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Final Report

Sachbericht Zum Verwendungsnachweis

Teil I & II

NEU Water
Nature Engineered Urban design for Water recycling & reuse
Natur-Technische Stadtentwicklung für Wasserrecycling und Wiederverwendung

Initial phase of co-operation project funded under the Water Security in Africa (WASA) of Federal Ministry of Education and Research (BMBF)

Initialphase des Kooperationsprojekts, das im Rahmen des Programms Wassersicherheit in Afrika (WASA) des Bundesministeriums für Bildung und Forschung (BMBF) gefördert wird

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Research Consortium – NEU Water

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Teil I: Kurzbericht//Short Summary

(Deutsch)

Aufgabenstellung und wissenschaftlich-technischer Stand, an den angeknüpft wurde

Das NEU Water Projekt zielt darauf ab, die dringenden Herausforderungen der Wassersicherheit in Südafrika anzugehen, mit besonderem Schwerpunkt auf der Westkap-Region durch das Management von Grau- und Regenwasser. Das Projekt zielte darauf ab, Prinzipien der wassersensiblen Stadtplanung (WSUD) umzusetzen, um die Wasserknappheit zu mildern und nachhaltige Wassermanagementpraktiken zu fördern. In diesem Zusammenhang legte das Projekt den Schwerpunkt auf die Einführung dezentraler und naturnaher Strategien, die sowohl auf informelle Siedlungen als auch auf Gebiete mit hoher Bevölkerungsdichte und mittlerem Einkommen abzielten.

In der Anfangsphase des NEU Water-Projekts ging es darum, den regionalen Kontext zu verstehen und die förderlichen und hinderlichen Faktoren für die erfolgreiche Integration von WSUD-Maßnahmen zu identifizieren. Umfassende Schreibtischstudien wurden durchgeführt, um die bestehenden politischen Strategien, Vorschriften und institutionellen Rahmenbedingungen im Zusammenhang mit der Wasserwirtschaft zu untersuchen. Diese Analyse gab Aufschluss über die Lücken und Hindernisse, die beseitigt werden müssen, um die breite Einführung von Wasserrecyclingverfahren in Südafrika zu erleichtern.

Darüber hinaus spielte die Einbeziehung von Interessengruppen eine entscheidende Rolle im Projekt. Das Projektteam arbeitete aktiv mit lokalen Gemeinden, Regierungsbehörden, akademischen Einrichtungen und relevanten Organisationen zusammen, um Einblicke in ihre Perspektiven und Prioritäten in Bezug auf die Wasserwirtschaft zu gewinnen. Dieser kooperative Ansatz stellte sicher, dass die Ziele des Projekts mit den Bedürfnissen und Wünschen der verschiedenen Interessengruppen übereinstimmten.

In der Anfangsphase zielte das NEU Water-Projekt darauf ab, einen gangbaren Weg für die Integration von Wasserrecycling und WSUD in die Stadtplanung Südafrikas zu entwickeln. Durch die Untersuchung der wissenschaftlichen und technischen Aspekte der Umsetzung dieser Maßnahmen sollte das Projekt innovative Lösungen aufzeigen, Herausforderungen bewältigen und praktische Empfehlungen für politische Entscheidungsträger und Stadtplaner geben. Die Hauptphase des Projekts wird darauf abzielen, das Verständnis dieser Konzepte zu verbessern, Systemlösungen zu testen und die Rahmenbedingungen für die Nachhaltigkeit solcher Systeme zu entwickeln.

Ablauf des Vorhabens

Die Initialphase des NEU Water-Projekts war in fünf verschiedene Arbeitspakete gegliedert, um einen systematischen Ansatz zu ermöglichen und eine umfassende Abdeckung der Projektziele zu gewährleisten. Die Arbeitspakete 1 und 2 konzentrierten sich auf die Durchführung eingehender Bewertungen des politischen und rechtlichen Rahmens für die Wasserwirtschaft in Südafrika. Ziel dieser Bewertungen war es, potenzielle Lücken und Herausforderungen zu ermitteln, die einer breiten Einführung von Wasserrecyclingverfahren im Wege stehen. Die Erkenntnisse aus diesen Arbeitspaketen wurden in einem Entwurf für ein Strategiepapier und ein Dokument zusammengefasst, in dem Risikobewertungsmethoden und vorläufige technologische Lösungen für den Umgang mit potenziellen Schadstoffen in recycelten Wasserströmen beschrieben werden.

Die Arbeitspakete 3 und 4 zielten darauf ab, solide Forschungskooperationen aufzubauen und die Beziehungen zu den Interessengruppen zu verbessern. Die Projektteams an der Hafencity

Universität Hamburg (HCU) und der University of Cape Town (UCT) förderten den Wissensaustausch, den Aufbau von Kapazitäten und gemeinsame Forschungsaktivitäten. Durch gemeinsame Treffen, Workshops und Besuche vor Ort gewann das Projektteam wertvolle Einblicke in den lokalen Kontext und nutzte das Fachwissen der akademischen Partner, um innovative Strategien zur Integration von WSUD-Prinzipien in die Stadtplanung zu entwickeln. Arbeitspaket 5 konzentrierte sich auf das finanzielle und administrative Management des Projekts.

Wesentliche Ergebnisse des Vorhabens

Die Initialphase des NEU Water-Projekts brachte mehrere wichtige Ergebnisse hervor, die eine solide Grundlage für die nachfolgenden Projektaktivitäten bildeten. Arbeitspaket 1 führte zu einem Entwurf für ein Strategiepapier, das wichtige Erkenntnisse über die bestehenden rechtlichen und regulatorischen Rahmenbedingungen in Südafrika enthält und Maßnahmen vorschlägt, um die Einführung von Wasserrecyclingverfahren zu ermöglichen. Dieses Strategiepapier diente als wertvolle Ressource für politische Entscheidungsträger und enthielt Empfehlungen zur Unterstützung politischer Reformen und zur Verbesserung des institutionellen Umfelds für eine nachhaltige Wasserwirtschaft.

In Arbeitspaket 2 erarbeitete das Projektteam einen umfassenden Studienbericht, der sich auf Risikobewertungsmethoden und vorläufige technologische Lösungen für den Umgang mit potenziellen Schadstoffen in recycelten Wasserströmen konzentrierte. Dieses Dokument lieferte eine wissenschaftliche Grundlage für den Entwurf und die Umsetzung sicherer Wasserrecyclingsysteme, die den Bedenken in Bezug auf die Wasserqualität und die öffentliche Gesundheit Rechnung tragen.

Durch die Arbeitspakete 3 und 4 wurde eine erfolgreiche Forschungszusammenarbeit zwischen der HCU, der UCT und den Interessengruppen im Projektgebiet aufgebaut, die den Aufbau von Kapazitäten und den Wissensaustausch zwischen den beiden Einrichtungen förderte. Diese Zusammenarbeit ermöglichte den Austausch von bewährten Verfahren, Forschungsergebnissen und technischem Fachwissen und trug zur Entwicklung innovativer Ansätze für eine wassersensible Stadtgestaltung bei. In dieser Phase wurde auch das Projektkonzept für die Hauptphase formuliert, das die Komponenten der angewandten Forschung, der Demonstration und des Kapazitätsaufbaus umreißt, die die nächste Phase des NEU Water-Projekts bestimmen werden.

Darüber hinaus suchte das Projektteam aktiv nach neuen Partnerschaften und bezog weitere Interessengruppen in die Hauptphase mit ein. Dieser proaktive Ansatz sorgte für eine breitere Zusammenarbeit, mehr Unterstützung und ein umfassenderes Verständnis der Herausforderungen und Möglichkeiten, die mit der Wasserwirtschaft in der südafrikanischen Westkapregion verbunden sind.

(English)

Task and Scientific-Technical Status:

The NEU Water project aims to address the pressing water security challenges faced in South Africa, with a particular focus on the Western Cape region through management of greywater and stormwater. The project sought to implement water-sensitive urban design (WSUD) principles to mitigate water scarcity and promote sustainable water management practices. In this context, the project primarily emphasized the adoption of decentralized and nature based strategies, targeting both informal settlements and high-density middle-income areas.

The initial phase of the NEU Water project revolved around understanding the regional context and identifying the enabling and limiting factors for the successful integration of WSUD measures. Comprehensive desk studies were conducted, exploring existing policies, regulations, and institutional frameworks related to water management. This analysis shed light on the gaps and barriers that needed to be addressed to facilitate the widespread adoption of water recycling practices in South Africa.

Additionally, stakeholder engagement played a crucial role in the project. The project team actively collaborated with local communities, government agencies, academic institutions, and relevant organizations to gain insights into their perspectives and priorities regarding water management. This collaborative approach ensured that the project's objectives aligned with the needs and aspirations of the various stakeholders.

Through the initial phase, the NEU Water project aimed to develop a viable pathway for the integration of water recycling and WSUD into urban planning strategies in South Africa. By examining the scientific and technical aspects of implementing these measures, the project sought to identify innovative solutions, overcome challenges, and provide practical recommendations for policymakers and urban planners. The main phase of the project will be aimed at improving the understanding of these concepts, testing system solutions and developing the enabling environment for sustaining such systems.

Course of the Project:

The initial phase of NEU Water project was structured into five distinct work packages to facilitate a systematic approach and ensure comprehensive coverage of the project objectives. Work Packages 1 and 2 focused on conducting in-depth assessments of the policy and regulatory frameworks governing water management in South Africa. These assessments aimed to identify potential gaps and challenges that hindered the widespread adoption of water recycling practices. The findings from these packages were consolidated into a draft policy brief and a document outlining risk assessment methodologies and preliminary technological solutions for managing potential pollutants in recycled water streams.

Work Packages 3 and 4 aimed to establish robust research collaborations and enhance stakeholder relationships. The project teams at Hafencity Universität Hamburg (HCU) and the University of Cape Town (UCT) to foster knowledge exchange, capacity building, and collaborative research activities. Through joint meetings, workshop, and site visits, the project team gained valuable insights into the local context and leveraged the expertise of academic partners to develop innovative strategies for integrating WSUD principles into urban planning. Work Package 5 focused on financial and administrative management of the project.

Main Results of the Project:

The NEU Water project's initial phase yielded several significant outcomes, providing a solid foundation for subsequent project activities. Work Package 1 resulted in a draft policy brief that

outlined key insights into the existing legal and regulatory frameworks in South Africa and proposed measures to enable the adoption of water recycling practices. This policy brief served as a valuable resource for policymakers, offering recommendations to support policy reforms and enhance the institutional environment for sustainable water management.

In Work Package 2, the project team developed a comprehensive study report that focused on risk assessment methodologies and preliminary technological solutions for managing potential pollutants in recycled water streams. This document provided a scientific basis for designing and implementing safe water recycling systems, addressing concerns related to water quality and public health.

Through Work Packages 3 and 4 successfully established a research collaboration between HCU, UCT and the stakeholders at the project area, fostering capacity building and knowledge exchange between the two institutions. This collaboration enabled the sharing of best practices, research findings, and technical expertise, contributing to the development of innovative approaches to water-sensitive urban design. The project concept for the main phase was also formulated during this stage, outlining the applied research, demonstration, and capacity building components that would drive the next phase of the NEU Water project.

Furthermore, the project team actively sought new partnerships and engaged additional stakeholders to participate in the main phase. This proactive approach ensured broader collaboration, increased support, and a more comprehensive understanding of the challenges and opportunities associated with water management in the Western Cape region of South Africa.

Teil 2: Detailed Report

Project Background and Overview

Water security challenges in South Africa, particularly in the Western Cape region, have become increasingly prominent due to rapid urbanization, population growth, and climate change. The Western Cape has faced severe droughts in recent years, leading to water scarcity and highlighting the vulnerability of the region's water supply. As a response to these challenges, the concept of water-sensitive cities has gained significance. Water-sensitive cities integrate sustainable water management practices into urban planning and design, aiming to enhance water security, reduce demand on traditional water sources, and build resilience to future water stress. In the face of mounting water challenges, the need for water-sensitive cities in South Africa, especially in the Western Cape, has become crucial for ensuring a sustainable and resilient water future.

Water recycling, including stormwater and greywater reuse, has been practiced for centuries but is rarely implemented in today's urbanized world. Even in Europe, less than 5% of treated wastewater is reused. While numerous studies have demonstrated the economic and agricultural benefits of recycling, its adoption in informal settlements and dense urban areas, particularly in Southern Africa, remains limited. This project aims to address this issue from an urban planning perspective by applying the principles of water-sensitive urban design (WSUD). WSUD integrates holistic management of the urban water cycle into urban planning and design, considering all aspects of water management and urban design principles. It has been recognized as a key approach to combat urban water stress.

The initial phase of the NEUWater project focussed on understanding an enabling framework and technology options for exploring alternative water resources, specifically greywater and stormwater recycling, in the vicinity of Cape Town. Special focus was given on informal settlements and high density middle income settlements. These settlements due to service delivery gaps and limited land availability, pose complex challenges towards implement WSUD measures. They also face higher risks with respect to water security and are often generate substantial volumes of complex wastewater, which includes a mixture of human excreta, greywater, and stormwater. This untreated wastewater is discharged into water systems, posing threats to freshwater quality and human/environmental health.

NEU Water aims to assess and address the policy and technology challenges of water recycling within the context of water-sensitive urban design and develop strategies to overcome them. The initial phase was hence designed as a pre-feasibility study for identifying the enabling and limiting factors for the adoption of stormwater and greywater recycling and to develop a concept for the main phase of the project. The objective of the initial phase was set as

Assessment of regional/local context and development of a viable transition pathway for integration of stormwater & greywater recycling and water sensitive urban design into Urban planning in South Africa

Based on these, the activities involved were desk studies to assess the potential for such initiatives and stakeholder engagement to foster collaboration and consensus and to learn from local practitioners. These were briefly divided into 5 work packages as listed in the upcoming section. The initial phase was planned from December 1, 2021 to February 28, 2023. The project team interacted with several stakeholders during this project period through informal interviews and research meetings.

Key Facts about the project

Project title	Natur-Technische Stadtentwicklung für Wasserrecycling und Wiederverwendung
Acronym	NEU Water
Lead	HafenCity Universität Hamburg (HCU)
Partners	University of Cape Town (UCT)- Future Water Institute, Cape Town, ZA URBANWaters Consulting (UWC) GmbH, Lübeck, DE Ardhi University (ARU) - School of Spatial Planning and Social Sciences, Dar es Salaam, TZ
Duration (Initial Phase)	01.12.2021 - 28.02.2023

Need for Research

Water sensitive urban design (WSUD) and the implementation of decentralized and nature-based solutions are proven strategies towards reducing water security risks. They are highly relevant in the context of the Western Cape region of South Africa due to the stress related to water quality and availability in the region. With increasing urbanization and climate change impacts and the existing infrastructure gaps especially in informal settlements, the region faces recurrent water scarcity and a growing strain on traditional water management systems. In the recent years, the City of Cape Town had announced initiatives for large scale recycling of treated water as well as a commitment to develop of water sensitive areas. Research on WSUD and nature-based solutions is needed to explore innovative approaches that integrate water management into urban planning and design. Moreover, decentralized systems like rainwater harvesting and greywater reuse can augment water supply, alleviate pressure on existing resources, and enhance water resilience in urban areas. In order to implement such solutions, research is required to assess:

- Policy and Planning: Research is needed to support policy development and urban planning processes enabling the integration of WSUD and nature-based solutions into regional and local planning frameworks. This can lead to the formulation of supportive regulations, incentives, and guidelines for sustainable water management practices in the Western Cape region.
- Technology solutions: Validation of technical concepts that fits the NEU Water approach can be achieved through piloting and monitoring the functionality in mitigating water risks, building climate change resilience and liveability. Applied research can support decision making and implementing nature based solutions.
- System sustainability: Assessing the economic feasibility and cost-effectiveness of WSUD and decentralized systems is essential for their successful implementation. Understanding on operational and management models are required to ensure adoption and replication of the concept. Research can analyse the long-term benefits, cost savings, and management models associated with these approaches, enabling decision-makers to make informed choices regarding urban water management strategies.

The initial phase of NEU Water developed a understanding of the status of research on these topics. The findings are described through Annex 1 and Annex 2.

Activities & Results

The activities of the project was divided into 5 work packages.

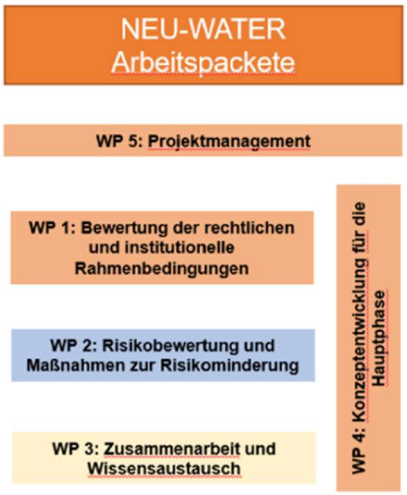

Figure 1: NEU Water Initial Phase Workpackages

Work packages 1 & 2 assessed technical and institutional challenges in mainstreaming the proposed approach in the context of South Africa. The assessment was carried out through desk studies lead by HCU and UCT with regular exchange of information. Draft reports on both topics have been prepared and is attached to this report. The project team intends to develop research publications out of these.

Workpackage 3 & 4 was aimed at developing stakeholder relationships in the region and developing the project concept for the main phase work. During the project, several stakeholders were contacted to understand their perspective of the challenges and to know their interest in supporting the project initiatives. The meetings were conducted virtually as well as in-person during the visit of the project staff to Cape Town in September- October 2022.

Within workpackage 5, the project team carried out bi-weekly online meetings to update on the work status and for thematic discussions. The project staff from HCU carried out a 3 week stay at UCT, carried out discussions with key stakeholders and visited the proposed main phase project site - Franschhoek. The entire project team met at UCT from 4th to & & 7th October 2022.

The following table details the results derived from each work package

Work Package 1	**Policy Assessment & Enabling Measures**
Goals	The goal of this work package was to understand gaps and challenges in the current legal and regulatory frameworks that would hinder the adoption stormwater and greywater recycling and possible measures that can enable this change in South Africa.
Expected results	• A knowledge publication on legal and regulatory frameworks • Identification of measures implementable under the main project phase
Results achieved	• Draft policy brief is prepared and attached as Annex 1. It is currently under internal review after which it is planned to publish.
Expected benefit/ Exploitation Plan	The assessment analysed the ongoing initiatives for development of water sensitive urban spaces and identified critical gaps in mainstreaming the proposed approach in South Africa. The policy brief shall stand as a guiding document in engaging with institutional, regulatory and financial systems while working in the main phase. The main phase project is proposed to have a strong utility partnership component to address these challenges and to foster peer learning.

Work Package 2	**Risk Assessment & Reduction Measures**
Goals	While recycling wastewater and runoffs several pollutants, especially the ones classified as PECs have been identified as potential risks. This work package aims to determine such pollutant risks, its flow into the streams and the necessary technological measures to limit them from entering the recycled water streams.
Expected results	• A knowledge publication on safeguards, risk mitigation measures and appropriate technology solutions. • Identification of measures implementable under the main project phase
Results achieved	• Draft document on risk assessment including a preliminary assessment of technologies was prepared. The document is attached as Annex 2. • As an additional step, Initial assessment of biofilters at the Water Hub as a technology option for mitigating pollution risks was carried out. The results related to pollutant uptake is expected by mid-2023.
Expected benefit/ Exploitation Plan	The document and the analytical results will form the basis for piloting and testing technologies in the main phase. This will be supplemented with a detailed feasibility study in the initial year of the main phase for developing the technical design of the pilots to be implemented.
Work Package 3	**Cooperation & Knowledge exchange**
Goals	The goal of this work package was to a. *Establish a research collaboration in South Africa on the topic of Water Sensitive Cities* b. *Initiate an international community of practise (CoP) through capacity building on thematic area of urban water recycling*
Expected results	A formal research collaboration between HCU and South African university is established. Capacity of local stakeholders enhanced on the topic of water recycling.
Results achieved	NEU Water is the first research collaboration between HCU and UCT. This was further strengthened through the work on joint proposals on the topic of nature based solutions in 2022. NEU Water project team collaborated with the AURA RESBEN project of UCT by joining Stakeholders Meeting which discussed on the vision and set of actions to improve the Stiebeuel river catchment . The catchment was decided as the site for the main phase of NEU Water project. The project team also held meetings with the community based organizations in the catchment to understand the pressing issues related to water management.

	 Figure 2: Project Partners visit to Langrug The main activities of NEU Water focussed on Stellenbosch municipality while there was already an existing CoP on Water Sensitive Cities functioning mainly from Cape Town. Hence a new CoP was developed. It is proposed that the project will join and foster the CoP discussions in the proposed main phase.
Expected benefit/ Exploitation Plan	The stakeholder network developed during the initial phase shall support the project activities in the main phase. It is proposed to have a project steering committee including the project team and the local stakeholders to address the practical challenges in scaling up the planned initiatives.
Work Package 4	**Concept Formulation for main phase**
Goals	The goal of this work package is to a. *Compile the learnings from the initial project phase to detail to sketch the methodology for mainstreaming urban water recycling* *Prepare the project concept and methodology for the main phase*
Expected results	Concept for the main phase project prepared
Results achieved	The main phase project concept was developed with three focus areas • Applied Research • Demonstration • Capacity Building The applied research questions were formulated through joint meetings between the project partners. The necessity and relevance of these questions were validated through the desk studies carried out within the project and are available within the draft papers attached. The applied research will detail upon the key questions

- What are the risks associated with water recycling and how can they be mitigated in the context of Franschhoek
- What are the driving factors and how can they effectively support the adoption and mainstreaming of NEU Water concepts in the region?

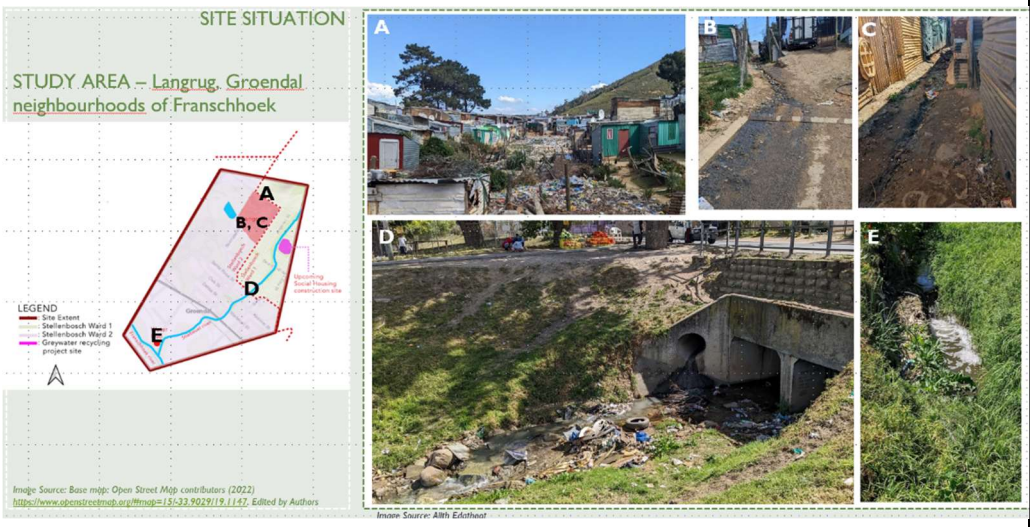

Figure 3: Visual overview of study area

The concept for demonstration was developed through multiple field visits carried out by the researchers. Within Franschhoek, the study area includes the dense informal settlement of Langrug and the downstream low/middle income settlement of Groendal. The map and the images above with locations marked as A-E describes the study area. Steibeuel river passes through these settlements and joins the Franschhoek near the Water Hub (marked as E) – a research facility managed by UCT. Due to limited waste and wastewater management services at Langrug, there is a high level of pollution of the river caused by greywater discharge (marked as B, D) and solid waste dumping (marked as A). The pristine river which originates upstream of Langrug becomes characterised by bad odour and frothy water as it reaches the Water Hub (E) which is only 2 km away. The demonstration concept is planned with multiple intervention locations between Langrug and Water Hub through WSUD measure types and nature based solutions for greywater treatment & stormwater management.

The stakeholder capacity building component of the main phase is aimed at development of institutional systems and building awareness among residents. To facilitate this a locally active NGO and the municipal utility was identified during the project to develop the activities and coordinate the capacity building activities.

Throughout the project several new stakeholders were identified and the project team carried out meetings with them. The following entities are expected to join the main phase application as new partners

- Viva con Agua (Hamburg, along with Viva con Agua South Africa to support awareness generation activities)
- Stellenbosch Municipality (to support research and implementation acitivities)

	• Langrug community project (Community based organization, based in the study area.) • Hamburg Wasser (to facilitate water operator partnership) • Seecon GmbH (to facilitate knowledge management)
Expected benefit/ Exploitation Plan	The results of the initial phase will be carried forward to the main phase. In case the main phase project is not funded, the results and the project plan shall be available for the project team to develop further initiatives based on the findings.
Work Package 5	**Project Management**
Goals	Management of activities and budget of the initial phase project
Expected results	Timely completion of initial phase achieving intended results
Results achieved	Initial phase was completed as scheduled within the approved budget