECSA)
3	Consulting Engineers South Africa (CESA)
4	Institute of Landscape Architecture of South Africa (ILASA)
5	Geological Society of South Africa (GSSA) (Groundwater division)
6	Institute of Municipal Engineering of Southern Africa (IMESA)
7	Institute of Plumbing South Africa (IOPSA)
8	South African Council for the Landscape Architectural Profession (SACLAP)
9	South African Council for Natural Scientific Professions (SACNASP)
10	South African Institute of Agricultural Engineers (SAIAE)
11	South African Institute of Civil Engineers (SAICE)
12	Southern African Asset Management Association (SAAMA)
13	Water Institute of Southern Africa (WISA)
	Research and Innovation Specialist Organisations
1	Agricultural Research Council (ARC)
2	Cap-Net
3	Council for Scientific and Industrial Research (CSIR)
4	Institute of Natural Resources (INR)
5	International Groundwater Resource Assessment Centre (IGRAC)
6	International Water Management Institute (IWMI),

	Institution
7	South African Environmental Observation Network (SAEON)
8	South African Institute for Advanced Material Chemistry (SAIAMC),
9	South African Network for Biosciences (SANBio)
10	Southern African Science Service Centre for Climate Change and Adaptive Land Management (SASSCAL)
11	The Water Academy
12	World Wide Fund for Nature (WWF)

The individual stakeholders or staff within these organisations included:

- Those conducting quality assurance oversight and management functions within HEIs.
- Short course creators that perform the necessary scoping and profiling exercises in the design of short courses.
- Short course facilitators or trainers.

These organisations and stakeholders were mapped through a desktop study and additional filtering of respondents sourced from the surveys related to research study volume 1 (Update RDI Roadmap Capability Map), and research study volume 2 (postgraduate map analysis).

3.2 Data Collection

The collection of data was achieved through a desktop review between April and June 2020, an online questionnaire in August/September 2020, and interviews in August 2020 as outlined below. Data was carefully cross-checked with literature and with input from various role-players within specific organisations and institutions.

3.2.1 Desktop Review

A preliminary desktop study of short courses as per the delineations stated above was listed in a spreadsheet forming the foundation of the data set. Organisations and institutions such as HEIs, professional bodies and associations, specialist research, and innovation specialist organisations involved in short course training in the water landscape in South Africa were targeted. The data set includes the course name, the organisation offering the course, the course objective, and the primary target audience.

3.2.2 Questionnaire Development

Engagements with identified stakeholders (as discussed above) took place to gain insight into what might be useful information for their purposes to inform the questionnaire, data analysis, and reporting. Insight into what indicators could be used to measure short course impacts and successes were also sought.

Primary data on available short courses were collected through an online questionnaire (see Appendix A for survey sample) which was circulated to the various individuals and organisations listed in the short course stakeholder database. Efforts were made to keep the questionnaire user-friendly, accessible, and quick-to-complete in order to maximise response rates. A social science specialist gave input into the design of the questionnaire and it was distributed to the reference group for further review. The following points guided the development of appropriate questions for the questionnaire:

- The inclusion of specific objectives, focus areas, and outcomes of the short courses;
- Understanding emergent knowledge that is shifted into the sector;
- Gaining insight into the structure (duration, registration cycle, accreditation, assessment type) and mode of implementation (face to face, online, self-paced) of short courses;
- Understanding the intended target market/s (including target industry/sub-sector, qualification level, years of experience, employment band);
- Gauging the impact and successes of short courses by investigating the frequency of the offering, student feedback, the number of enrolments, and percentage completion;
- Identifying lessons learnt;
- Gaining insight into the drivers for the creation and offering of new courses on both the supply and demand sides.

Questionnaire data was also used in understanding trends and strategies for future short course implementation, while emergent themes were identified for inclusion and further investigation in a series of interview sessions (discussed below).

3.2.3 Semi-Structured Interviews

Using an online platform, semi-structured interviews were conducted with identified stakeholders including course creators, course presenters, and quality assurers across a broad spectrum of institutions and organisations and geographical locations to validate and triangulate the information generated through the online questionnaires.

The semi-structured interviews provided the opportunity to obtain, explore, and unpack additional information and key themes that emerged during the questionnaire process. The guidelines for the interview sessions can be found in Appendix B.

3.3 Verification

To verify and validate the data obtained through the desktop study and online survey questionnaire, a verification process was undertaken during the scheduled semi-structured interviews. Additional verification emails were sent to identified stakeholders performing quality assurance oversight and management functions within the identified organisations.

3.4 Data Analysis

The raw data and information collected were grouped according to the types of short courses being conducted in the sectors nationally, and a comprehensive analysis of opportunities, overlaps, and gaps was undertaken. The findings in this study from both an operational and strategic standpoint were compared to a desired future state in terms of the sector needs and the roadmap targets (WRC, 2015). Recommendations were then formulated around bridging the identified gaps.

A second activity was to understand how this fit in relation to the seven Roadmap clusters. For consistency across all volumes in this project, the adjusted clusters as depicted in Table 2 were utilised.

Table 2: Clusters of needs and intervention: WRC (2015) and current project.

No	Clusters WRC (2015)	Adjusted Clusters for current project
1	Increase ability to make use of more sources of water, including alternatives	Increase ability to make use of more sources of water
2	Improve governance, planning and management of supply and delivery	Governance, planning, and management of supply and demand
3	Improve adequacy and performance of supply infrastructure	Adequacy and performance of supply infrastructure and operational performance (Built infrastructure).
		Adequacy and performance of supply infrastructure and operational performance (Ecological infrastructure / ecosystems)
4	Run water as a financially sustainable "business" by improving operational performance	Running the water sector as a smart business
5	Improve governance, planning, and management of demand and use	
6	Reduce losses and increase efficiency of productive use	Efficiency use of water (Agriculture, industry, and consumers)
7	Improve performance of pricing, monitoring, billing, metering and collection	Monitoring and metering

3.5 Reporting

A detailed technical report including a literature review, a results/data matrix, data analysis, and gap analysis was compiled with the target audience in mind. A user-friendly and visual online summary tool was designed in conjunction as an accessible sector communication deliverable, which could be found at www.wrc.org.za. This will facilitate professional practitioners, prospective students, water sector organisations (e.g. Water Utilities, WRC, HEIs, Research and innovation specialist agencies, Local Government, National Government such as the DWS, SMMEs, SETAs, professional bodies, to interpret, evaluate, and to coordinate training options and priorities.

The following linkages have been made:

- Short courses and their alignment with research, innovation, new technologies, and commercial activities that allow for the opportunity to expose practitioners to emerging trends;
- Short course linkages with a formal degree and occupational programs;
- Short courses and linkages with continuous professional development;
- Understanding trends that can be observed and strategies for future short course implementation;
- Understanding gaps, overlaps, and opportunities of the short course landscape.

4 RESULTS

The following chapter discusses the results of the data collection and verification processes that inform this short course skills landscape.

4.1 Database and stakeholder identification Results

In the study, a total of 10 stakeholders in human resource management and skills deployment positions at HEIs, Local Government, Private Industry and CMAs were identified and approached for advice and input on the desktop review and questionnaire development. Of these, stakeholders that provided input were from Rand Water, IOPSA, Breede Gouritz Catchment Management Agency (BGCMA), Swellendam Local Municipality, Drakenstein Local Municipality, and Knysna Local Municipality.

A further 278 stakeholders were identified from the listed institutions as per Table 1 for research and innovation related data collection. These stakeholders included: those conducting quality assurance oversight and management functions within HEIs, short course creators and short course facilitators/trainers.

4.2 Desktop Study Results

118 unique water-related short courses for the 2015 to 2020 period were identified through the desktop study. It is evident that short courses have been undertaken at 14 HEIs (CPUT, DUT, NMMU, NWU, RU, SU, UCT, UFS, UKZN, UMP, UP, UNISA, WITS, and UNIVEN), five professional bodies (IMESA, SAAMA, SAIAE, SAICE, and WISA) and three research and innovation specialists (ARC, CAP-NET and the Water Academy).

The desktop study results can be found in Appendix C.

4.3 Online Questionnaire Results

While the response rate for the questionnaire was relatively low (36 responses/ <14%), there was a broad representation from key organisations. 60% of respondents were from the public sector, with the remainder from HEIs, the private sector, and the semiprivate sector and non-governmental organisations. 70% of respondents indicated involvement in the development or offering of water-sector-related short courses. Specific roles with regards to short courses are indicated in Figure 3, with around 50% of respondents being short course creators and/or facilitators.

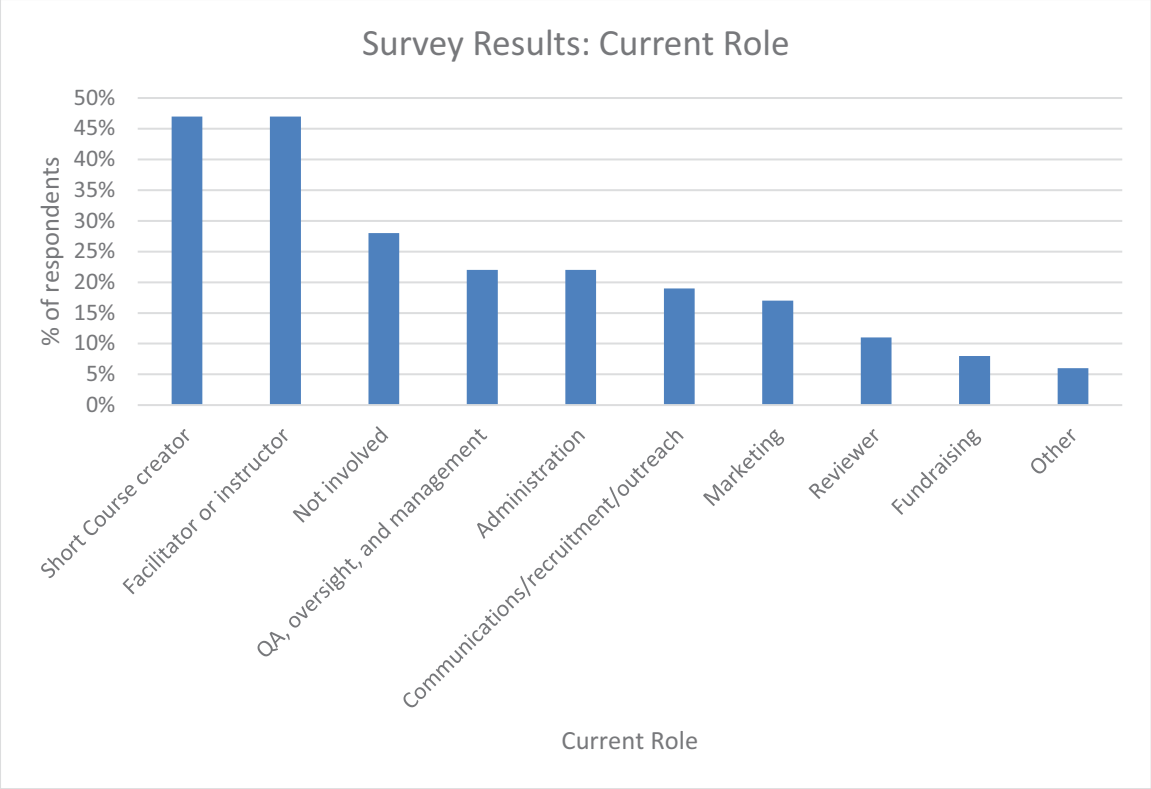


Figure 3: Questionnaire Results – Specific Short Course Roles of Respondents

27 short courses were listed in response to the survey. The list of these short courses can be found in Appendix D (including course name, institution, objective and accreditation). Listings marked with an asterisk (*) are unique (i.e. were not identified as part of the desktop study (Appendix C)). This translates to an additional 16 short course offerings and additional short course training providers including Green Cape, Gerald de Jager (Pty) Ltd, Chris Swartz Water Utilisation Engineers (CSWUE) and Water Utilities Corporation.

4.4 Semi-Structured Interview Results

Of the 29 stakeholders approached from the various HEIs, professional bodies and Research and Innovation institutions, the following semi-structured interviews were held:

Table 3: Results: Semi-structured Interviews

Institution	Participants	Date
University of Cape Town	Dr. Kirsty Carden (Future Water)	26 August 2020
North West University	Dr. Wynand Malherbe (Senior Lecturer Aquatic Health)	12 August 2020
University of Stellenbosch	Professor Heinz Jacobs (Associate Professor Civil Engineering and Head of Department)	19 August 2020
University of Free State	Dr. Francois Fourie (Institute for Groundwater Studies)	21 August 2020
University of KwaZulu-Natal	Professor Chris Buckley (Pollution Research Group)	20 August 2020
Water Institute of South Africa	Ms. Anita Pillay (Training and accreditation manager)	4 August 2020

4.5 User-friendly Summary Tool

The visual summary tool was created as an online tool based on the findings of the desktop study and questionnaire (see Appendix C and Appendix D). The tool was designed to be user friendly, dynamic and will be an accessible management summary for the short course sector. The on-line dashboard tool can be found www.wrc.org.za.

4.6 Verification

In addition to a verification process that was undertaken as part of the semi-structured interviews (see Table 3), verification emails were sent out on 3 December 2020 to quality assurance stakeholders at RU, UKZN, CPUT, UCT, SU, WITS, NWU and UFS. Verification responses were received from UCT and CPUT.

5 DATA ANALYSIS

5.1 Desktop Study and Questionnaire: Short Course Offerings

Table 4 is a summary of the short course offerings per institution (see Table 1) from 2015 to 2020 as identified through both the desktop study and the online questionnaire. Each short course was mapped to the WRC (2015) clusters of needs and interventions (see Table 2).

Table 4: Short course offerings and cluster allocation as identified through the desktop study and online questionnaire

Institution		No. of short courses	Cluster 1	Cluster 2	Cluster 3	Cluster 4	Cluster 6	Cluster 7
HEIs	CPUT	6	1	5	0	0	0	0
	CUT	0	0	0	0	0	0	0
	DUT	2	0	2	0	0	0	0
	IIE MSA	0	0	0	0	0	0	0
	LU	0	0	0	0	0	0	0
	MUT	0	0	0	0	0	0	0
	NMMU	1	1	0	0	0	0	0
	NWU	4	0	2	1	0	0	1
	RU	4	0	4	0	0	0	0
	SMU	0	0	0	0	0	0	0
	SPU	0	0	0	0	0	0	0
	SU	17	1	5	11	0	0	0
	TUT	0	0	0	0	0	0	0
	UCT	13	0	3	8	0	2	0
	UFS	3	0	0	3	0	0	0
	UFH	0	0	0	0	0	0	0
	UJ	0	0	0	0	0	0	0
	UKZN	1	0	1	0	0	0	0
	UMP	1	1	0	0	0	0	0
	UP	14	0	5	5	1	2	1
	UNISA	1	0	1	0	0	0	0
	UNIVEN	2	0	1	1	0	0	0
	WITS	3	0	3	0	0	0	0
	UWC	0	0	0	0	0	0	0
	UNIZULU	0	0	0	0	0	0	0
	VUT	0	0	0	0	0	0	0

Institution		No. of short courses	Cluster 1	Cluster 2	Cluster 3	Cluster 4	Cluster 6	Cluster 7
	WSU	0	0	0	0	0	0	0
Research and Innovation Specialists	ARC	6	3	0	3	0	0	0
	CAP-NET	7	1	6	0	0	0	0
	CSWUE	1	0	0	0	0	1	0
	CSIR	0	0	0	0	0	0	0
	INR	0	0	0	0	0	0	0
	Green Cape	1	1	0	0	0	0	0
	Gerald de Jager	3	0	3	0	0	0	0
	IGRAC	0	0	0	0	0	0	0
	IWMI	0	0	0	0	0	0	0
	SAEON	0	0	0	0	0	0	0
	SAIAMC	0	0	0	0	0	0	0
	SANBio	0	0	0	0	0	0	0
	SASSCAL	0	0	0	0	0	0	0
	Water Academy	6	0	0	6	0	0	0
	Water Utilities Corporation	1	0	0	1	0	0	0
	WWF	0	0	0	0	0	0	0
Professional Bodies	ASAQS	0	0	0	0	0	0	0
	CESA	0	0	0	0	0	0	0
	ECSA	0	0	0	0	0	0	0
	ILASA	0	0	0	0	0	0	0
	GSSA	0	0	0	0	0	0	0
	IMESA	8	2	2	3	0	1	0
	IOPSA	0	0	0	0	0	0	0
	SACLAP	0	0	0	0	0	0	0
	SACNASP	0	0	0	0	0	0	0
	SAAMA	5	0	4	1	0	0	0
	SAIAE	2	0	1	1	0	0	0
	SAICE	7	0	4	3	0	0	0
	WISA	15	1	3	8	0	2	1
	Total	134	12 9%	55 41%	55 41%	1 1%	8 6%	3 2%

A total of 134 water-related short courses were identified in both the desktop study and questionnaire. The institutions with the most short course offerings include: SU (17), WISA (15), UP (14) and UCT (13).

HEIs not currently offering any water-related short courses include: CUT, LU, IIE MSA, MUT, SMU, SPU, TUT, UFH, UJ, UWC, UNIZULU, VUT, and WSU; with the majority of these institutions classified as “previously disadvantaged”.

Professional bodies (as identified in Table 1) not offering water-related short courses include ASAQS, CESA, GSSA, ILASA, IOPSA, SACLAP, SACNASP, and ECSA. It should be noted, however, that ECSA (while a role-player) performs a statutory function within the engineering fraternity, with SAICE being a voluntary association striving to advance knowledge and improve the practice of civil engineering.

Of the specialist research and innovation organisations that were identified in this study, those not offering water-related short courses as per the methodological process (see section 3.2) include the IWMI, IGRAC, SAEON, SANBio, SAIAMC, WWF, and SASSCAL.

54% of the identified water-related short courses are offered by HEIs, 28% by professional bodies and the remaining 19% by research and innovation specialists.

Of the 134 short course offerings, 102 are current (i.e. still being presented) with 32 offered previously within the 2015 to 2020 period but no longer being presented (see Appendix C). The possibility of previously offered short courses no longer listed online is, however, taken into consideration.

The outright majority of short course offerings address Clusters 2 [*Governance, planning and management of supply and demand*] and Cluster 3 [*Adequacy and performance of supply infrastructure and operational performance (Built infrastructure/Ecological infrastructure/ecosystems)*]. The least number of short course offerings address Cluster 4 [*Running the water sector as a smart business*] and Cluster 7 [*Monitoring and metering*]. The institutions offering short courses in the broadest range of clusters are UP and WISA.

5.1.1 Short Course Groupings

The short course findings were grouped according to Research Focus Areas (RFAs) as listed in WRC (2015) based on the broad theme of the short course objectives. The number of short courses per RFA are depicted in the graph in Figure 4.

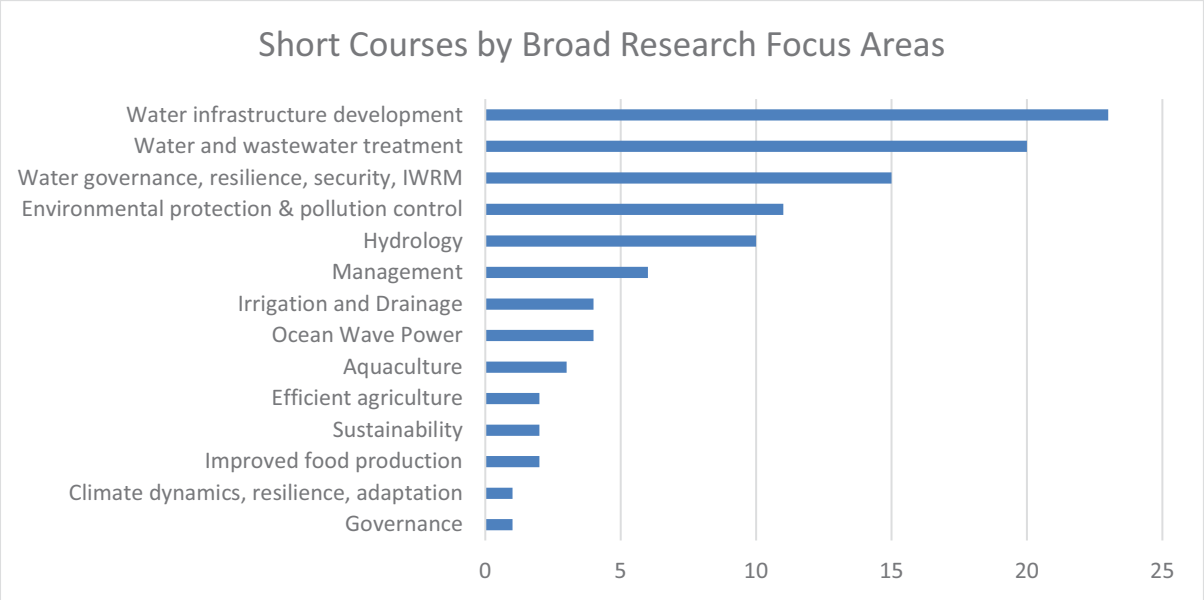


Figure 4: Short courses by broad themes/research focus areas

The bulk of the water-related short course offerings cover the broad themes of water infrastructure development, water and wastewater treatment, and water governance, resilience, security, and IWRM.

5.2 Questionnaire and Desktop Study: Short course target audience and industry

An analysis of the target audience from short courses identified in the desktop study and questionnaire indicates unique titles as listed in Table 5. It is evident that there are gaps and overlaps in terms of title descriptions due to a lack of consistency (e.g. researcher versus academic, local government versus a municipal official). It is further evident that while years of experience/employment band is at times implicit (e.g. mid-level professional, junior engineer), it is very seldom listed and is not standardised.

Table 5: Desktop and Questionnaire Results – Short Course Target audience: Unique Titles

Target Audience		
General	**Technical**	**Government**
Industry role players	Process Technologists	Local government, provincial or central government managers
Managers	Plant operators	Employed in local government
Decision-makers	Technical Manager	Local Authorities
Port Users	Technologist	Government Agent
Water Leaders	Maintenance Personnel	Policy Makers
Persons in the planning, design, and management	Process controllers	Technical staff at municipalities
Staff members of the built environment	Superintendents	Government Officials
Civil society	Plant managers	Municipal Officials
Regulated Community	Wastewater treatment works staff	Bulk Water Suppliers
Those with a basic knowledge of the water sector	Plant technicians	Municipal Personnel
Intermediaries	**Other professionals**	Departmental Officials
Practitioners involved in stakeholder relationships in water sector	Professional 3-year bachelor's degree/Advanced Diploma/Equivalent Qualification	**Other**
Service Providers	Consultant	Rural and Smallholder farmers
Water Users	Asset Managers	Non-Governmental Organisations
Private Entrepreneurs	Officials of the custodian of water resources & regulators	Community development practitioners
Science	Lawyers	Community-based organisations
Water Quality Practitioner	Food scientists	Those working in food production environment
All persons involved with the advancement of scientific knowledge	Food safety professionals	Farmers
Environmentalists	Food safety auditors	Prospective Farmers
Environmental Manager	Mining Planners	Extension Officers from the Department of Agriculture
Environmental Practitioners	Mining Executives	**Engineering**
Scientists	Mid-level Professionals	Engineers
Hydrologist	Port Planners	Chemical Engineers
Environmental Scientist	Water sector officials	Process Engineer
Hydrogeologist	Officials involved in the treatment of water	Municipal Engineer
Soil Scientist	Water quality managers	Junior engineers
Academia	Risk professionals	Geotechnical Engineers
Academics	Risk consultants	Engineering Professionals
Postgraduate Students	Assessors	Qualified Civil Engineers (Professional 4-yr bachelor's degree/Bachelor Honours degree/Equivalent Qualification)
Lecturers	Moderators	Port Engineers
Lecturers at TVET colleges and universities	Supervisors	Installation Engineers
Researchers	Health and Safety Managers	Consulting Engineers
TVET College Lecturers	Mining personnel and consultants	Candidate Engineers, technologists, technicians
	Water Resources Planner	Maintenance Engineer
	Professional in management and planning in public and private sector	Application Engineers
	Water Resource Managers	Mining Engineer
	Water Use Practitioners	Engineering Geologist
	Water Professionals	
	Young Water Professionals	
	Water Sector Professionals	

The short course target audiences as identified in the desktop study broadly include engineers, scientists, and other professionals, technical staff, researchers, managers, non-governmental organisations, government officials, those working in food production, and agriculture. Certain audiences that operate in the water space such as Landscape Architects are notably omitted.

The short course target industries include agriculture, engineering, mining, national and local government, legal professionals, water boards and utilities, community-based organisations, and institutions involved in water-related research. ‘

These findings are in alignment with the questionnaire results where, as per Figure 5 and Figure 6, it is evident that the key target audiences are professionals of various experience bands and technical staff mostly in the RDI, engineering, and water board/utilities sectors. This is in alignment with the desktop study findings (see Section 5.2).

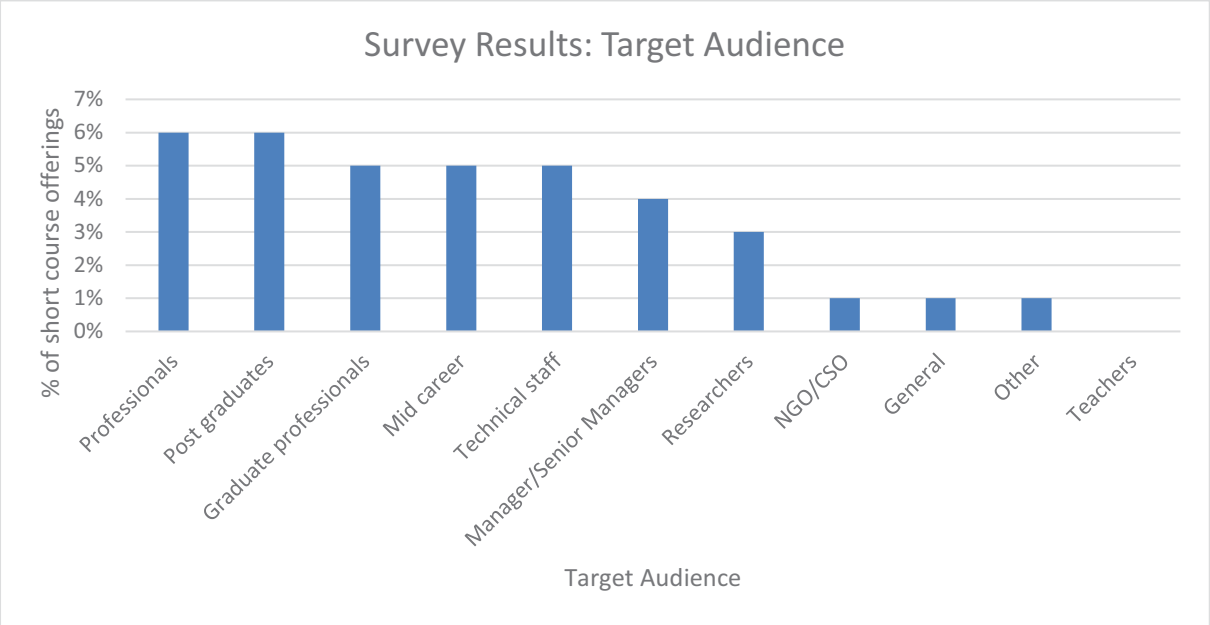


Figure 5: Online Survey Questionnaire Results: Target Audience

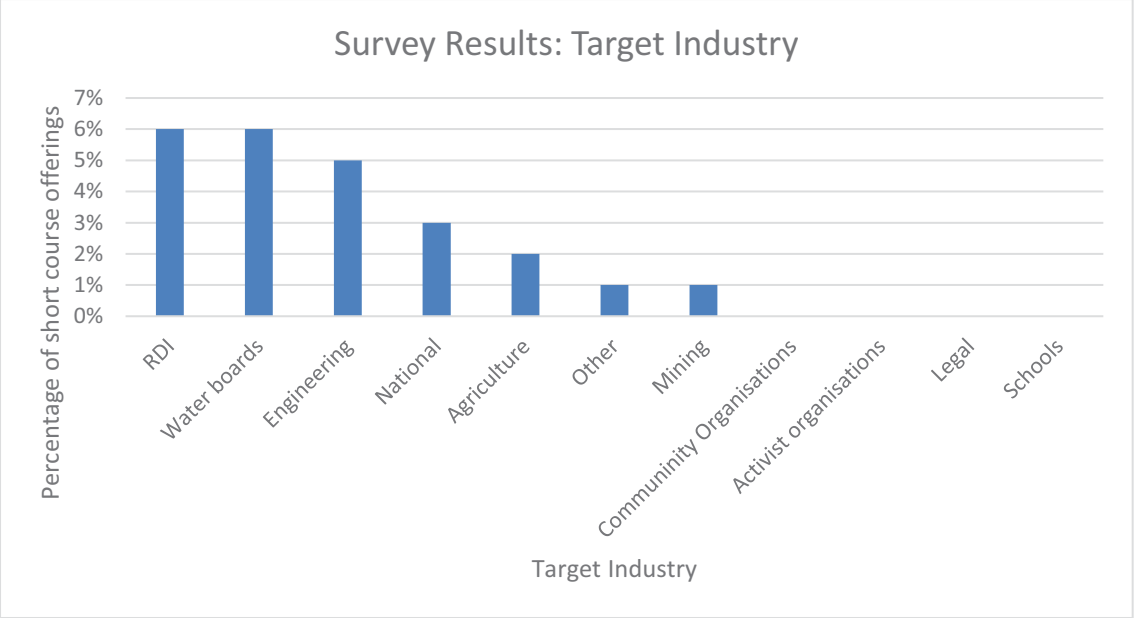


Figure 6: Online Survey Questionnaire Results: Target Industries

5.3 Questionnaire Results: Accreditation

27 short courses were listed in response to the survey (see Appendix D), of which 70% are accredited or in the process of being accredited either for CPD or against a formal or academic programme. Accrediting bodies listed included ECSA, SACNASP, South African Irrigation Institute (SABI), or internal accreditation by HEIs. 60% of respondents stated that their short course offerings did not have admission requirements.

5.4 Questionnaire Results: Short course structure and mode of implementation

The following summary table provides insight into the structure and mode of implementation of the listed short courses as identified in the questionnaire.

Table 6: Summary of short course structure and mode of implementation

Short Course Structure	Findings
Duration	**86%:** 1 day, 2 days or 3-5 days
Frequency	**4%** not yet implemented **11%** once-off **22%** on demand **11%** once a year **30%** twice a year **22%** biennial
Delivery mode	Majority classroom-based or blended, with 77% of respondents indicating that the course could be offered online.
Additional Activities	**13%** of the short courses offer additional activities (e.g. practical work, field trips, panel discussions, internship)
Assessment	**14%** of the short courses are assessed by either essay, assignment, exam, presentation, or portfolio.

5.4.1 Questionnaire Results: Short course marketing and evaluation

Table 7 provides a summary of responses from the open-ended survey questions on short course marketing and evaluation.

Table 7: Survey response summary: Open-ended questions

Topic	Summary of Responses
Reasons for institutions/organisations entering the short course environment	• Capacity-building and empowerment. • CPD purposes. • Postgraduate studies. • Skills development. • Inclusion of new technologies. • Additional income stream for postgraduate programmes. • Ethical training opportunities for postgraduate students. • Potential service to external parties other than registered students and staff. • Relevant applied qualifications, lower cost than a full degree.
Lessons learnt from offering short courses	• Administration heavy processes particularly involving candidates from other institutions. • Building municipal engineering capacity. • Departments should be capacitated with resources to do short courses regularly. • Accreditation processes should be efficient. • Short courses offer a favoured means for professional development, they are often supported by experienced professionals. This, in turn, provides an excellent opportunity for sharing ideas, experiences and new methodologies. • Need buy-in of relevant stakeholders. • Opportunity for interaction with delegates and networking opportunities. Sometimes it is just a refresher course and for others, it is a new field they would like to enter.

Topic	Summary of Responses
	• It is important to keep costs reasonable, although sometimes difficult as venues become expensive and there are other overhead costs. • Delegates should leave the course feeling they have tools to solve problems in their work environment. • Competent experts with practical experience add value to short courses. • Industry and academia need to be aligned. • Short courses should be relevant by keeping up to date with the latest research and trends. • Short courses are a good means of raising awareness on innovation • Short courses are a lot of work and require a lot of funding. If you do not get the number of enrolments, it is not sustainable.
Barriers to enrolment for potential short course participants	• Internet access for some participants. • Lack of funding. • General loss of expertise and as a result, a lack of understanding and/or appreciation for the field of water resources. • Time and cost. • Long and cumbersome approval process.
Impact of COVID-19 on short course implementation or delivery	• Slowed down the rolling out of the training plans. • The laboratory component cannot be delivered. • Some courses had to be cancelled or postponed (delegates do not have access to supporting technology/data and/or large practical component). • Some courses converted to an online format which has necessitated a change in course delivery and assessment and posed certain challenges. • Post-COVID may see more courses offered online.

Key findings from these interviews are summarised in Table 8.

Table 8: Semi-Structured Interviews: Key findings

Institution	Key Drivers	Key Short Course Themes	Barriers	Collaboration	Market Research	Popularity and Feedback
SU Civil Engineering	Individuals and their expertise/research interests and willingness to disseminate knowledge. Stipulations in funding contract agreements Presenting to a broader audience over and above students to ensure financial viability.	Port and Coastal engineering (this is unique to SU). Hydraulics. Hydrology. Water treatment.	Accreditation body running courses in-house leads to a conflict of interest. University courses division can be cumbersome and bureaucratic. Little financial benefit to course leaders.	There are collaborations within the civil engineering disciplines. There is ad hoc collaboration with experts from other institutions. ECSA and SAICE inform the accreditation process while SAICE also assists with marketing.	Explicit market research is not undertaken.	Feedback from courses is mostly around food and venue.
UCT, Future Water	Building capacity and awareness National Government goals Responding to the need for sustainable solutions to environmental problems (e.g. climate change) Experts looking to address research interests Student development Funding	Water treatment. Sustainable drainage systems. Water Sensitive Urban Design Resilience. Circular economy. Social impacts. Public health. Urban metabolism	Highly dependent on the individual. Expertise come and go. Funding. Keeping pace with what is happening in the landscape and keeping content relevant. Dedicated people that are properly funded and supported with relevant processes	Some short courses are intentionally transdisciplinary with over 20 lecturers from various disciplines including engineering, public health, social science, anthropology and economics. External collaboration occurs with consulting firms (e.g. Umvoto groundwater specialists), the Freshwater Research Group, experts from various institutions, CSC India (rainwater harvesting)	Explicit market research is not undertaken but certain high-level strategies are put in place at a department level to inform short courses on offer.	Attractiveness around course relevance, accreditation of institution, CPD points and cost.
UFS, Groundwater	A lack of knowledge needs in government (specifically in local municipalities and the DHWS) and the mining sector. Demand from the mining industry and independent from the university's curricula.	Groundwater geophysics. Groundwater chemistry. Hydrology. Aquifer mechanics. Groundwater environment. Geophysics. Groundwater contamination. Power generation and mining of water	Short course dependent on demands and requests by the mining sector. Registration and accreditation are time-consuming. Overlapping roles between academics and course coordinators (act as consultants)	Collaboration from external parties from the mining industry. No internal collaborations.	No market research undertaken.	
UKZN	Independent funding University students Needs of global banks and markets	Sanitation and water.	The time-consuming process of registration and accreditation. Overlapping roles of academics involved in short courses. Difficulty in advertising, and administration of the course itself. There is a shortage of skilled people in municipalities which influences the relationship with HEIs. Bureaucracy.	External collaborations include the World Bank, the Gates Foundation, and the African Development Bank. Others include UCT, SU, and UJ, professional bodies in Russia, Europe, Canada, and South East Asia, as well as with the Global Sanitation Graduates School. Affiliation with eThekwini Municipality in KwaZulu-Natal.	Short courses stay the same over time. Market research changed in COVID-19 to online education and learning/teaching practices.	
WISA	Short courses are designed by experts in the water sector. .	Wastewater management, Water conservation and demand management	Accreditation is questionable; Short Course does undergo some form of accreditation and valuation process. Short courses are not optimised nor improved.	No collaboration with innovation and research sectors. There is however a recent attempt of collaboration, between WISA and UNISA, as an HEI.	Short course assessments/feedback forms provide market research.	

Institution	Key Drivers	Key Short Course Themes	Barriers	Collaboration	Market Research	Popularity and Feedback
NWU, Aquaculture	The short course is driven by the ethical need for students to work with aquatic animals and aims to bridge the ethical clearance gap between HEIs and the aquatic community. The ethical need to work with aquatic fish.	Fish specialisation. Aquatic animals (fish, amphibians, vertebrates) regarding the handling, operation, data collection, professionalism, and sampling of aquatic animals.	COVID-19 effects collaboration and participation of short courses. Too many requests from consultants. Funding is unviable	Internal collaborations look at water research groups, students, and the Department of Environmental Management at NWU. External collaborations consider experts including veterinarians and engineers, as well as partnerships with UL, the Department of Forestry and Agriculture, and the Southern African Society of Aquatic Scientists (SASAqS).	No market research undertaken.	

6 DATA ANALYSIS: GAP ANALYSIS

Table 9 is a gap analysis of the short course training landscape. The "current state" is taken from the results of the desktop study, online questionnaire and semi-structured interviews and compared to an "ideal or future state" in terms of the sector needs and the roadmap targets (WRC, 2015) to determine a gap.

Table 9: Data Analysis: Short course training landscape gap analysis

Current State of Short Courses	Ideal State of Short Courses	Gap
Operational		
During the period from 2015 to 2020, 134 unique water-related short courses have been offered at 14 HEIs (CPUT, DUT, NMMU, NWU, RU, SU, UCT, UFS, UKZN, UMP, UP, UNISA, WITS, and UNIVEN), five professional bodies (IMESA, SAAMA, SAIAE, SAICE, and WISA) and seven research and innovation specialist (ARC, CAP-NET, CSWUE, Green Cape, Gerald de Jager, the Water Academy, and Water Utilities Corporation).	Short course offerings by a broad range of HEIs, professional bodies, and research and innovation specialists to ensure accessibility.	There are no short course offerings at the following HEIs: CUT, LU, IIE MSA, MUT, SMU, SPU, TUT, UFH, UJ, UWC, UNIZULU, VUT, and WSU. The majority of these HEIs are HBHEIs. The lowest proportion of short course offerings identified is by research and innovation specialists. The professional bodies identified in this study as not offering water sector short courses include: ASAQS, CESA, GSSA, ILASA, IOPSA, SACLAP, SACNASP, and ECSA.
There is geographical representation of water sector short course in 8 of the 9 provinces.	There is geographical representation of water sector short courses in all 9 provinces to increase accessibility to prospective participants.	None of the short courses identified in this study are offered in the Northern Cape.
70% of the short courses as identified in the online questionnaire are accredited or in the process of being accredited either for CPD or against a formal or academic programme.	Ensure due diligence, transparency, fairness and risk management through accreditation (CHE, 2016).	30% of the short courses identified through the online questionnaire are not accredited.
There is inconsistent terminology used in short course marketing material in terms of titles/description and there is infrequent listing of years' experience/employment band of potential participants.	Marketing material for short courses should provide all necessary information accurately to enable potential participants, sponsors and other stakeholders to make informed decisions (CHE, 2016). This could include standard industry-wide terminology and a standard listing of years' experience/employment band.	There is a lack of consistent standardised descriptions for the target audience (titles, employment band) which may hamper potential participants from making informed decisions about enrolment.
The majority of short courses identified in this study are classroom-based.	Increased hybrid and online offerings where possible to curb costs and increase accessibility.	Less than 10% of the short courses identified in the questionnaire and desktop study have an online offering (particularly pre COVID-19).

Current State of Short Courses	Ideal State of Short Courses	Gap
Strategic		
Minimal formal market research is undertaken.	A needs analysis and market research are undertaken to inform the design and development of short courses so as to ensure that each short course has a clearly defined need to satisfy (CHE, 2016).	There is insufficient formal market research being undertaken by short course role-players to inform the design and development of short courses.
The strongest thematic clusters for all of the short course programmes are Cluster 2 and 3. The weakest cluster is Cluster 4. The bulk of the water-related short course offerings cover the broad themes of Water infrastructure development, Water and wastewater treatment; Water governance, resilience, security, IWRM; and Environmental protection and Pollution Control.	Strength in Cluster 1 and 6 is a roadmap target (WRC, 2015)	There is an under representation of water-related short courses in Clusters 1 and 6 (WRC, 2015).
While internal collaborations (i.e. within departments and transdisciplinary) were identified as occurring; only ad-hoc collaborations with local government, private sector, national government, professional bodies and international organisations were identified.	Establish transdisciplinary internal collaboration and external collaboration with HEIs, research and innovation specialists, professional bodies, government, the private sector both nationally and internationally (UNESDOC, 2008).	There are few collaborations with previously disadvantaged HEIs in particular, and with international HEIs, industry, water sector organisations and Local Government for the pooling of resources and knowledge exchange.
Short course target audiences as identified in this study include engineers, scientists, and other professionals, technical staff, researchers, managers, non-governmental organisations, government officials, those working in food production and agriculture. Target industries identified in this study include: agriculture, engineering, mining, national and local government, legal, water boards and utilities, community-based organisations, and institutions involved in water-related research.	The short course offerings should have target audiences/industries as relevant to the entire water sector.	The following water-related audiences are not explicitly targeted in the water-related short course landscape: • Landscape Architects • Educators • Those involved in: sustainability/climate change, social justice and the water-energy nexus.
The following drivers in the water sector short course landscape were identified as: • Individuals and their expertise/research interests and willingness to disseminate knowledge • Stipulations in funding contract agreements	Optimising drivers and optimal awareness of drivers.	There is a shortfall in the optimisation of the following drivers: • Individuals and their expertise/research interests and willingness to disseminate knowledge • Stipulations in funding contract agreements

Current State of Short Courses	Ideal State of Short Courses	Gap
• Broader audience over and above students to ensure financial viability. • Building capacity and awareness • National Government goals • Responding to the need for sustainable solutions to environmental problems • Student development • Student research • Demand from industry		• Broader audience over and above students to ensure financial viability. • Building capacity and awareness • National Government goals • Responding to the need for sustainable solutions to environmental problems • Student development • Student research • Demand from industry
The following barriers for Short Course creators/facilitators were identified: • Bureaucracy. • Time-consuming processes for registration and accreditation. • A lack of consistent funding • A conflict of interest with accreditors running courses in-house. • Short courses linked to individuals do not ensure longevity. • Loss of expertise.	No barriers to short course creation and facilitation.	There is a lack of: • Streamlined and efficient processes for registration and accreditation of short courses. • Consistent funding. • Sufficient succession planning and retaining of experts in the field. • Differentiation between course creators/presenters and accreditors to avoid a conflict of interests.
Barriers for the attendance of short course by delegates were identified in this study as: • Cost (travel and accommodation). • Time away from the office. • Internet access for online courses.	No barriers to short course attendance.	There are data and internet barriers for delegates. There are few online and time-efficient/"at your own pace" offerings to reduce costs and increase accessibility.

7 CONCLUSIONS AND RECOMMENDATIONS

7.1 General Conclusions

This study involved exploratory research of the South African water sector short course landscape through a desktop study, questionnaire, and series of semi-structured interviews.

A total of 134 short courses on offer during the 2015 to 2020 period were identified in both the desktop study and questionnaire. These short courses were identified as being on offer at 14 HEIs (CPUT, DUT, NMMU, NWU, RU, SU, UCT, UFS, UKZN, UMP, UP, UNISA, WITS, and UNIVEN), five professional bodies (IMESA, SAAMA, SAIAE, SAICE, and WISA) and seven research and innovation specialist (ARC, CAP-NET, CSWUE, Green Cape, Gerald de Jager, the Water Academy, and Water Utilities Corporation).

The institutions with the most short course offerings include: SU (17), WISA (15), UP (UP) and UCT (13).

HEIs identified as not active in water-related short course offerings include: CUT, LU, IIE MSA, MUT, SMU, SPU, TUT, UFH, UJ, UWC, UNIZULU, VUT, and WSU; with the majority of these institutions classified as HBHEIs.

Professional bodies (as identified in Table 1) not offering short courses include ASAQS, CESA, GSSA, ILASA, IOPSA, SACLAP, SACNASP, and ECSA.

Of the research and innovation specialists that were identified in this study, those not offering water-related short courses as per the methodological process include the IWMI, IGRAC, SAEON, SANBio, SAIAMC, WWF, and SASSCAL.

54% of the identified short courses in the water sector are offered by HEIs, 28% by professional bodies and the remaining 19% by Research and Innovation Specialists.

The mapping of the short course findings to the WRC (2015) thematic clusters of needs and interventions relating to supply and demand for the water community revealed that the outright majority of short course offerings address Clusters 2 [*Governance, planning and management of supply and demand*] and Cluster 3 [*Adequacy and performance of supply infrastructure and operational performance (Built infrastructure/Ecological infrastructure/ecosystems*)]. The fewest number of short course offerings address Cluster 4 [*Running the water sector as a smart business*] and Cluster 7 [*Monitoring and metering*]. The institutions offering short courses in the broadest range of clusters are UP and WISA.

In the Update of the RDI Capability Map Study (Volume 1) and Postgraduate Map (Volume 2) the strongest thematic clusters across the two research studies were Cluster 1 [*Increase ability to make use of more sources of water*], Cluster 6 [*Efficiency use of water (Agriculture, industry, and consumers]* and Cluster 2 *[Governance, planning, and management of supply and demand]* at 31%. Cluster 2 therefore emerges as the strongest thematic clusters across all the research studies.

7.2 Limitations

The timing of the study was such that data collection (desktop study and questionnaire) took place prior and during the onset of the global COVID-19 pandemic. While high level questioning around COVID-19 was undertaken during the semi-structured interviews, the timing did not allow for the analysis of the effect of the pandemic on short course offerings (including their availability and mode of implementation).

7.3 Gaps and Overlaps

Gaps in the water sector short course landscape have been identified as follows:

Operational Gaps:

- There are no short course offerings at the following HEIs: CUT, LU, IIE MSA, MUT, SMU, SPU, TUT, UFH, UJ, UWC, UNIZULU, VUT, and WSU. The majority of these HEIs are “previously disadvantaged”.
- The lowest proportion of short course offerings identified are by research and innovation specialists.
- The professional bodies identified in this study as not offering water sector short courses include: ASAQS, CESA, GSSA, ILASA, IOPSA, SACLAP, SACNASP, and ECSA.
- None of the short courses as identified in this study are offered in the Northern Cape.
- 30% of the short courses identified through the online questionnaire are not accredited.
- There is a lack of consistent standardised descriptions for the target audience (titles, employment band) which may hamper potential participants from making informed decisions about enrolment.
- Less than 10% of the short courses identified in the questionnaire and desktop study have an online offering (particularly pre COVID-19).

Strategic Gaps

- There is insufficient formal market research being undertaken by short course role-players to inform the design and development of short courses.
- There is an under representation of short courses in Cluster 1 and 6 as required by WRC (2015).
- There are few collaborations with previously disadvantaged HEIs in particular, and with international HEIs, industry, water sector organisations and Local Government for the pooling of resources and knowledge exchange.
- The following water-related audiences are not explicitly targeted in the water-related short course landscape:
    - Landscape Architects
    - Educators
    - Those involved in: sustainability/climate change, social justice and the water-energy nexus.
- There is a short fall in the optimisation of the following drivers:
    - Individuals and their expertise/research interests and willingness to disseminate knowledge
    - Stipulations in funding contract agreements
    - Broader audience over and above students to ensure financial viability.
    - Building capacity and awareness
    - National Government goals

    - Responding to the need for sustainable solutions to environmental problems
    - Student development
    - Student research
    - Demand from industry
- There is a lack of:
    - Streamlined and efficient processes for registration and accreditation of short courses.
    - Consistent funding.
    - Sufficient succession planning and retaining of experts in the field.
    - Differentiation between course creators/presenters and accreditors to avoid a conflict of interests.
- Barriers such as internet and data accessibility exist for online and time-efficient/"at your own pace" offerings to reduce costs and increase accessibility.

7.4 Recommendations

To address the gaps identified in this study, and ultimately to improve coordination and awareness among the various stakeholders and role-players in the water-related short course training landscape, the following recommendations are made:

- Increase standardisation across the sector by organising water-related short course quality management on a regional scale (Jonker et al., 2012), particularly in higher education. Draw on international best practice whereby HEIs follow guidelines to establish quality management of short courses despite having their own internal assurance mechanisms (CHE, 2016). The pooling of resources could empower those identified as not operating in the short course landscape, particularly previously disadvantaged HEIs, Landscape Architects and those involved in: sustainability/climate change, social justice and the water-energy nexus. Nurturing and developing strong thematic clusters and stimulating additional short courses to address weaker thematic clusters are key strategic decisions that can be undertaken through shared expertise. Explore options to optimise the accreditation and registration processes for short courses to ensure greater user-friendliness and a less cumbersome and time-consuming process. Eliminate the conflict of interest between short course creators and accrediting bodies by ensuring accrediting bodies are not running in-house courses.
- Optimise and increase awareness of the short course drivers as identified, to ensure alignment with various water sector needs, retain knowledge, and increase access to funding.
- Foster and build collaborative programmes and synergy between professional practitioners, prospective students, water sector organisations, HEIs, Research and innovation specialist agencies, Local Government, National Government, SMMEs, SETAs, and professional bodies. Examples of collaboration include UKZN and the World Bank, the Gates Foundation, the African Development Bank, eThekwini Municipality, UCT, SU and UJ and overseas professional bodies. Foster coordination between the various role-players by utilising and updating the summary tool created as part of this study.
- Where possible, increase online short course offerings that can be done at the delegates' own pace both in response to the COVID-19 pandemic, and to increase access and reduce costs of short courses. Barriers to entry of this format of teaching such as access of delegates to devices and data as well as large practical components will require further consideration.

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9 APPENDICES

9.1 APPENDIX A: Data Verification: Online Survey Questions

Section One: Background Information:

Respondent Details:

1. Name:
2. Surname:
3. Contact number:
4. Email address:

Employer Details:

1. Employer/Company name:
2. Department/unit name:
3. Job Title:
4. Into which category does your organisation fall?
   Private sector
   Public Sector
   Semiprivate Sector
   Non-profit or Non-governmental Organisation
   Other (please specify):

5. Which of the following best describes the principal focus or role of your organisation?
   Funding body
   Higher Education Institution
   Non-governmental organisation
   Policy or regulatory body
   Professional body or association
   Research and innovation
   Training accreditation and quality assurance body
   Training organisation
   Other (please specify)

Section Two: Short Course Mapping

1. Is your organisation involved in the development or offering of **water-sector-related** short courses?
   Yes
   No
   Other (Please Specify)

2. Which of the following best describes your current role with regards to short courses in your organisation?
   Fundraising
   Quality assurance, oversight, and management
   Short course administration
   Short course communications/student recruitment/marketing/outreach
   Short course creator
   Short course facilitator or instructor
   Short course reviewer
   Not involved with short courses in any capacity
   Other (Specify)

Section Three: Short Course Detail

Please list the water-sector-related short courses your organisation currently offers or has offered between 2015 and present by answering the following questions and/or attaching relevant course information.

1. Short course title:

2. Course Description:

3. What are the short course learning outcomes?

   LO 1:
   LO 2:
   LO 3:
   LO 4:
   LO 5:

4. When was the short course first developed? (year drop down)

5. When was the short course first offered? (year drop down)

6. Course objective:

7. Course Purpose:
   In-service training programme
   Professionalisation/Professional accreditation
   Training in new-to-market and emergent knowledge: (select as appropriate)
   Technical skills, new technologies, new solutions (Specify)
   Legislation, professional standards, regulation (Specify)
   Development of skills and competencies (Specify)
   Professionalisation (Specify)
   Community development (Specify)
   Lecturer development (Specify)
   Post graduate capacity building (Specify)
   Other (Specify)

8. Equivalent NQF-Level
   List NQF levels (respond if details available)

9. What is the duration of the short course?
   One day
   2-3 days
   3-5 days
   >one week
   Other (Please specify)

10. Please indicate the notational hours required to complete the short course:
    Is the short course accredited?
    Yes
    No
    In process
    I don't know
    Other

a. If yes: or in process:
   Accredited (please state the number of credits)
   Where relevant, against which formal program is the course accredited?
   CPD accredited
   please state the number of CPD points

Please state the relevant professional body

b. Quality Assurance and Accrediting body [Drop down list]
Allied Health Professions Council (AHPCSA)
Engineering Council of South Africa (ECSA)
Environmental Assessment Practitioners Association (EAP-SA)
Health Professions Council of South Africa (HPCSA)
Independent Regulatory Board for Auditors (IRBA)
Institute of Professional South African Mariners (IPSAM)
South African Council for Natural Scientific Professions (SACNASP)
South African Council for Project and Construction Management Professions (SACPCMP)
South African Council for Social Service Professions (SACSSP)
South African Council for the Architectural Profession (SACAP)
South African Council for the Landscape Architectural Profession (SACLAP)
South African Council for the Property Valuers Profession (SACPVP)
South African Council for the Quantity Surveying Profession (SACQSP)
South African Geomatics Council (SAGC)
South African Pharmacy Council (SAPC)
Other (Specify)

11. Intended Target Industry/Sector
Agriculture
Engineering
Mining
National, Provincial or Local Government
Activist organisations
Community-based organisations
Schools
Legal
Water Boards and Utilities
Institutions or organisations involved in water-related Research, Development, and Innovation activities
Other (Specify)

12. Intended target audience (can choose more than one)
Registered Professionals
General Public
Graduate Professionals
Manager and senior Managers
Mid-career professionals (10-15 years' experience)
Technical staff
Postgraduate students
Community development organisations/non-governmental organisations
Teachers
Researchers
Other (Specify)

13. Admission Requirements
Please list admission/course entry requirements
Include drop down box with:
a. Qualification level (NQF equivalent)
b. Years of experience

14. How often is the short course offered?
Once a year
Twice a year
Every 3 months
On demand
Other (please specify)

15. What modes of delivery are used? (select more than one)
    Online distance learning
    Classroom-based
    Blended learning (online and classroom-based)
    Other (please specify)
    a. Can this course be offered remotely? (i.e. fully online)
    Yes
    No

16. Does the short course include additional activities? (select more than one)
    Practical work
    Field trips
    Internship programme
    Panel discussion
    Other (please specify)

17. How is the short course assessed?
    Assignment
    Presentation (group or individual)
    Portfolio
    Exam
    Essay
    Other (please specify)

18. How many participants can be enrolled per course offering?

19. What are the general enrolment figures per course offering?
    <50% of intended enrolment figures
    50-75% of intended enrolment figures
    75 >% of intended enrolment figures
20. What are the completion figures per course offering?
    <50%
    50-80%
    80-100%

Section Four: Marketing and Short Course Evaluation

Open-ended responses:

1. *Is your organisation required to do market research before developing a short course?*
    a. *Yes*
    b. *No*
        i. *Provide details*

2. *Is your organisation required to develop a marketing plan when developing a new short course?*
    a. *Yes*
    b. *No*
        i. *Provide details*

3. *Does your organisation/institution currently collaborate with any departments or organisations in the development or offering of water-sector-related short courses?*
    a. *Yes*
    b. *No*
    c. *In Process*
    d. *I don't Know*
        i. *If Yes or In Process are these organisations/departments:*
            1. *Internal (please list details)*
            2. *External (please list details)*

4. *Briefly explain the quality assurance processes at your institution for the development, registration, and offering of short courses.*

5. *In your opinion, what are the main reasons for institutions/organisations, etc. entering the short course environment?*

6. *In your opinion, what are the lessons that can be learned from offering short courses?*

7. *In your opinion, where relevant, what is preventing potential participants from enrolling in your short course?*

8. *Has COVID-19 and/or the lockdown impacted the short course implementation in any way?*

9.2 APPENDIX B: Data Verification: Interview Guideline Questions

1. What are the drivers for the development of water-related short courses at your organisation/faculty/department/institute/centre?

    1.1. Research and development and generation of new knowledge with specific focus areas
        - Specify

    1.2. Human capacity development and development of specific skills and competencies
        - Specify

    1.3. Deployment of innovation, which includes development, testing, demonstration, positioning, and deployment of new solutions, know-how, and technologies.
        - Specify

    1.4. Commercialisation activities related to the deployment of innovation, and includes development, testing, demonstration, positioning, and deployment of new solutions, know-how, and technologies
        - Specify

2. Based on the water-related short courses that you currently offering, list the key knowledge themes and focus areas, and the accompanied gaps if any, it seeks to address.

3. Does your organisation/faculty/department/institute/centre foster internal collaboration in the development and offering of water-related short courses?
        - Specify

4. Does your organisation/faculty/department/institute/centre foster external collaboration in the development and offering of water-related short courses?
        - Specify

5. In your opinion what will be the drivers for the development and implementation of new water-related short courses at your organisation/faculty/department/institute/centre within the next five years?
        - Open ended

6. In your opinion what will be the key barriers for the development and implementation of new water-related short courses at your organisation/faculty/department/institute/centre within the next five years?
        - Open ended

7. How does your organisation/faculty/department/institute/centre do their market research ahead of offering a course (training needs of employers, competition, etc.)?

8. Explore course “attractiveness/popularity” (feedback/attendance) and cost implications.

9.3 APPENDIX C: Desktop Study Results: Short Course Offerings (2015-2020)

Name of Institution	Institution	Name of Short Course	Course Description (Brief Overview)	Availability
CPUT	HEI	Short Course Water, Gender and Development in a South African Context (2015)	Creation of awareness on gender with a focus on an understanding & application of the interconnectedness between gender, & water development in the SA context. Course includes training related to: -Key principles & approaches relating to gender & water management generally & in a SA context, -Knowledge & capacity for gender analysis of water policies, strategies & policies, -Gender mainstreaming & its role within water management, -Tools, methods & methodologies to apply a more nuanced gender perspective to water management.	Unavailable (last offered: 7-11 September 2015)
CPUT	HEI	National Certificate: Water and Wastewater Treatment Process Operations*	Apply fundamental knowledge and understanding of current legislation specific to water and wastewater treatment. Operate process at a water and wastewater treatment works. Demonstrate an understanding and knowledge of equipment to be used to perform water and wastewater treatment works. Apply basic health and safety principles in the workplace	Available
CPUT	HEI	National Certificate: Water and Wastewater Process Control (NQF Level 3)*	Use the system international (SI) and appropriate formulae to perform calculations needed to operate water and wastewater treatment plant. Perform water quality analysis and monitoring. Compare water and wastewater works performance with legislative and workplace requirements at an operational level. Apply communication and leadership skills in the work environment. Demonstrate administration required on a wastewater treatment works.	Available
CPUT	HEI	Process Control Supervision (Level 4)*	Operate water and/or wastewater works. Demonstrate knowledge of hydraulics, valves, pumps, and motors. Demonstrate knowledge of relevant national laws, regulations, and guidelines as they apply to water or wastewater treatment. Demonstrate an ability to supervise and lead a team, problem-solving and investigative skills	Unavailable
CPUT	HEI	Adaptive Strategies for Water Use and Demand Management	(Partnership with Wageningen University) Theoretical approaches to adaptation in the water sector & adaptation methods & tools. A focus on developing adaptation strategies based on analysis of the socio-ecological systems. Main topics for the course: -Conceptual frameworks for adaptation, -Methods & tools to identify adaptive strategies, -Designing adaptive strategies	Unavailable (last offered: 13-17 October 2014)
CPUT	HEI	Environmental Remediation for Water Quality (July 2015)	(Partnership with the UNIVERSITY OF TWENTE). Course provides participants with the knowledge & skills in environmental remediation as a means of treatment, containment, removal or management of chemical substances or waste so that they no longer represent an actual or potential risk to human health/the environment. On successful completion of this short course participants will: Understand the key issues related to environmental pollution prevention & remediation, critically appraise the range of remediation approaches & techniques, selecting key indicators for sustainable remediation, select & evaluate accepted decision tools to assess remediation performance and &-points.	Unavailable (last offered: 20-24 July 2015)
DUT	HEI	Short course consultations	Water utility in municipal governance	
DUT	HEI	Safety And Sanitation In A Food Production Facility	This course addresses the needs of acceptable sanitation and safety practices in food handling industries.	Available
NMMU	HEI	Renewable Energy Technology	An overview of the most significant renewable energy resources (incl. hydropower), concepts, technologies & challenges to overcome climate change & other sustainable development goals. It will provide an insight into the possible solutions to sustainable energy usage.	Available
NWU	HEI	Environmental Law for Integrated Water Resource Management	The transferring of skills and knowledge in the field of Environmental law – integrated water resource management.	Available
NWU	HEI	Short course in aquatic ectothermic vertebrates handling and ethics	To inform all persons involved of animal welfare and ethical principles, also referred to as tenets, which apply to each and every situation where aquatic ectotherms are involved. Secondly the course will focus on Standard Operating Procedures (SOP) that form part of operations for specific organisms	Available
NWU	HEI	Water Quality Monitoring (2019)	This course provides an understanding of the principles & the practical approaches & techniques required to effectively monitor the chemical, hydrological, microbiological and aquatic elements of water quality. It is also focussed at assisting in the design & development of effective water quality monitoring programmes, which take cognisance of the relevant legal, institutional, technical & practical issues	Available on demand (last offered: 2-4 September 2019)

Name of Institution	Institution	Name of Short Course	Course Description (Brief Overview)	Availability
NWU	HEI	Engineering Infrastructure Systems Management	This short course focusses on capacity building of students in the basic infrastructure, technological & financial management principles in managing infrastructure systems. The lack of formal knowledge of engineering principles underlying infrastructure systems management is one of the main reasons for infrastructure failure& dysfunctionality (inclusive of bulk- and reticulation services). In the process limited knowledge related to obligations in terms of the applicable policy and legislative framework pertaining to infrastructure is evident.	Available
RU	HEI	The Working for Water Training Programme for the Biological Control of Weeds	Course introduces both the theory & practice of weed biological control. It familiarizes those new to science with the theory that underpins host specificity & thus the safety of biological control & provides an understanding of not only HOW but WHY it works.	Unavailable (now available and called Weeds Biological Control Short Course)
RU	HEI	Environmental Water Quality (EWQ) in Integrated Water Resources Management (IWRM)	Aquatic ecotoxicology, biomonitoring and analysis of environmental water chemistry data.	Available
RU	HEI	Introduction to Freshwater Aquaculture	Not provided	Unavailable (last offered: 2017)
RU	HEI	Tools for Wetland Assessment	Wetland delineation, assessment of wetland ecosystem services, assessment of wetland integrity, buffer guidelines	Available on demand (Last offered: 2012)
SU	HEI	Hydro and Ocean Energy	To introduce the different forms of ocean energy (review the available resources, discuss the conversion principles & technologies, present existing & future ocean energy projects, relate to South Africa). To introduce hydrological resources, technological advances and future scenarios of Hydropower.	Available
SU	HEI	Sewer Systems Planning and Design	Sewer system-design considerations, case studies, adapting to change, practical issues	Unavailable (last offered: 2017)
SU	HEI	Aquaculture Production Management	Aquaculture development in Southern Africa is hampered by a lack of skilled manpower. Local opportunities for training in aquaculture (i.e. certificate, diploma, degree, etc.) are limited. This short course seeks to address this gap.	Available
SU	HEI	Water Resource Management	This course will expose participants to the need for development of both surface & groundwater resources & will use the newly developed WR2012, WRSM/PITMAN, as well as the Water Resource Yield Model, as basis to demonstrate the available techniques. Attention will also be given to catchment management aspects (e.g. CMA structures). Desalination as an alternative option will also be discussed.	Available (last offered: 2019)
SU	HEI	Biodiversity and Ecosystem Services	Course to understand the links between biodiversity & ecosystem services such as freshwater, crop production, grazing, & climate regulation, which underpin the economy & well-being of different groups in society. However, biodiversity, ecosystem services & human well-being are all multidimensional issues characterized by complex interactions.	Available (last offered: 2019)
SU	HEI	Water and Waste Water Treatment Process Management	To provide an overview evaluation of operation & maintenance of water & wastewater treatment processes. To provide the core principles and management concepts of water and wastewater treatment and to select and apply water and wastewater treatment processes to meet specific water treatment needs. To enable participants to plan operation and maintenance plans for water and wastewater treatment processes.	Available
SU	HEI	Water Quality and Risk Assessment at Water Treatment Works	Set-up, service and monitor a technical project team implementing an integrated water quality management plan starting in the catchment progressing through the purification and distribution system ending at the point of delivery. Understand and apply in practice the important physical, chemical and microbiological water quality issues, with specific attention on regulatory and compliance requirements. Identify the scope and requirements of a water quality safety plan. Manage water quality in drinking water supply systems. Develop, draw up and evaluate Water Safety Plan and Wastewater Risk Abatement Plan. Interpret and communicate the results of water quality analyses and programmes on various levels of the water supply organisation.	Available
SU	HEI	Resilient Water Services	The aim of the course is to present material on increased resilience of water services. As part of this course, a workshop will be conducted with delegates from Sheffield University, towards fulfilment of certain obligations we have due to an existing collaboration agreement	Available (last offered: 2019)
SU	HEI	Coastal Engineering	Topics are mostly focused on nearshore/marine hydrodynamics, geophysical coastal processes, coastal structures and coastal planning/management (related to engineering). Interact with experts, practicing professionals, lecturers, peers and students in this exciting field! The Short Course is an opportunity to receive lectures regarding aspects of coastal engineering from eminent local and international renowned specialists, including Prof Torsten Schlurmann, LudwigFranzius-Institute for Hydraulic, Estuarine & Coastal Eng., Leibniz University Hannover, Germany. An excursion and presentations of practical case studies from invited local and international specialists, authorities, consultants and contractors in this field, are also included.	Unavailable

Name of Institution	Institution	Name of Short Course	Course Description (Brief Overview)	Availability
SU	HEI	Introduction to Coastal Engineering	The objective of the course is to transfer the latest knowledge on Coastal Engineering and to present a number of case studies/projects as examples.	Available (last offered: 2018)
SU	HEI	Design and Management of Dams and other Hydraulic Structures	Design and Construction of Hydraulic Structures: course to give state-of-the-art theory and practice on dam site selection, dam design aspects such as dam type, geotechnical and structural aspects, spillways, energy dissipation and outlet work, and hydropower schemes. Apart from dams, the design of other structures such as water transfer tunnels will also be dealt with. Dam safety aspects, design floods and guidelines on freeboard for dams will also be presented. Presenters are mainly drawn from government, university and consulting engineering companies.	Available (last offered: 2019)
SU	HEI	Pipeline and Pumpstation Design	This 3.5 day course on Hydraulic Design of River Abstraction Works, High Lift Pumpstations and Pipeline Design has been structured to give state-of-the-art theory and practice on pipe hydraulics, the design of river abstraction works, high lift pump stations, sand/silt traps, valves and control systems. Several case studies will be discussed including planning, design, construction and environmental aspects. Presenters are drawn from university, consulting engineering, environmental companies, and industry	Available (last offered: 2019)
SU	HEI	Port Engineering	The Short Course is presented by international and local experts, including Prof Elen Twrdy, Dean of the Faculty of Maritime Studies and Transport, University of Ljubljana, Slovenia and Prof Ron Cox, Honorary Associate Professor, School of Civil and Environmental Engineering, University of New South Wales, Sydney, Australia. Prof Twrdy will lecture on the regional planning for the Port of Koper (Slovenia) and how it ties in with the European transport corridors, the regional rail links to the Ports of Trieste (Italy), Koper and Rijeka (Croatia) and the One Belt One Road (Silk Road) Chinese initiative and its impact on the ports in the North Adriatic Sea. Prof Cox is a Board member of PIANC Australia and the Convenor of the Australian Climate Change Adaptation Research Network for Settlements and Infrastructure. He will talk on climate change impacts on ports, enhancing the resilience of seaports, a climate change risk assessment for Avatiu, Cook Islands and upgrading of breakwaters for climate change. An excursion to the CSIR Hydraulic Laboratory in Stellenbosch will be undertaken. Case studies will be presented by leading consulting engineers and contractors.	Unavailable (last offered: 14-17 August 2017)
SU	HEI	Water Treatment Process Management TVET Lecturers Drakenstein	A short course piloted at the Drakenstein Municipality in Water Treatment Process Management for TVET College Lecturers in order to upskill lecturers in training related to water treatment.	Unavailable (last offered 2018)
SU	HEI	Short Course on Port Engineering: Liquid Bulk Terminals and Ship Navigation	The Short Course is presented by international and local experts. Experts from the US Army Corps of Engineers, including Dr Martin Schultz, Katherine Touzinsky and Dr Keith Martin, will present on aspects of ship navigation, vessel traffic and maritime safety. Furthermore, Dr Christoph Burmeister from the Fraunhofer Center for Maritime Logistics and Services in Hamburg, Germany will lecture on navigational risk and safety assessments. Captain Nick Sloane from Sloane Marine will talk on the salvaging of the Costa Concordia in Italy. Captain Ravi Naicker (SA Maritime Safety Authority) will address maritime safety and the prevention and combatting of pollution at sea. An excursion to the ship simulators of the SA Maritime Training Academy in Simon's Town will be undertaken. Case studies on liquid bulk facilities will be presented by leading consulting engineers and contractors.	Unavailable (last offered: 14-17 August 2017)
SU	HEI	Flood Hydrology	The objective of this course is to advance knowledge on flood calculation methods to post graduate students. Methods will be illustrated with appropriate sessions.	Unavailable (last offered: 2018)
SU	HEI	Water Governance for Water Leaders	Course Objectives: -To provide a foundational orientation to the concept of leadership and provide for contextual and conceptual issues of leadership within the paradigm of water governance; -To interrogate the issues, challenges, competencies and capacity needed in water leadership. -To develop the competency of participants in an experiential learning style, thereby installing andragogics as the preferred style of learning facilitation on advanced leadership development programmes in the South African context; and -To assess participants progress against the standards required for a declaration of competence on the outcomes of the course,	Unavailable (last offered: 2017)
UCT	HEI	Design and Modelling of Water Distribution Systems	The aim of this course is to provide a structured introduction to the design and modelling of water distribution systems. The modelling component of the course will lead the delegate step-by-step through the different capabilities of the public domain hydraulic network software EPANET. This software provides a state-of-the art hydraulic engine used by many commercial products, but can be downloaded for free.	Available on demand

Name of Institution	Institution	Name of Short Course	Course Description (Brief Overview)	Availability
UCT	HEI	International Training Programme on Water Sensitive Urban Design and Planning	Centre for Science and Environment (CSE), India in partnership with Water Research Commission (WRC), South Africa and University of Cape Town (UCT) organized an international virtual training programme on "Water Sensitive Urban Design and Planning" (WSUDP) for African practitioners from 14-22 July, 2020. The training was scheduled in two parts: Part A: Pre-reading Material (14-20 July, 2020) Part B: Virtual Sessions (21-22 July, 2020) Part A was conducted on the Moodle Platform, supported by webinars. The aim of Part A was to introduce the concept of WSUDP to the participants, and provide the context for the need, applicability and potential of WSUDP strategies in urban areas of Africa. Part A also provided relevant material on linkages of WSUDP with climate change and COVID-19; and how this concept contributes to building against both. For Part A, the participants were provided essential reading material (8-10 hours). This was also supported by other recommended reading material, videos, recorded presentations and experience-sharing webinars.	Available on demand (last offered: 2017)
UCT	HEI	Water Loss Management in Distribution Systems	The aim of this course is to provide a structured introduction to the theoretical and practical aspects of water loss management in distribution systems.	Unavailable (last offered: 23-27 May 2016)
UCT	HEI	Water Quality Engineering: Introduction to Waste Water Treatment (CIV5032Z): 03-22 February 2020	To produce graduates with the necessary knowledge and skills to engage effectively in theory, design, modelling and operation of biological and chemical wastewater and sludge treatment systems.	Available on demand
UCT	HEI	Water Quality Engineering: Activated Sludge System (CIV5045Z): 02-28 March 2020	To produce graduates with the necessary knowledge and skills to engage effectively in theory, design, modelling and operation of biological and chemical wastewater and sludge treatment systems.	Available
UCT	HEI	Water Quality Engineering: Sewage Sludge Treatment (CIV5047Z): 04-25 May 2020	To produce graduates with the necessary knowledge and skills to engage effectively in theory, design, modelling and operation of biological and chemical wastewater and sludge treatment systems.	Available
UCT	HEI	Water Sensitive Urban Design & Planning (WSUDP)*	Overview of urban water challenges. Introduction to WSUDP concepts. WSUDP framework for implementation in SA. Specifics on WSUD planning and designing at different scales	Unavailable (last offered 2013)
UCT	HEI	Water Quality Engineering: Separation Processes (CIV5046Z): 09-30 April 2020	To produce graduates with the necessary knowledge and skills to engage effectively in theory, design, modelling and operation of biological and chemical wastewater and sludge treatment systems.	Unavailable
UCT	HEI	Water Quality Engineering: Steady State BNR design (CIV5048Z) 03 August-07 September 2020	To produce graduates with the necessary knowledge and skills to engage effectively in theory, design, modelling and operation of biological and chemical wastewater and sludge treatment systems.	Unavailable (now offered as a MEng module)
UCT	HEI	Water Quality Engineering: WWTP Design (CIV5050Z): 20-30 July 2020	To produce graduates with the necessary knowledge and skills to engage effectively in theory, design, modelling and operation of biological and chemical wastewater and sludge treatment systems.	Unavailable (now offered as a MEng module)
UCT	HEI	Making Waveforms	An outdoor-education-meets-art-activism program championing global water justice. Through experiential learning, demonstrations and a number of field trips (i.e. water sports, riverside soundwalk, etc.), participants in this course are asked to explore their relationships with water. They are paired with local Knowledge Keepers and are tasked with building meaningful connections over a period of five weeks, to create short, site-specific videos to raise awareness about the importance of healthy waterways.	Available
UCT	HEI	Sustainable Water Management	This course adopts an interdisciplinary approach to examine the current water crises, trends and conditions in developing countries. It critically engages with the technical, social, cultural, economic, political, economic and environmental challenges of water demand, supply and treatment with an understanding of the role of water in society and in sustaining livelihoods. Further, it addresses the need to derive maximum benefit from each water resource used while incurring minimum burden and the need to secure "new taps" in a water sensitive urban design context.	Available (last offered in 2019)

Name of Institution	Institution	Name of Short Course	Course Description (Brief Overview)	Availability
UCT	HEI	Course 1003: Water Sensitive Cities	Introduction to water-sensitive design Sustainable urban drainage systems Groundwater supply for Cape Town The Cape Town water crisis: why and what is being done Tips for making your home more water sensitive	Available (last offered in 2018)
UFS	HEI	GIS Intermediate: Hydrological modelling and terrain analysis using digital elevation models	Course to teach practitioners to derive a number of important environmental datasets from digital elevation models. A series of catchment modelling tools will be explored and used to model water flows in river catchments. Students will be exposed to a number of terrain analysis tools that will allow them to model terrain morphology and visibility. Although each of these tools is fairly easy to use, it is in combining them into complex models that their power lies. By learning how to combine these tools effectively, participants will be provided with a powerful means of effective	Unavailable
UFS	HEI	Watershed Assessment of River Stability and Sediment Supply (WARSSS)	Exposure to watershed processes because the underlying hydrologic and hydrogeologic processes drive the energy regime that forms fluvial features in a watershed. Concepts of sediment supply and transport along with the basic Rosgen stream classification system are introduced; this information is fundamental to the application of WARSSS.	Available
UFS	HEI	Integrated Hydrologic Modelling	The course covers the physical and modelling aspects of all the processes in the hydrologic cycle. It provides ample time for hands-on experience with MIKE SHE (integrated surface water/groundwater-modelling tool), as well as time for open discussion related to hydrologic projects relevant to the participants.	Unavailable (last offered: 2011)
UKZN	HEI	Management Development Programme (Umgeni Water)	Course to build capacity to lead organisations & challenge views about management, expand horizons, and enhance understanding of the relevance and role of managers in today's organisations. The course provides the opportunity to focus on best practice in management, and provide personal and professional tools to strengthen effectiveness as a manager and leader.	Available (last offered: 2019)
UMP	HEI	Rain Water Harvesting	Unspecified	Available on demand
UP	HEI	Advanced Course in Water Treatment Processes	Course provides an overview of the theoretical & practical aspects of industrially relevant advanced water treatment processes. Topics include chemical water treatment, advanced oxidation processes, calculating the required chemical doses required for various chemical water treatment processes, desalination & membrane technology. The course also includes a review of the current South African water crisis & the need for alternative water resources, development of new treatment processes, energy considerations, basic water chemistry, examples of advanced water treatment technologies, the scientific basis & limitations, operational considerations, case studies & advances in membrane technologies.	Available
UP	HEI	Transient flow in pipe systems*	Delegates build a sound understanding of how the dynamic analyses are performed. Delegates will gain knowledge on the various surge alleviating devices.	
UP	HEI	Pipeline System Design	Course provides a sound theoretical background and practical skills in some of the hydraulic, mechanical and electrical design aspects related to the design of pipeline systems. With the latest updates on the practical aspects of pipeline design and operations, the course specifically focuses on issues of pipeline engineering, the optimisation process of pipeline systems, as well as the effect of energy escalation in pump systems. You will also be introduced to other related topics, including pipeline hydraulics, surge analysis, pipeline component design and installation, lifecycle costing, testing and operation of pipeline systems.	Available
UP	HEI	Flood Hydrology and Urban Runoff Modelling	The practical Flood Hydrology and Urban Runoff Modelling short course covers flood estimation methods and flood routing. The application of the theory, through practical exercises, will be undertaken. Flood estimation methods such as deterministic, empirical, and statistical analysis will be applied in the exercises. The popular freeware software programme, EPA Storm Water Management Model (EPASWMM) will be demonstrated and used in the modelling of urban drainage systems. EPASWMM is a dynamic rainfall-runoff simulation model used for single event or long-term (continuous) simulation of runoff quantity and quality from primarily urban areas.	Available
UP	HEI	Free Surface Flow Modelling (Basic HEC-RAS)	The course will focus on the theory and analyses of practical free surface flow problems. The basic theory of free surface flow, mass; energy and momentum conservation, will be reviewed and the application to determine flood lines, culvert sizing, bridge flow hydraulics and dam break analysis will be covered. The widely used HEC-RAS software package will be reviewed and demonstrated by performing one-dimensional (1D) hydraulic calculations for steady and unsteady flow conditions. Delegates will learn how to approach and construct a numerical (1D) model for various flow conditions, and to effectively view and analyse results. A number of practical problems will be discussed and solved. This will acquaint participants with background and confidence to conduct various flow simulations.	Available

Name of Institution	Institution	Name of Short Course	Course Description (Brief Overview)	Availability
UP	HEI	Pump Station Design	The course will focus on the theory, analyses and practical problems related to the Pump Station Design. The basic theory of pump selection, energy efficiency, operational control, valve selection, life-cycle cost assessment, case studies and dynamic pressures will be reviewed. Delegates will be assisted to solve a number of practical problems related to pump station design. This will familiarise participants with the topic and provide confidence to undertake the design of a pump station.	Available
UP	HEI	Advanced HEC-RAS	The course focuses on the theory and analyses of practical free surface phenomena. The application of the basic theory of free surface flow, mass; energy and momentum conservation, will be demonstrated in the determination of flood lines, culvert sizing, bridge flow hydraulics and dam break analysis. The widely used and worldwide accepted HEC-RAS software package will be reviewed and demonstrated by performing two-dimensional (2D) hydraulic calculations for unsteady flow conditions as well as dam break analysis. Delegates will learn how to approach and construct a numerical 2D model for various flow conditions, and to effectively view and analyse results. A number of practical problems will be discussed and solved. This will provide participants with an enriched knowledge of the functionalities, limitations and application options to utilize the software with confidence to conduct various flow simulations.	Available
UP	HEI	Environmental Compliance Monitoring and Enforcement	The Environmental Compliance Monitoring and Enforcement is a 6-week mixed-mode (i.e. Internet supported as well as face-to-face) course designed to prepare you with knowledge and insights to align company policies and objectives to current environmental legislation to ultimately minimise liabilities and interact with audit, inspection and enforcement processes. Environmental legislation seeks to protect our natural resources and, during this course, you will acquire the know-how to optimally interact with laws and regulations to ensure sustainability. The course covers further aspects of both industrial and wildlife-related environmental activities, and encompasses legal perspectives on environmental compliance monitoring and enforcement implications for the regulated community.	Available
UP	HEI	Mine Dewatering Design and Implementation	This course covers the basics and advanced detailed planning for the accurate control and management to prevent uncontrolled water ingress to open pit and underground mines, the mine types studied range from simple open pit to complex block caves and include examples from base metals, precious metals, diamonds, industrials and coal. The dewatering aspects of transition from open pit to underground mine is also covered. Delegates will be trained in the basic theory of mine dewatering and the application of the knowledge to real world situation. The steps required to design and implement a successful and cost effective dewatering strategy will be learned, including; project assessment, planning, site investigations, data interpretation and management, types of dewatering, monitoring techniques and permit preparation. The course is very comprehensive and includes all types of mines and minerals worldwide. Delegates will develop a dewatering strategy and implementation plan for their chosen mine. Emphasis is on understanding the sources, pathways followed by water into a mine then devising the best approach to control the water and enhance mine production. Focus is on a thorough understanding of how water impacts a mine and all the techniques available to control the water including pumping, diversion, and grouting and storm water control.	Available
UP	HEI	Modelling and Simulation of Wastewater Treatment Processes	The short course in Modelling and Simulation of Wastewater Treatment Processes provides you with a framework for demonstrating and fine-tuning the processes that are commonly used in wastewater treatment plants. During the course, basic kinetic concepts for the removal of water pollutants will be presented together with the application of kinetic principles in several reactor designs. You will not only be provided with a comprehensive overview of important biochemical kinetic reactions, but you will also be able to apply practical skills and expand your knowledge in the design and operation of real systems through specialised software that simulates these processes.	Available
UP	HEI	Operation of Water and Wastewater Treatment Plants	The Operation of Water and Wastewater Treatment Plants short course provides you with a theoretical and practical knowledge base on water and wastewater treatment, as well as the operation of water treatment plants. During the course, you will be empowered to make informed decisions about drinking water treatment processes and the quality of drinking water. The course also covers topics of basic water chemistry, drinking water quality requirements, wastewater treatment, effluent quality and the proper disposal of effluents. You will be able to apply your acquired skills to better evaluate the operation and control of water and wastewater treatment plants.	Available

Name of Institution	Institution	Name of Short Course	Course Description (Brief Overview)	Availability
UP	HEI	The Vadose Zone: Hydrology of Variable Saturation in Engineering Geology and Hydrogeology	Variably saturated flow conditions are increasingly relevant to geotechnical and hydrogeological assessments. This is most evident in the so-called vadose zone that extends from land surface to the phreatic surface, and which is characterized by variably saturated hydrological systems mostly at negative pore water pressures. This zone is fundamental in understanding the subsurface component of the hydrological cycle, emphasizing processes such as evapotranspiration, interflow, and groundwater recharge. Variable saturation provides special conditions whereby water not necessarily gravitates, and where aerobic or oxidizing conditions can exist. This has important implications on groundwater recharge, vulnerability and susceptibility to contamination, as well as on the integrity of infrastructure and water management in the built environment.	Available
UP	HEI	Water Analysis and Monitoring	Course specifically designed to update on current & new methods of sampling, handling, analysis & data management that have recently emerged towards better decision-making in the field of water resource treatment & preservation. The water quality of natural water resources around the world is in a state of decline due to nutrient inputs from various municipal, industrial and/or agricultural activities. This course equips you with the innovative skills & practical know-how to reverse the trends towards hypertrophication in water bodies and to make recommendations for advanced treatment of effluent sources.	Available
UP	HEI	Water Quality Management and Effluent Treatment	The Water Quality Management and Effluent Treatment short course provides you with a comprehensive overview of and practical insights into the various processes that are involved in the evaluation of drinking water quality, as well as water and wastewater treatment. The course covers topics of basic water microbiology and chemistry, biological treatment processes, sludge treatment and effluent disposal, as well as biological, chemical and physical water quality parameters, the flow of material and mass balances, among others. The course will ultimately empower you to make more informed decisions around the treatment, operation and control of water and wastewater treatment plants.	Available
UNISA	HEI	Short Course in Environmental Law & Environmental Management Legal Enforcement (76983)	Short course to develop competencies in the law aspects behind environmental management enforcement and to develop competencies in conducting environmental management compliance inspections and investigating suspected non-compliance and gaining experience in the practical application of the legal principles of Environmental compliance and enforcement with special emphasis on Environmental law.	Available
WITS	HEI	Mining and The Environment	To gain an understanding of the theory, concepts and legislation related to mining and the environment so that the student is able to broadly identify and develop plans to address environmental impacts associated with mining activities.	Unavailable (now Mining Engineering)
WITS	HEI	Water Law	The Water Law course is intended to facilitate a comprehensive and critical engagement with the principles, policies, institutions and regulatory framework governing the management and use of raw water in South Africa. The themes of the course will include a strong transformation focus; the nexus between water, energy and food; environmental and social justice; ecological integrity and allocation of water resources. It will consider the constitutional obligations relating to the right to water and aims to stimulate a deeper awareness and understanding of these constitutional obligations and the entitlements to which they give rise.	Unavailable (last offered: 2019)
WITS	HEI	Climate Change and Energy Law	Climate Change and Energy Law will provide students with a comprehensive understanding of the international climate change regime, South African climate change policy, and the country's commitment to mitigate its greenhouse gas emissions. The course will thereafter examine, from the perspective of meeting demand for electricity and transport fuels in light of South Africa's climate change obligations, the governance and regulation of fossil fuels (coal, oil and natural gas), unconventional gas (fracking), nuclear power, and renewable energy.	Available
UNIVEN	HEI	Catchment Management strategy	The course gives the principles of water quality management with detailed overview of DWAF's best practice guidelines and the National Water Resource Strategy. After completing this course learners will understand the principles of water quality management according to the National Water Act 36 of 1998 and gain advantage over others during interviews for water management careers.	Available
UNIVEN	HEI	Water use License Authorization (WULA) Application Process and Legislated Requirements	To increase the level of understanding and application of the Integrated Water Use Licence Application/Water and Waste Management Plan. (IWWMP).This is a critical need for most of the employees responsible for the Environmental Management of the various institutions.	Available
ARC	Research & innovation specialist organisations	Irrigation Water Saving technologies	A training course on Irrigation Water Saving technologies with a special focus on smallholder irrigators. The course is highly hands on for participants in the form of interactive lectures, demonstrations and practical exercises.	Available

Name of Institution	Institution	Name of Short Course	Course Description (Brief Overview)	Availability
ARC	Research & innovation specialist organisations	Climate-smart agricultural technologies	Knowledge on the application of applicable climate-smart agricultural technologies and practices	
ARC	Research & innovation specialist organisations	Irrigation Systems Planning and Design	To introduce participants to: the importance of irrigation in agricultural production & food security, soil-plant-water-atmosphere relations, components of irrigation systems, & irrigation scheduling. To equip participants with working knowledge on: selection criteria for irrigation systems; the operational principles of irrigation systems & interpretation of troubleshooting incidences.	Unavailable
ARC	Research & innovation specialist organisations	Irrigation Design and Evaluation	Training in the field evaluation of an irrigation system. It will entail the theory and the investigation of the actual performance of an existing irrigation system. It will take into account the operation of the pump station, the pipeline supply network and the field irrigation system.	Available
ARC	Research & innovation specialist organisations	Sustainable Farming Systems and Natural Resources Conservation	To understand the importance of maintaining and increasing biodiversity and the role of natural resource management in sustainable agricultural practices. To understand more about sustainable agricultural practices, applied in the animal, plant and mixed farming sub-field, benefiting the environment. To plan farming practices with knowledge of the environment.	Unavailable
ARC	Research & innovation specialist organisations	Rainwater Harvesting	To introduce prospective farmers and extension officers to rainwater harvesting and crop plantations	Available
CAPNET	Research & innovation specialist organisations	Water Pollution Management in Achieving SDG Target 6.3	The course aims to improve practitioners' understanding of water pollution drivers, stakeholder involvement, and strategic planning for pollution prevention and management. The course considers the interlinkages among different sectors and issues related to water pollution and provides guidance on identifying interdisciplinary challenges, bringing them into policy discourse, and planning for pollution prevention and management.	Available
CAPNET	Research & innovation specialist organisations	Preparing proposals to access funding for groundwater-related infrastructure	The purpose of this course is to increase knowledge & skills & build capacity to prepare successful funding proposals for groundwater related infrastructure, emphasising the importance of treating groundwater as a resource in a sustainable manner. This course will teaches the development of successful project proposals.	Available
CAPNET	Research & innovation specialist organisations	Water Integrity: Principles and Concepts	This online instructor-led course aims to create awareness and strengthen water governance through increased knowledge on how to improve transparency and accountability.	Available
CAPNET	Research & innovation specialist organisations	Integrated Urban Flood Risk Management (IUFRM)	Urban flooding is a serious and growing development challenge. The main objective of this online course is to change the mindset and the decision-making behavior of the water professionals and related decision makers in the government and the private sector. Another objective is to change the way of thinking (mindset) of water professionals and decision-makers from the traditional way of structural engineering design applying existing rainfall-runoff calculation methods and models to one that thinks in terms of risk and probabilities.	Available
CAPNET	Research & innovation specialist organisations	GEF IW:LEARN International Waters Project Management Course	The International Waters Project Management Online Course intends to be a primer for new project staff and those key stakeholders (implementing and executing agency staff, government officials and civil society partners) to understand the processes and approaches used in GEF IW projects.	Available
CAPNET	Research & innovation specialist organisations	A Human Rights Based Approach (HRBA) to Integrated Water Resources Management (IWRM)	This online course brings together two fields that, until recently, have been separate: human rights and IWRM. These two fields have been brought together as awareness has grown within the human rights community that water management is fundamental to the realisation of a range of human rights	Available

Name of Institution	Institution	Name of Short Course	Course Description (Brief Overview)	Availability
CAPNET	Research & innovation specialist organisations	Water Education for Sustainability and Global Citizenship	This online course aims to create awareness and strengthen water education through increased knowledge on how to embed it into a more challenging and meaningful approach towards Education for Sustainability	Available
Chris Swartz Water Utilisation Engineers (CSWUE)	Research & innovation specialist organisations	Water Quality Management	Development of skills and competencies	Available
Green Cape	Research & innovation specialist organisations	Alternative water installation	To equip qualified plumbers with the necessary skills and knowledge to safely install the alternative water supply to residents in Cape Town	Available
Gerald de Jager	Research & innovation specialist organisations	Introduction to Water Resources Planning*	Introduction to water resources, planning, and managing risk, basic water resources modelling principles	Available
Gerald de Jager	Research & innovation specialist organisations	Introduction to Water Resources Yield Model (WRYM)*	Role of Water Resources Yield Model (WRYM) in the planning process, configuration, testing, and execution of the model. Careers in water resource planning, water infrastructure development, hydrological modelling, and climate change adaptation planning.	Available
Gerald de Jager	Research & innovation specialist organisations	Introduction to the WRSM2000 Rainfall-Runoff Model*	A hands-on, practical introduction to the Water Resources Simulation Model 2000 (WRSM2000); an application in the water resources planning process	Available
The Water Academy	Research & innovation specialist organisations	Process Controller Trainee	A qualifying learner will be able to explain the elements of the water cycle and water catchment management and gain a broad perspective of the water sector including relevant legislation. This knowledge will equip the learner with the foundational knowledge and understanding of water that is required to function effectively within the water sector as this knowledge is required in all areas. This competence will enable the learner to value water as a scarce resource and share this knowledge to improve community understanding of the importance of conserving water resources.	Available
The Water Academy	Research & innovation specialist organisations	Process Controller Shiftman	This course focuses process controllers on the practical application of the occupational Health and Safety Act (OHSA) to work on a water or wastewater treatment works. It raises awareness of their roles and responsibilities within the OHSA.	Available
The Water Academy	Research & innovation specialist organisations	Process Controller Supervisor	Provides in depth knowledge and use of: Various disinfection technologies, Operation and use of chlorination equipment, Connecting and disconnecting chlorine cylinders, Dosage Calculations, Residual chlorine measurement, and measuring and interpreting chlorine dosage	Available
The Water Academy	Research & innovation specialist organisations	Reticulation Serviceman Trainee	Knowledge for reticulation servicemen and includes: different types of pipes and fittings, specifications for pipes fittings, types of valves used in reticulation services, types of meters used in reticulation services, methods for handling and storing pipes, valves and meters.	Available
The Water Academy	Research & innovation specialist organisations	Reticulation Serviceman Assistant	Water treatment systems, Water distribution systems, Cleaning pipe systems good practising to prevent contamination during construction during construction during construction maintenance, Cleaning reservoirs	Available
The Water Academy	Research & innovation specialist organisations	Reticulation Serviceman Team Leader and Supervisor	Read and Interpret maps and engineering drawings of water and wastewater reticulation systems	Available

Name of Institution	Institution	Name of Short Course	Course Description (Brief Overview)	Availability
Water Utilities Corporation	Research & innovation specialist organisations	Pipefitting and Water Technology	Understand basic water treatment technologies. Application of sterilisation after pipe laying and understanding different pipe materialism	Available
IMESA	Professional Body	Design Guidelines for Small Coastal Stormwater Outlets	To present comprehensive design guidelines for small coastal stormwater outlets; including: coastal processes; design methods; beach usages; aesthetics and location; shoreline changes and scour; protection of the outlet; water quality; and to list applicable legislation. Recommendations on the construction of small stormwater outlets will also be made.	Available
IMESA	Professional Body	Capacity Building Design Guidelines for Small Coastal Stormwater Outlets	To provide training to relevant municipal personnel and practising engineers by presenting comprehensive design guidelines for small coastal stormwater outlets.	Available
IMESA	Professional Body	Infrastructure Asset Management	To empower and refresh participants by exploring : (1) Infrastructure Asset Management (4 days), (2) 10 Step Program to Developing and Asset Management Program (2 days), (3) Risk Management Guidelines, (4) Maintenance Guidelines , (5) GRAP 17, (6) IIMS, (7) Condition Assessment	Available
IMESA	Professional Body	Water Conservation/Water Demand Management	Water Conservation/Water Demand Management tool for Municipalities	Available
IMESA	Professional Body	Water Reclamation/Reuse Guidelines	Water Reclamation/Reuse Guidelines for designers in the Local Government.	Available
IMESA	Professional Body	Capacity Building Guidelines in URP Project*	Municipality technical capacity building and design guidelines	Available
IMESA	Professional Body	New Developments in Water and Wastewater Treatment for Municipal Engineering Personnel		Available
IMESA	Professional Body	Sustainable Infrastructure Asset Management (SIAM): Asset Management Program Learning Environment (AMPLE) learning system	Web-based tool or knowledge management system that provides a set of online process and practice guidelines, templates and decision support tools that will simplify the development of consistent Asset Management Strategic Plans (AMSP), provide effective implementation guidelines for agencies to assess and drive meaningful improvements in asset management and list asset management systems from around the world.	Available
SAAMA	Professional Body	Engineering Asset management and Asset maintenance	Not provided	Unavailable
SAAMA	Professional Body	Water Treatment: Advanced Design, Operations, Maintenance and Trouble Shooting	Not provided	Available
SAAMA	Professional Body	Dams Management, Operations	Not provided	Unavailable
SAAMA	Professional Body	Sewer System Design and Construction	Not provided	Unavailable
SAAMA	Professional Body	Groundwater Modelling	Not provided	Unavailable
SAIAE	Professional Body	Small dam design principles	The practical understanding of the principles in small dam designs. Irrespective of how a dam is classified, the conditions and requirements as set according to its size and threat potential must be met.	Unavailable (last offered: 15-16 August 2018)
SAIAE	Professional Body	Hygienic design of Food Processing plants	The course aims to make established & potential food processors aware of the standards that are required for modern, safe food processing installations, how to implement such standards & what documentation with regard to such standards is available locally.	Unavailable

Name of Institution	Institution	Name of Short Course	Course Description (Brief Overview)	Availability
SAICE	Professional Body	Water Law of South Africa	Course to understand the principles of the water law of South Africa. The course will familiarise the attendees with these principles so that they have a better working knowledge & understanding thereof and can afterwards participate with confidence in their daily work.	Available
SAICE	Professional Body	Surface Water and Integrated 1D-2D Modelling with EPA SWIMMS and PCSWMM	Getting modelers up to speed on the full capabilities of PCSWMM & EPA SWMM5 software packages (theory, time-saving tools & practical hands-on applications of hydrologic & hydraulic modeling for stormwater, wastewater & watershed systems, with special emphasis on system design, system remediation, green infrastructure (LIDs), integrated 1D-2D & flood modeling).	Unavailable
SAICE	Professional Body	Getting acquainted with sewer design	The composition of complete sewerage systems, including the conveyance network, treatment works & associated infrastructure. The selection of appropriate sanitation systems & the challenges associated with operations & maintenance. The design of sewerage networks, including the selection of pipes and fittings & the parameters to be considered when laying pipes. Policies, guidelines, health, hygiene & community requirements which must be considered when designing sewerage systems & associated community education.	Unavailable
SAICE	Professional Body	Equipment options to reduce hammer water	To provide delegates with a better understanding of what causes water hammer & what practical solutions are most common	Available
SAICE	Professional Body	Pressure Pipeline and Pump Station Design and Specification – A Practical Overview	Course to help candidates understand the complexity and importance of design and operation of pressure pipelines and pump stations (Selecting appropriate materials & fittings, losses & water hammer, how to read & interpret pump duty curves, the construction process).	Available
SAICE	Professional Body	Getting Acquainted with Water Resource Management	By attending this course, delegates will gain insight into: Water uses and constraints, Yields and water balances, Governing legislation & Other issues including climate change	Available
SAICE	Professional Body	Stormwater Drainage	Unavailable	Unavailable
WISA	Professional Body	Water Governance	This three-day course has been designed to facilitate understanding of the principles of Water Governance from a Human Rights perspective, and covers international water governance approaches, sustainable water resource management initiatives, and the implementation of measures in South Africa through statutes, the relevant regulations made under these laws, as well as their respective requirements for authorisation. It furthermore focusses on facilitating understanding of water use authorisation and the circumstances under which a water use license (WUL) is required, as well as of the process to apply for (and amend) a WUL.	Available
WISA	Professional Body	Serving the Water Sector with Professionalism	This theme will address the fundamentals of both water and wastewater treatment process control with a different perspective – presenters/facilitators will all be Professional Process Controllers.	Unavailable
WISA	Professional Body	Advanced Water Treatment Control: Coagulation & Flocculation	Online course aimed at Process Controllers, Superintendents, Plant Managers, Plant Technicians, and Water Sector Officials. An Assessment will be conducted upon conclusion of the course to ensure quality and a CPD certificate will be awarded to successful learners.	Available
WISA	Professional Body	Advanced Water Treatment Control: Activated Sludge	Many of the Process Controllers who are involved in wastewater treatment are quite proficient in their understanding of the processes being applied during treatment, but need some assistance when it comes to the calculations required to optimise these processes. This course focuses on those calculations as they apply to the Secondary Treatment Processes, especially Activated Sludge. The course is intended to be an interactive training event where the calculations will be unpacked, practiced and then interpreted in practical on-site situations.	Unavailable
WISA	Professional Body	Energy Efficiency Audits at a Wastewater Treatment Works		Unavailable

Name of Institution	Institution	Name of Short Course	Course Description (Brief Overview)	Availability
WISA	Professional Body	Anaerobic Digestion of Municipal Wastewater Sludge		Available
WISA	Professional Body	Catchment Management	A detailed in-depth look into sustainable resource management approaches from a catchment perspective, in contrast to a piecemeal approach that artificially separates land management from water management. This holistic view can define ways for protecting the surrounding land around drinking water sources. The course will explore the major issues and the changes required by all stakeholders, highlighting current research and available tools in order to aid better decision making.	Available
WISA	Professional Body	Emerging Pollutants	In depth look into the raft of new & unknown pollutants that are entering our waterways. The course will explore pollution pathways, impact of the pollutants & potential preventative measures to minimise & prevent further deterioration.	Available
WISA	Professional Body	Water Governance	This Course covers international water governance perspectives, sustainable water resources management initiatives, and the implementation of measures in South Africa through statutes such as the NEMA, NWA, WSA, and the Promotion of Administrative Justice Act, and relevant regulations. Practical aspects associated with the substantive and procedural issues around WULs, as currently described in regulations, procedures and guidelines of the Department of Water and Sanitation (DWS), including the preparation of specific documents such as Integrated Water and Waste Management Plans (IWWMPs), and regulatory requirements for water quantity and quality monitoring, as well as the auditing of compliance with WUL-conditions, and the amendment of an incorrect WUL, are also addressed.	Available
WISA	Professional Body	Advanced Wastewater Treatment Control: Secondary Treatment Process		Available
WISA	Professional Body	Technical Assessment of Wastewater Treatment Plants	The Green Drop programme of the Department of Water and Sanitation incorporates this principle in the Green Drop Audit programme with several sections of the scoresheet asking for information about maintenance, operation and human competence. A cornerstone for a well operated and maintained Wastewater Treatment Works, is regular inspection of electrical, mechanical, civil and instrument components associated with the treatment processes. The more structured the inspection, the more valuable the results, the better the effluent quality. It is the purpose of this one day course to help staff at wastewater treatment works towards an efficient technical assessment by demonstrating the application of the WRC checklist and other practical tools: Theoretical motivation for inspection; In-class examples of defects on plants and its implications; Practical coaching sessions on a wastewater treatment plant; Application of what has been learner by completing an inspection at the participants own wastewater treatment works.	Unavailable
WISA	Professional Body	Advanced Water Treatment Control: Coagulation & Flocculation		Available
WISA	Professional Body	Quantitative Microbial Risk Assessment	Treatment plants and monitoring systems are used to control the quality of drinking water supplied to the consumers; drinking water must be treated to remove pathogens so that it will not cause any diseases through water-borne outbreaks. A useful method to make estimations of the number of people being infected by the drinking water is to carry out a quantitative microbial risk assessment (QMRA). The Swedish water and wastewater association financed the development of a computer based QMRA model. This tool will be used in this course to enable participants to study the risk of infection for the consumers in a number of different local drinking water treatment plants (WTPs), with different treatment processes and various raw water qualities based on different scenarios. An assessment will be conducted and CPD certificate awarded to successful candidates	Available
WISA	Professional Body	Water Conservation and Water Demand Management Capacity Building Course	The importance of managing existing water resources through Water Conservation and Water Demand Management (WC/WDM) initiatives and measures. A framework has been developed to facilitate the implementation of WC/WDM by the mining sector. Participants will improve their understanding of the principles, guidelines and procedures for WC/WDM applicable for the sector, and gain an understanding of water use efficiency (WUE) benchmarks for various mining subsectors and gain insight to how to approach WC/WDM in the mining sector.	Available

Name of Institution	Institution	Name of Short Course	Course Description (Brief Overview)	Availability
WISA	Professional Body	The Sustainable Operation and Maintenance of Water Treatment Works	The Sustainable Operation and Maintenance of Small Water Treatment Plants short course provides participants with a sound theoretical and practical knowledge base on water treatment, as well as the operation and maintenance of water treatment plants. The course will enable participants to evaluate the operation and control of water treatment plants, and to draw up and implement operational and monitoring programs, as well as maintenance schedules.	Available

9.4 APPENDIX D Online Questionnaire Results

Course name	Institution	Objective	Accreditation
Tools for Wetland Assessment	RU	Wetland delineation, assessment of wetland ecosystem services, assessment of wetland integrity, buffer guidelines,	CPD, SACNASP
Alternative water installation*	Green Cape	To equip qualified plumbers with the necessary skills and knowledge to safely install the alternative water supply to residents in Cape Town	No accreditation
Introduction to Water Resources Planning*	Gerald de Jager (Pty) Ltd	Introduction to water resources, planning, and managing risk, basic water resources modelling principles	No accreditation
Introduction to Water Resources Yield Model (WRYM)*	Gerald de Jager (Pty) Ltd	Role of Water Resources Yield Model (WRYM) in the planning process, configuration, testing, and execution of the model. Careers in water resource planning, water infrastructure development, hydrological modelling, and climate change adaptation planning.	No accreditation
Introduction to the WRSM2000 Rainfall-Runoff Model*	Gerald de Jager (Pty) Ltd	A hands-on, practical introduction to the Water Resources Simulation Model 2000 (WRSM2000); an application in the water resources planning process	No accreditation
Short course consultations*	DUT	Water utility in municipal governance	"Accreditation process by an external agency should be efficient"
Water Conservation/Water Demand Management*	IMESA	Water Conservation/Water Demand Management tool for Municipalities	NQF Level 6
Water Reclamation/Reuse Guidelines*	IMESA	Water Reclamation/Reuse Guidelines for designers in the Local Government.	In process (ECSA)
Small Coastal Stormwater Outlets	IMESA	Design appropriate Stormwater outlets	In process (NQF Level 6) (ECSA)
Capacity Building Guidelines in URP Project*	IMESA	Municipality technical capacity building and design guidelines	In process (NQF Level 5) (ECSA)
Irrigation Design Course	ARC	Understand the interaction between soil, water, climate, and plants during irrigation. Apply the principles of hydraulics to plan and design the different components of irrigation systems	NQF Level 5 with SABI
Climate-smart agricultural technologies*	ARC-SCW & AE	Knowledge on the application of applicable climate-smart agricultural technologies and practices	No accreditation
Pump station design	UP	Provide theoretical background and understand the steps required in pump station design	NQF Level 8 (CPD) (ECSA)

Course name	Institution	Objective	Accreditation
Free Surface Flow Modelling	UP	Provide a theoretical sound background in hydraulic analyses and provide a greater understanding of numerical modelling	NQF Level 7 (CPD) (ECSA)
Pipeline system design	UP	Understand the various components of pipeline design and obtain the confidence to design a pipeline system	NQF Level 8 CPD (ECSA)
Flood hydrology and urban runoff modelling	UP	Familiarise delegates with the various flood estimation methods: Introducing numerical modelling used in urban drainage. Understanding of the limitation of the flood estimation methods.	NQF Level 8 CPD (ECSA)
Transient flow in pipe systems*	UP	Delegates build a sound understanding of how the dynamic analyses are performed. Delegates will gain knowledge on the various surge alleviating devices.	NQF CPD (ECSA)
Aquatic Ectothermic Vertebrates Handling and Ethics	NWU	To inform all involved participants of animal welfare cross-cutting principles. Knowledge of general SOPs involved in the general handling of aquatic ectothermic vertebrates. Knowledge of specific SOPs involved in the handling of specific aquatic ectothermic vertebrates	NQF Level 6 (CPD) (SACNASP)
Water Quality Management*	Chris Swartz Water Utilisation Engineers (CSWUE)	Development of skills and competencies	NQF Level 6 at the Water Boards and Utilities
Pipefitting and Water Technology*	Water Utilities Corporation	Understand basic water treatment technologies. Application of sterilisation after pipe laying and understanding different pipe materialism	NQF Level 1
National Certificate: Water and Wastewater Treatment Process Operations*	CPUT	Apply fundamental knowledge and understanding of current legislation specific to water and wastewater treatment. Operate process at a water and wastewater treatment works. Demonstrate an understanding and knowledge of equipment to be used to perform water and wastewater treatment works. Apply basic health and safety principles in the workplace	NQF Level 2 (CPD)
National Certificate: Water and Wastewater Process Control (NQF Level 3)*	CPUT	Use the system international (SI) and appropriate formulae to perform calculations needed to operate water and wastewater treatment plant. Perform water quality analysis and monitoring. Compare water and wastewater works performance with legislative and workplace requirements at an operational level. Apply communication and leadership skills in the work environment. Demonstrate administration required on a wastewater treatment works.	NQF Level 3 (CPD)
Process Control Supervision (Level 4)*	CPUT	Operate water and/or wastewater works. Demonstrate knowledge of hydraulics, valves, pumps, and motors. Demonstrate knowledge of relevant national laws, regulations, and guidelines as they apply to water or wastewater treatment. Demonstrate an ability to supervise and lead a team, problem-solving and investigative skills	NQF Level 4
Water Sensitive Urban Design and Planning (WSUDP)*	UCT	Overview of urban water challenges. Introduction to WSUDP concepts. WSUDP framework for implementation in SA. Specifics on WSUD planning and designing at different scales	NQF Level 8
END5129S: Sustainable water management in Africa *	UCT	Understand the urban water system and key drivers. Working knowledge of water scarcity, its link to climate change, and its impact on developing nations and on meeting	NQF Level 9 (20 CPD points) (ECSA)

Course name	Institution	Objective	Accreditation
		the SDGs. Understand key technologies for water supply, demand and quality, and their intrinsic link to the water-food-energy nexus. Know the more important options associated with the three main water services and the linkages between them	
Flood hydrology	SU	Advance knowledge on flood calculation methods to post graduate students. Apply all methods. Aware of the newest methods and developments	NQF Level 7
Water resource management	SU	Application of modelling techniques. Aware of the newest developments in water resources	NQF Level 9

** Unique listing (not identified in the desktop study)*