Co-UDlabs
COLLABORATIVE URBAN DRAINAGE RESEARCH LABS COMMUNITIES

Grant Agreement No. 101008626

Co-UDlabs

Building Collaborative Urban Drainage research labs communities

D10.2 – 2nd Periodic Report

Technical Report (Part B)

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List of acronyms

Acronym	Full definition
AMR	Antimicrobial resistance
CA	Consortium Agreement
CCTV	Closed-circuit television
CEE	Central Eastern Europe
CFS	Certificate of Financial Statements
CNTs	Carbon nanotubes
CSO	Combined sewer overflows
DIC	Digital Image Correlation
DL	Deep Learning
DMP	Data Management Plan
DoA	Description of Action
EDM	Event duration monitoring
EEP	External Evaluation Panel
EJSW	European Junior Scientists' Workshop
ESBLs	Extended-spectrum beta-lactamases
EU	European Union
EURO-SAM	European Sewer Asset Management JCUD Working Group
EWA	European Water Association
FTIR	Fourier-transform infrared spectroscopy
GA	Grant Agreement
HMs	Heavy metals
IAB	International Advisory Board
IAHR	International Association of Hydro-environmental Research
ICUD	International Conference on Urban Drainage
IWA	International Water Association
JCUD	Joint Committee on Urban Drainage
JRA	Joint Research Activity
KER	Key Exploitable Result
KoM	Kick-off meeting
KPIs	Key Performance Indicators

LiDAR	Light Detection and Ranging
LJMU	Liverpool John Moores University
LSPIV	Large-Scale Particle Image Velocimetry
MAP	Methodology and Access Plan
ML	Machine Learning
MS	Milestone
MST	Management and Support Team
NA	Networking Activity
NCP	National Contact Points
OGC	Open Geospatial Consortium
PA	Project Advisor
PBPM	Polyurethane Bound Permeable Mixture
PEDR	Plan for Exploitation and Dissemination of Project Results
PI	Principal Investigator
PM	Person/Month
PR	Periodic Report
PRM	Project Review Meeting
PTV	Particle tracking velocimetry
RDS	Road-deposited surface
RI	Research Infrastructure
RP	Reporting Period
SC	Steering Committee
SfM	Structure from Motion
SME	Small-Medium Enterprise
SuDS	Sustainable urban drainage systems
SWMM	Storm Water Management Model
TA	Transnational Access
TRL	Technological Readiness Level
UA	Uncertainty Assessment
UD	Urban Drainage
UDMT	Urban Drainage Metrology Toolbox
UDS	Urban Drainage Systems
UFA	User Facility Agreement
UPCT	Polytechnical University of Cartagena
UPP	User Project Plan
UWWTD	Urban Wastewater Treatment Directive
WG	Working Group
WP	Work Package
WwTW	Wastewater treatment works

List of project partners acronyms

Acronym	Institution
UDC	Universidade da Coruña
USFD	University of Sheffield
DEL	Stichting Deltares
EAWAG	Eidgenoessische Anstalt für Wasserversorgung Abwasserreinigung und Gewaesserschutz
IKT	IKT - Institut für unterirdische Infrastruktur GmbH
INSA	Institut national des sciences appliquées de Lyon
AAU	Aalborg Universitet
GRAIE	Groupe de recherche animation technique et information sur l'eau
EURO	Euronovia

1 Explanation of the work carried out by the beneficiaries and overview of the progress

Co-UDlabs is a four-year project funded by the European Union (EU) in the framework of its H2020-INFRAIA programme. The project integrates research and innovation activities at the European level in the field of Urban Drainage Systems (UDS), water management, and water resilience and sustainability. To do so, Co-UDlabs addresses from both a technical and academic perspective key and pressing public policy challenges such as health impact, flood risks, and environmental issues connected to urban drainage. At the end of Reporting Period (RP) 2 — the key object of this report — the nine partners of Co-UDlabs had been working together for 36 months on a wide range of initiatives that included scientific research on cutting-edge issues of sustainable urban drainage; training and education for a whole spectrum of relevant social, academic, and private stakeholders; and an active and effective programme of transnational access (TA) to a 17-facility research infrastructure (RI) across seven different European countries. This report provides evidence, figures, and results about the activities carried out within the project from November 2022 to April 2024. This period brought about significant outcomes and results for many of the initiatives led by Co-UDlabs and laid the groundwork for the final 12 months of Co-UDlabs' implementation (until April 2025).

After RP1, Co-UDlabs had already successfully consolidated its RI as a presence in the current UDS landscape in Europe. Within its Networking Activities (NAs),[1] Co-UDlabs had expanded the network of contacts, partnerships, and collaboration of Co-UDlabs' consortium by creating a database of relevant stakeholders that were constantly involved in project communication, dissemination, and open activities. It also carried out a review of current needs, requirements, and gaps in the UDS research and practice community. It set up and managed several training workshops, webinars, and in-person seminars for a diverse audience of early-stage researchers, practitioners, utility manager and local government representatives, and the private sector. The consortium worked on communicating and disseminating Co-UDlabs activities and early results. The project set up its ambitious TA programme with the first global TA Call and coordinated the implementation of 13 selected TA projects in 10 Co-UDlabs facilities. Research teams began working on the Joint Research Activities (JRAs) goals detailed in the project's Grant Agreement, outlining a plan for relevant scientific publications and a timeline to achieve all the expected results for the project's scientific collaboration efforts.

Building on this foundation, in RP2 Co-UDlabs has refined and consolidated its work on the European's UDS community. The outcomes of the review on RI community needs and prospects have been published in an international peer-reviewed journal that has since been central in the debate on the creation of a truly inclusive and effective pan-European UDS expertise network. As Co-UDlabs keeps expanding and diversifying — as explicitly mentioned in the review of its RP1 work — its network of stakeholders and collaborators, the project has also led the initiative to establish the first ever Large RI working group within the IAHR-IWA Joint Committee on Urban

[1] NAs include Work Packages (WPs) 1, 2, 3, and 4.

Drainage (JCUD). Co-UDlabs has expanded its offer of webinars, workshops, and training initiatives. Internally, it has improved coordination on data management and on the definition of project-wide exploitable results — the project's legacy within the UD community and a starting point for 'life after Co-UDlabs' for the whole RI involved in the project. Co-UDlabs also set up two additional global TA Calls and oversaw the timely and effective realisation of accepted TA projects in its facilities. Several JRA tasks have been completed during RP2 and the research staff involved in these WPs has already been working on the academic, technical, and dissemination output of their work.

The remainder of this section outlines the key efforts, initiatives, and results carried out and obtained by Co-UDlabs' Work Packages. This overview offers an assessment of progress in the implementation of Co-UDlabs' ultimate goals and impact, before the report delves in a detailed description of the work carried out by the consortium in the last 18 months.

WP1. Sectorial Integration and Sustainability Strategy. WP1 is developing knowledge and working methods to promote the long-term sustainability and impact of Co-UDlabs' integrated actions on the EU's UDS community. During RP2, the Work Package carried out the following key tasks:

- Consolidation of the outcomes of Deliverable D1.1 to encourage the swift adoption of newly available knowledge on UDS: a peer-reviewed publication and dissemination at various national and international events worked as catalysts for this knowledge exchange. WP1 also organised a workshop within the Novatech 2023 international conference: the session, which built on the testimonials of four researchers involved in as many Transnational Accesses in Co-UDlabs facilities, highlighted several of the key outcomes of the programme and helped the Consortium advertise the 2nd TA Call to a wider audience of scientists and practitioners.
- Establishment of an updated workplan for Task T1.2, in order to engage a growing network of scientists and practitioners also outside of Co-UDlabs, with special reference to the activities and objectives of similar networks such as Water4All or JCUD, among others.
- Consolidation of the surveying tools and practices — both within and outside the consortium — in order to increase response rate and quality for the project's data harmonisation objectives (WP2) and the analysis of current changes in UDS practices (WP1).
- Transformation of WP1 and its key outcomes into a project-wide project Key Exploitable Result via the establishment of UDRAIN, a new Working Group under the aegis of JCUD, whose first official meeting is part of the programme of the next International Conference on Urban Drainage (ICUD) conference in Delft, in June 2024.

WP2. Harmonisation and capacity building. Work Package 2 (WP2) continues to drive the harmonization of data formats and collection procedures for UDS, reinforcing our commitment to capacity building and knowledge exchange among project partners.

Task 2.1. *Ensuring interoperability by definition of common standards, protocols and methods*.

- Collection and analysis of Data Management Plans (DMPs). Analysis revealed inconsistencies across topics and a focus on post-publication in the DMP template.
- The Renkulab platform of the Swiss Data Science Center ("data, code, compute- all under one roof") was explored for managing data, tracking provenance, and reproducibility. It could potentially look promising as a backbone of an open science platform in the field of urban drainage.

Task 2.2. *Development and mobility of personnel staff*.

- Staff mobility activities were reorganized to be shorter but more frequent to optimize resources, with some activities conducted remotely after initial face-to-face meetings. Between November 2022 and April 2024, 19 mobility sessions were conducted, totalling 84 days.

Task 2.3. *Smart governance and public access to data*.

- In conjunction with Task 6.3, a comprehensive survey strategy was devised to streamline data collection and analysis processes. The survey has being refined based on feedback from the individual partner countries and tester utilities to enhance usability. It is rolled out via national water associations and professional networks. Initial results from the questionnaire are expected by August 2024.

WP3. Training activities. WP3 tasks develop Co-UDlabs' training, education, and awareness-raising activities, aiming to improve collaboration among Co-UDlabs beneficiaries and the widest range possible of external stakeholders active in the field of UD and water management. WP3 expressly addresses relevant groups such as junior researchers, industry and utilities representatives, and the larger general public as a key recipient of UD policy and initiatives. Current results of training activities are reported in Deliverable 3.2 (submitted on M34) and include:

- Arrangement and performance of three Webinars (made available via Co-UDlabs dissemination channels):
    - Acoustic monitoring of suspended solids in natural and engineered systems (May 16, 2023).
    - Routine Uncertainty Assessment (UA) in urban drainage data (June 12, 2023).
    - Optical and computer vision techniques for flow and processes measurements (March 15, 2024).
- The organization of two industrial courses:
    - Industrial course on capacity problems and flow rate determination in pressurized systems (November 17, 2022).
    - Industrial and water professionals' workshop on Uncertainty Assessment in UD monitoring data (March 6-7, 2024).

- Preparatory activities for the 26th European Junior Scientist Workshop (which will take place in RP3, on May 26-June 1, 2024).

WP4. Communication, dissemination, and exploitation of results. Co-UDlabs outcomes and activities are being disseminated in a structured way within the framework of WP4 to a wide range of relevant stakeholders and to society through a series of dissemination activities designed to engage the urban drainage community and the public:

- The project mailing list has significantly expanded, as well as the number of followers on social media, thanks to the active media strategy and online presence of the project.
- The communication and dissemination activities have been carried out in line with the Grant Agreement and the strategy and the objectives defined in deliverable D4.2 Plan for the exploitation and Dissemination of project Results (PEDR), which has been updated.
- Several new communication materials were produced, including a factsheet, a brochure on TA, a video motion design and 2 newsletters.
- Project partners applied and participated in the Horizon Results Booster seminar on exploitation to receive guidance from experts on the development of an exploitation strategy for the project results.
- During RP2 project partners organized 10 events and participated in 21 external events where Co-UDlabs activities were presented, and results disseminated.
- Over the period, Co-UDlabs published 12 scientific publications (conference papers and journal articles).
- Preparation, validation, and submission (in the form of Deliverable 4.1) of new versions of the project's Data Management Plan.

WP5. Management of Transnational Access (TA). During RP2, WP5 oversaw the organisation of Co-UDlabs' 2nd and 3rd Transnational Access Calls — from advertisement to evaluation and the eventual acceptance of 18 selected proposals. While some of the experimental campaigns from this latest round of TA submissions have already begun operations, most of them are already being planned in collaboration with the facility providers, with formal commitment by the selected user-groups to commence their access in the coming weeks. Most concrete TA activities for this round of TAs, accordingly, will be developed and carried out in RP3.

The main tasks executed by WP5 members during RP2 include:

- Revising the documentation for the TA, taking into particular consideration the lessons learned from shortcomings and good practices of the procedure when applied to the 1st TA Call.
- Launching the 2nd TA Call and setting up an extraordinary 3rd TA Call. This allowed the project to fulfil the expectations of the Grant Agreement in terms of project and facilities allocation.
- Executing specific TA promotional and engagement activities. These included a preliminary webinar, a workshop at the Novatech 2023 conference in Lyon to officially

launch the 2nd TA Call (July 2023), revamping the project's Ideas Marketplace, and a successful 2nd Co-UDlabs TA Hackathon, in September 2023. Following requests and recommendations from Co-UDlabs' first Project Review, specific efforts were made to reach and engage Eastern European Countries in the TA process.

- Managing the submission and evaluation of 26 access proposals, while coordinating the efforts of the External Expert Evaluation Panel.
- Coordinating TA set-up, commencement, and arrangements for the selected 18 TA proposals.

Considering the activities and tasks carried out in RP1 and RP2, most of WP5's workplan has been already successfully executed. The results of the 2nd and 3rd TA Calls can be found in Deliverable D5.3 (M34),[2] which — in agreement with the office of the Project Advisor — was postponed to include the 3rd TA Call in the report.

WP6. JRA 1 – Smart sensing and monitoring in urban drainage. WP6 fosters a paradigm shift in UDS management: transitioning from current inefficient approaches towards a digitised, informed, shared, evidence-based decision process based on truly smart monitoring. During the second reporting period (RP2) substantial progress was made regarding sensor testing, uncertainty assessment and the value of space distributed monitoring.

- The sensor testing completed the first phase by the end of 2023, which involved initial measurements for eight sensors, with data analysis still ongoing for some. Due to insufficient results, further evaluation for Coliform and PAH sensors was abandoned. It is currently in the second phase, where WP6 tested six sensors further, including long-term monitoring in real wastewater and at utilities. As expected, sensor testing showed various success, with some sensors performing well and others facing challenges for UDS applications.
- For uncertainty assessment, WP6 developed the Urban Drainage Metrology Toolbox (UDMT) into a user-friendly web application based on Matlab codes to maximize accessibility. A free downloadable exe version is also available for users who do not wish or are not allowed to transfer their data on internet.
- To assess the value of spatially distributed monitoring in UDS, WP6 analysed the combined sewer overflows (CSO) event duration monitoring dataset in England, which revealed issues with prolonged spills and complex regulation. Despite limited monitoring and reliance on simulations for compliance, open data has empowered citizen groups and NGOs to scrutinize water quality.
- Spatial analysis found correlations between CSO durations and regional climate/ topography, with ongoing higher resolution studies. This enables analysts to improve

[2] For transparency and record-keeping, the Deliverable is also publicly available online: https://co-udlabs.eu/wp-content/uploads/2024/05/Attachment_0.pdf.

understanding of CSO dynamics and inform better regulations, with findings presented at international conferences and prepared for journal publication.

WP7. JRA 2 – Evaluation of assets deterioration in UDS. WP7 is focused on enhancing our comprehension of common UDS issues like pipe failures or obstructions, and it seeks to establish a common ground regarding the standard and volume of defects and condition data for urban drainage and sewer assets. During RP2 the main outcomes of the WP are:

- Deliverable 7.1 a report on inspection methodologies to identify in-pipe defects was submitted in M18. The deliverable report described the review of current in-pipe inspection technologies in WP7 and highlighted their technological and practical strengths and weaknesses.
- Deliverable 7.2 a report on current sewer and drainage pipe condition assessment techniques was completed on M24. This report contained a state-of-the-art review of condition assessment techniques used throughout the world. Evidence was shown to highlight the uncertainty of pipe condition gradings determined used data collected by techniques described in D7.1. A defect focussed assessment scheme was proposed and discussed with various members of the consortium. To support the use of a defect focussed condition assessment approach an efficient visual defect identification was assessed. Code to demonstrate such an approach was made openly available on a github repository along with sample defect data (MS16),
- Deliverable 7.3 was produced in M24, this was a catalogue of different in-sewer defects and how they could be replicated in a laboratory environment. This work was strongly based on the knowledge at IKT who have been developing defect scenarios with end users for many years. Additional information was added by university researchers especially in the field of intermittent defects such as blockages.
- In this reporting period, preparations were made to enable Task 7.2 1 – a small number of laboratory tests to investigate the failure mechanism of a pipe defect. Defective pipe joints were selected for study (MS17) as these were common, and the exfiltration and infiltration they produce were seen to be of interest to water utilities in a number of countries. A search of the literature indicated very little experimental data was available with regard to pipe joint articulation and infiltration and exfiltration. These preparations involved the development of new low-cost imaging equipment to measure pipe joint displacement in full scale tests.
- Preparations were also made to collect sufficient network models to carry out Task 7.3, in which the impact of defects on the hydrodynamics of networks would be tested. Hydrodynamic models were supplied by water utilities in Denmark, Belgium and the United Kingdom. This met MS18. One other model may be available in Switzerland.

WP8. JRA 3 - Improving resilience and sustainability in urban drainage solutions. Work Package 8 (WP8) has concentrated on comprehending the performance of hydraulic and pollutant retention of new forms of urban drainage infrastructure and asses the sustainability of

some sustainable urban drainage systems (SuDS) techniques. The primary tasks executed during the second reporting period (RP2) included the following:

- In Task 8.1 two deliverables were submitted on M30 (D8.1 and D8.2). Deliverable 8.1 deals with the provision of new solutions and services related with the analysis and assessment of new technologies to build-up the topography of urban drainage infrastructure, the application of velocimetry techniques for urban drainage applications, the investigation of geometrical effects on head losses in urban floodings. Deliverable 8.2 investigates the transport of pollution in sewers and urban drainage systems, the development of new measurement techniques for sediment bed estimation and the definition of standards to assess permeable pavement clogging.
- In Task 8.2, WP8 have been working in the understanding of two drainage assets to improve their resilience. In particular, the work was focused on the road sediment mobilization in sewers and also in the analysis of green operation under failure conditions.
- Lastly, in Task 8.3 the hydrodynamic design for stormwater detention ponds was analysed to optimise cost-efficient maintenance (reported at Deliverable 8.4) and the definition of designer soils for Sustainable Urban Drainage Systems including experimental tests and numerical model development.

WP9. Transnational Access provision. WP9 oversees coordinating and streamlining the Transnational Access programme and the availability of the 17 facilities in the 7 research infrastructures offered by Co-UDlabs. In RP2, partners have worked both on the execution and completion of the 13 TA proposals that had been accepted in the 1st Co-UDlabs TA Call and on the arrangement and organisation of the 18 TA proposals that have been selected in Co-UDlabs' 2nd and 3rd TA Calls in late 2023 and early 2024. Table 1.1 below includes all TA projects accepted in the three Calls, as well as an overview of provided access days. The 13 proposals from the 1st Call were completed by 2023. The 18 proposals from the 2nd and 3rd Call have begun planning and arrangements since February 2024.

WP10. Project Management. WP10 is tasked with managing and organising the project's day-to-day functioning, as well as ensuring coordination among partners and the various Working Packages. During RP2, WP10's activities centred on three core items: a) supporting the implementation of the project's Transnational Access programme in collaboration with all facility-providing partners; b) coordinating project institutions like the Steering Committee and the General Assembly; and c) managing internal and external reporting, including the timely execution of project tasks and Deliverables. WP10 assisted WP5 and WP9 for the effective running of the 13 TA proposals that had been accepted for the 1st TA Call and the organisation of the 2nd and 3rd TA Calls. It also coordinated the organisation of two Co-UDlabs General Assemblies, the 2nd General Assembly in Lyon, in July 2023, and the 3rd General Assembly in Zürich, in January 2024. WP10 oversaw the organisation of five Steering Committee (SC) meetings throughout RP2. It was in charge of coordinating the work of the SC with the TA calls' External Evaluation Panel (EEP) and maintained contact with the members of the International Advisory Board (IAB).

Table 1.1. Summary of work performed in Co-UDlabs facilities during RP2 per TA (dates after the conclusion of RP2 in April 2024 are still tentative and marked with an asterisk).

Host Institution	Facility	Awarded Proposal – Acronym	Call	Project start date	Project end date	Days of access provided		
						RP1	RP2	Expected
UDC	STREET	UDC-03-STREET-Bellos	1	17/10/2022	14/12/2022	11	29	40
UDC	STREET	UDC-06-STREET-Linnemann	2	15/09/2024*	15/11/2024*	-	-	40
UDC	STREET	UDC-07-STREET-Lutze	2	01/04/2024	20/06/2024*	-	26	60
UDC	BLOCK	UDC-02-BLOCK-Zafra	1	09/01/2023	25/04/2023	-	66	60
UDC	BLOCK	UDC-04-BLOCK-Franca	2	01/07/2024*	31/10/2024*	-	-	60
UDC	BLOCK	UDC-05-BLOCK-Coupe	2	01/10/2024*	31/12/2024*	-	-	60
UDC	BENS	UDC-01-BENS-Peña	1	11/04/2023	20/09/2023	-	71	60
USFD	RTCRIG	USFD-07-RTCRIG-Vanderwerf	2	01/07/2024*	31/8/2024*	-	-	40
USFD	RTCRIG	USFD-08-RTCRIG-Gutierrez	2	06/06/2024	28/6/2024*	-	-	20
USFD	BURIED	USFD-04-BURIED-Li	1	28/02/2023	22/06/2023	-	60	60
USFD	BURIED	USFD-06-BURIED-Joksimovic	2	22/07/2024	21/08/2024	-	-	22
USFD	ANNULAR	USFD-02-ANNULAR-Regueiro	1	01/06/2023	01/09/2023	-	60	60
USFD	ANNULAR	USFD-03-ANNULAR-Morato	1	15/03/2023	15/06/2023	-	50	60
USFD	ABFLUME	USFD-05-ABFLUME-Martins	2	15/04/2024	09/07/2024*	-	12	60
USFD	ABFLUME	USFD-01-ABFLUME-Mignot	1	30/10/2022	10/01/2023	1	27	28
DEL	B-LOOP	DEL-01-BLOOP-Besharat	2	29/04/2024	07/06/2024	-	3	40
DEL	B-LOOP	DEL-02-BLOOP-Farhadiroushan	2	01/07/2024	16/09/2024	-	-	40
EAWAG	HALL	EAWAG-01-HALL-Bares	1	15/05/2022	15/04/2024	18	18	40
EAWAG	HALL	EAWAG-02-HALL-Langeveld	1	01/06/2022	01/03/2023	28	12	40
EAWAG	UWO	EAWAG-04-UWO-Abdelaal	2	01/03/2024	31/12/2024*	-	3	20
EAWAG	UWO	EAWAG-05-UWO-Dittmer	2	01/03/2024	28/02/2024*	-	-	20
EAWAG	UWO	EAWAG-03-UWO-Dittmer	1	15/01/2023	30/06/2024*	1	39	20
IKT	LTF	IKT-01-LTF-Verhulst	1	23/03/2023	11/08/2023	-	95	40
IKT	LTF	IKT-02-LTF-Beenen	1	24/04/2023	23/08/2023	-	40	40
IKT	TEST	IKT-03-TEST-Carnacina	2	30/09/2024*	18/19/2024*	-	-	15
IKT	TEST	IKT-04-TEST-Johansen	2	03/06/2024	05/07/2024*	-	-	20
INSA	DRB	INSA-04-DRB-Lhomme	2	06/06/2024	06/09/2024	-	-	10
INSA	OTHU - GROOF	INSA-03-OTHU-Prodanovic	2	18/06/2024	01/09/2024	-	-	11
INSA	OTHU	INSA-01-OTHU-Fuchs	1	30/08/2022	01/04/2023	3	-	10
INSA	GROOF	INSA-02-GROOF-Foerster	2	01/09/2024	31/03/2025	-	-	9
AAU	FREJLEV	AAU-01-FREJLEV-Laanearu	2	Now 2024*	Dec 2024*	-	-	10

WP10 also curates all internal communication and is the consortium's intermediary with the European Commission. WP10, finally, coordinated work on the first Periodic Report (submitted in December 2022) and collaborated with the office of the Project Advisor (PA) for the organisation of Co-UDlabs' first Project Review Meeting (PRM) in February 2023. It is now in

charge of coordinating Periodic Report 2 — including reporting on financial information and project deviations — and will assist the PA office for the 2nd PRM.

1.1 Objectives

Co-UDlabs primarily aims to establish a transnational, multidisciplinary collaborative research infrastructure. This infrastructure will offer European stakeholders, academic researchers, and innovators in the urban drainage and water management sector a platform for collaboration and new opportunities for joint research and technological innovation. The Co-UDlabs framework facilitates the sharing of ideas, co-production of project concepts, and provides access to top-tier research facilities and installations. Its ultimate goal is to develop, enhance, and test innovative methods and technologies, thereby supporting and broadening a collaborative European Urban Drainage innovation community — especially one able to include academic researchers, utility managers, local regulators and policy-makers, as well as the private sector and technicians and practitioners.

This growing community will enable other institutions and organisations across the EU to contribute to the development of an efficient research and innovation environment centred around the research infrastructure within Co-UDlabs.

Since the definition of its core Description of Action, Co-UDlabs has articulated its main vision and purpose into three key objectives. Project review is an essential step to assess how the activities carried out in the 18 months of RP2 have helped the consortium achieve or work towards these goals and lay the groundwork for the tasks and initiatives that will follow in the next Reporting Period. A more detailed per-objective assessment is as follows.

O1: To foster a culture of co-operation between RIs and the urban drainage community through a set of coordinated Networking Activities (NAs, WP1 to WP4), which help to develop a more inclusive, open and efficient research and innovation environment. A programme of collaborative activities will engage the EU urban drainage sector to exchange knowledge, collaboratively generate and encourage innovation and enable multiple avenues of research, development of technology and innovation, thereby contributing to the delivery of a long-term, sustainable Research Infrastructure in the European water sector.

In **Work Package 1**, the definition of UDS research needs serves as a blueprint for defining the contribution of the research infrastructure to Europe's overall research and innovation capacity. This information is essential to help industry make the transition to more sustainable and intelligent UD systems. The work carried out as part of RP2 helped meet with and mobilise various end-users at Novatech 2023, particularly during the Co-UDlabs workshop, but also during the remaining days of the conference's sessions and poster exhibitions. The presence of the researchers, with a stand on the international conference site, provided an opportunity for greater visibility.

Work Package 2 aligns closely with Co-UDlabs' Objective 1, fostering a culture of cooperation between Research Infrastructures (RIs) and the urban drainage community. In terms of its contributions to data governance and standardization, WP2 established a structured framework

by defining and implementing FAIR (Findable, Accessible, Interoperable, and Reusable) standards, ensuring high-quality and safe research data. The initial collection and analysis of Data Management Plans (DMPs) from TA and JRA activities highlighted clarity issues. WP2 revised these templates for improved simplicity and balance, facilitating easier completion by researchers. WP2 standardized variable names and units across facilities, comparing them with established ontologies and conventions. This effort reduced discrepancies in data interpretation, ensuring uniformity in data representation across Co-UDlabs RIs.

As for its contributions to metadata standards and data harmonization, WP2 promoted robust metadata standards for data representation and exchange, specifically those from the Open Geospatial Consortium (OGC). Capacity-building activities, including monthly WP2 meetings and a visit to the University of A Coruña, helped project members understand and evaluate the application of these standards. WP2 implemented test cases transforming sensor data from CSV to XML-based structures compatible with OGC models like O&M, WaterML, and SensorML. These datasets were enriched with metadata, improving accessibility and reproducibility.

As regards its contributions to reproducibility and data compliance, WP2 adopted the open science platform Renku to improve data management, provenance tracking, and reproducibility in research workflows.[3] Practical demonstrations with Co-UDlabs TA datasets showcased Renku's capability to correct data errors and maintain integrity. As regards its contributions to Data Compliance, WP2 addressed bottlenecks in data-based compliance assessment, supporting public access to compliance data and preparing for the upcoming Urban Wastewater Treatment Directive (UWWTD). This proactive approach ensures UDS management practices will meet new monitoring requirements by 2025.

Work Package 3 coordinates the Co-UDlabs training and education programme. In support of its research activities and the establishment of a pan-European Network for Urban Drainage Innovation, Co-UDlabs is organising a series of training activities and initiatives throughout its implementation, as part of WP3. The project's training strategy is based on three main pillars:

- UD early-stage and junior researchers' activities and training events (Task 3.1)
- UD industry professionals and practitioners training activities (Task 3.2)
- Public webinars on specific and emerging monitoring techniques in UD (Task 3.3)

WP3 envisions multiple (non-codependent) actions focusing on tailored training events or dissemination of techniques addressing the different actors of the UD community (i.e., academia, industry, institutions etc.). These tasks are often led by one of the Co-UDlabs partners with the support of other institutions according to the different expertise of personnel. The main plan stablished in the Grant Agreement (GA) has been carried out through the project with minimal deviations. Attending to the nature of the events (i.e., courses, webinars etc.) actions are advertised with sufficient time (usually between two and six months in advance) and disseminated through our social media platforms (e.g., LinkedIn, Twitter), Webpage, newsletter and institutional channels. The organization of these events is flexible to delay or advance the

[3] Renku is accessible online at: https://renkulab.io/.

delivery date to better adapt for conditions (nearby conferences, or synergies with other events). During RP2, WP3 has keep their main plans and objectives.

Work Package 4 provided all project partners with continuous support for actively communicating project activities and disseminating project results to a wide range of relevant stakeholders in the urban drainage community and to the public in general. The work carried out within RP2 focused on the promotion of the Transnational Access calls for proposal and the communication of their results, the promotion of the events and trainings organised by the project partners to attract new participants and the support provided to partners in participating in several events to increase collaboration and knowledge exchange with other researchers in the field.

> **O2:** To facilitate free of charge Transnational Access (TA, WP5 and WP9) to 17 leading European facilities by two open calls. The calls and the project both focus on support to scientific communities and water utility and supply chain innovators in their access to highly relevant research facilities. Co-UDlabs will provide research infrastructure (physical and knowledge-based) to undertake breakthrough engineering and scientific research and innovation using multi-institutional and multi-sectorial teams to develop solutions that have the potential to transform the European urban drainage sector and provide credible evidence that these solutions work.

The main contribution of WP5 to the achievement of this objective during RP2 was related with the organization and management of 2nd and 3rd call user's groups unified entry-point for project call applications, the creation of engagement activities to promote multi-sectorial teams and also reach other public such as Eastern European Countries, the coordination of the evaluation procedure and the communication of the results to the users. Within WP9 activities, 13 projects of the 1st have been finalised and up to 18 projects have been selected for its development during the project lifetime. The development of the projects has allowed scientific contributions in several UDS fields such as the development of new monitoring techniques, improvement of the knowledge of pollution transport processes, flood analysis, or the development of new sustainable technologies.

Following the 2nd and 3rd Calls, 18 new TA projects will be carried out at Co-UDlabs' research infrastructure starting from early 2024. Co-UDlabs has granted TA slots to user groups from 24 different countries (12 non-EU), whose leaders are based in 10 different countries (3 non-EU). The 18 projects will involve 126 members from 61 different institutions. 27.8% of user-group members are female, an increase by 9% compared to the 1st TA Call's results. 27.8% are from outside academia, a drop by 11.8% if compared to the first call. This datum has been considered as an incentive to multiply the efforts to reach out to the industry, private sector, and utilities and regulators to broaden the potential public of Co-UDlabs activities and key results.

O3: To enlarge and strengthen the quality and quantity of the services offered at European level by Co-UDlabs through a combination of interconnected Joint Research Activities (JRAs, WP6, WP7, and WP8). These activities will improve our understanding of asset deterioration and secure the long-term resilience and sustainability of urban drainage systems with the help of more robust, autonomous and interconnected smart monitoring techniques, and digital water data analysis tools.

In **Work Package 6**, first, the comprehensive assessment of novel sensors will enhance the resilience and sustainability of UDS and promote new smart monitoring techniques within the UDS community. For example, innovative sensors for water quality and sediment monitoring secure the long-term resilience and sustainability of urban drainage systems by providing continuous, real-time data on water quality, enabling rapid detection and response to pollution events. The UDMT aids researchers and practitioners in delivering higher quality data in urban drainage facilitating the application of metrology best practices. Finally, analysing spatially distributed monitoring data, specifically the CSO event duration dataset from the United Kingdom, revealed issues with prolonged spills and complex regulations, which demonstrates the importance of interconnected smart monitoring techniques, and digital water data analysis tools. Our results also suggest that open data has empowered citizen groups and NGOs, enhancing transparency and sustainability in urban drainage management. Spatial analysis identified correlations between CSO durations and regional climate/topography, deepening our understanding of CSO dynamics and informing better regulations, i.e. the implementation of the UWWTD.

In **Work Package 7** the activities have provided evidence that the current methods of closed-circuit television (CCTV)-based analysis do not provide data that is suitable for the efficient planning of sewer rehabilitation and repair. Image analysis code has been provided in an open access repository to allow water utilities to explore the potential for image-based analysis to aid sewer defect identification. New joint measurement techniques have been developed to measure joint movement as a first step to link joint movement with exfiltration/infiltration. Code has been developed that will automatically include defects into existing network models so that the impact of individual defects on hydraulic capacity and flood risk of networks can be determined.

In **Work Package 8** the activities performed in RP2 showed that imaging techniques allows to gain more information of urban assets as topography and help to improve the determination of relevant parameters such as runoff velocities or sediment transport. Novel techniques for sediment bed deposits were tested in different urban assets, complementing the work developed in two TA projects. Tailored experiments were also performed to assess sustainable urban drainage techniques including permeable pavements and green roofs. Lastly, the last set of activities which are being developed within this WP were aimed at examining the performance of stormwater ponds and the design of tailored soils for sustainable urban drainage techniques.

1.2 Explanation of the work carried per WP

1.2.1 Work Package 1 - Sectorial Integration and Sustainability Strategy

WP1 works to develop the knowledge base and methodologies required to enhance the long-term sustainability and impact of Co-UDlabs' Integrated Action within Europe's UDS community. The activities of WP1 aim to identify the needs of existing and potential users within the UDS community, as well as the resources available. A key goal is to foster consensus on the use of common research infrastructure and to develop practices that enhance the implementation of relevant EU environmental, economic, and societal policies. WP1 will collaborate with all other work packages to ensure effective knowledge transfer from the various NA, TA, and JRA activities to all WP1 deliverables. WP1 is led by GRAIE and all project partners, except Euronovia are involved.

Task 1.1. Mapping of RI users and community needs to transition to more sustainable and smart urban drainage systems (Lead GRAIE)

This task aims to collect information on and improve the definition of what a truly sustainable and smart research infrastructure on UDS should be. To do so, it explores the needs and requirements, the policy visions and expectations of a large and diverse group of stakeholders that — in the EU as well as elsewhere — is looking at the existing large-scale UD research infrastructure for more opportunities for scientific, academic, industrial, technological, and policy advancement.

To achieve this goal, WP1 worked with a variety of different sources: (i) policy documents from the countries represented in the project; (ii) input from academic researchers and scientists participating in the Co-UDlabs project; and (iii) feedback from early adopters and potential users of Co-UDlabs' research infrastructure, which the project's TA programme made available to an unprecedentedly large and diverse public.

This task has been successfully completed and has contributed to Deliverable D1.1, submitted within RP1. Additionally, WP1 published an article in the Urban Water Journal in April 2023 and presented our findings at the Novatech international conference in July 2023.[4]

Task 1.2. Development of a roadmap to identify the role of RI to transition to more sustainable and smart urban drainage systems (Lead GRAIE)

If Task 1.1 aimed to provide a thorough and updated snapshot of the existing landscape of policy needs and visions with which users may approach infrastructure, research, and policy progress on UDS, the purpose of Task 1.2 has been more oriented towards the future of the existing RI, as WP1 wants to provide a roadmap with guidance and directives for the near future to bring about a more effective, efficient, and safer transition towards smarter and better UDS. Task 1.2, moreover, feeds directly off the results — both academic and practical — of many of the activities that are being conducted as part of the workplan of Co-UDlabs' JRAs. The following describes in detail progress with specific sub-tasks in this direction.

[4] The article is available online in open access: https://doi.org/10.1080/1573062X.2023.2211559.

Sub-task 1.2.1. Enhancing Early Adoption of Knowledge for Urban Drainage Systems. (M13-M42). WP1 has undertaken two major initiatives in this context:

- **Co-UDlabs' Workshop at Novatech 2023.** Within the programme of a renowned international event such as Novatech 2023, Co-UDlabs organized a workshop, "Building a Collaborative Urban Drainage Innovation Community", with the aim to bring the transnational access programme and its opportunities for more coordinated, open, and inclusive research to a large public from a diverse background. The workshop (July 3, 2023) introduced Co-UDlabs' 2nd TA Call trying not just to explain the technicalities of the application process, but also to make clear how path-breaking the programme's collaborative and multidisciplinary approach could be for SMEs, utility managers, or local policy-makers and regulators and their specific, localised agendas. 40 participants attended the event, which ultimately played a significant role in the diversification of the programme's reach and visibility.
- **Water4All (W4A) Partnership.** France's Agency for Geological and Mining Research (*Bureau de Recherches Géologiques et Minières*, BRGM) invited Co-UDlabs to attend an event (Orléans, France, April 8-10, 2024) of the Water4All partnership — a trans-continental programme co-funded by the European Union's Horizon framework, with a focus on ensuring water security for all.[5] Because of its strategic proximity with the partnership's scope, Co-UDlabs was invited to present its research infrastructure and the initial results of the TA programme and the project's other collaborative and co-owned tools and platforms. Participation in Water4All was also an opportunity for Co-UDlabs partners to find out more about the work that such alliances are carrying out on challenges and benefits of more interconnected and interoperable research infrastructures, while also being positively exposed to more horizontal cooperation and mutual learning knowledge on such a sensitive policy field.

SubTask 1.2.2. Roadmap of the Research Infrastructure required to support UDS transitions at EU level (M13-M42). The outcomes from these participative processes with different users in Task 1.1 and 1.2.1 will serve as the groundwork for the establishment of a roadmap on a more effective, policy-oriented use of existing UD large research infrastructure — and an opportunity for a clearer policy vision about what a more sustainable and smart urban water-management system should look like in today's EU landscape of technology, tools, and agents. The sub-task aims to use the knowledge developed within Co-UDlabs' research infrastructure as it opens to a larger and transversal public via the TAs, the knowledge developed by similar networks and policy partnerships in Europe and elsewhere, to draw the most effective roadmap possible to improve dissemination, mutual support, and policy direction for UDS improvement and transitions.

Because of the knowledge that WP1 is able to collect in this field and with this purpose, these tasks will include, in the upcoming months:

- A survey of Co-UDlabs RI users to investigate how access to the infrastructure has improved their work and expanded the opportunities connected to their agenda and

[5] See also online: https://www.water4all-partnership.eu/water-security-planet.

expertise — as well as recommendations to improve accessibility and adaptability of the RI, while also making it a welcoming platform for even more institutions across Europe and beyond.

- Additional bibliographical, benchmarking, and standardisation work on policy levers, institutional venues, and research opportunities developed in various countries and UDS at European and non-European level to foster change and innovation in regulations, practices, academic knowledge, and policy applications of such changes in a variety of local contexts.

Work on these tasks will be collected and assessed through Deliverable D1.2, due on M42 (October 2024). To begin work on D1.2 and put the rest of the consortium up to speed on this work, WP1 organised a quick workshop during Co-UDlabs' 3rd General Assembly in Zürich, in January 2024. Ideas, input, and the specific experience of Co-UDlabs' partners were key to kickstart work on the Deliverable and provide baseline knowledge with which WP1 will approach external stakeholders too. This work developed into a series of semi-structured interviews with Co-UDlabs' partners. The interviews were essential to identify progress based on the categories and baseline data of Deliverable D1.1 and the previous work with the identification of needs and demands of RI users. Deliverable D1.2, which aims to streamline the effectiveness of RI as a disruptive tool for more collaborative and innovative research on UDS, is currently being drafted.

Task 1.3. Co-UDlabs Strategy for RI Sustainability and Community (Lead UDC)

The work on this task should be completed in M48. Some preliminary progress was made during RP1 and RP2, starting with contacts with other RI and EU projects such as W4A, the ENVRI community,[6] or Distributed RI project promoted by the European Science Foundation. Co-UDlabs facility providers have contributed to this collaborative, Europe-wide framework by participating in surveys — e.g., the Water4All's initiative — and other initiatives carried out by comprehensive European networks that are aiming to map a comprehensive atlas of distributed RIs across various countries and disciplinary themes. Co-UDlabs was also engaged in the definition of the Access–RI working paper carried out by the European Strategy Forum on Research Infrastructures (ESFRI).[7] Furthermore, the workshop and survey work carried out for the two previous tasks are providing important input for a more effective sustainability and community-development strategy in the field of UDS and sustainability transitions.

When participating in the European Commission-backed Horizon Results Booster initiative,[8] Co-UDlabs also agreed to select as a Key Exploitable Result (KER) the support that the project had given to the establishment of the Urban Drainage Research Infrastructures Network (UDRAIN) as a Working Group within JCUD. UDRAIN brings on a strategic agenda on urban drainage research infrastructures and is looking for the participation, inclusion, and proactive contributions of UDS RIs around the world. The group's first launch meeting will take place at ICUD 2024 in Delft, in June 2024. The key agenda since its inception has included:

[6] See online: https://envri.eu/.
[7] See online: https://www.esfri.eu/.
[8] More information online: https://www.horizonresultsbooster.eu/, and in Section 1.2.4 below.

- Developing UDRAIN as a platform for participation and co-ownership of the UD community as a whole — including practitioners, water associations, large and SMEs, industry, academic institutions, and policymakers.
- Keeping annual meetings to maintain dialogue and awareness even after Co-UDlabs formally ends.
- Promoting an updated and growing atlas of research infrastructures in the field of UDS.
- Consolidating the strategic agenda and identify a viable institutional structure to support the organisation and its work.
- Finding funding opportunities for enhanced activities at the EU level and beyond.
- Maintaining a network of scientists and practitioners, in partnership with other relevant international networks.

Summary of Deliverables

Deliverables completed:	None
Deliverables submitted past due date:	None

Summary of Milestones

Milestones completed:	**MS02 - Seminar/Special Session on Novatech 2023 to consolidate the early adoption of good practices in UDS was held on July 3 (M26).** The initial date for the MS02 is 30 June 2023. It was postponed for a few days as Novatech congress was held in July 2023.
Milestones submitted past due date:	None

1.2.2 Work Package 2 – Harmonization and Capacity Building

WP2 is led by EAWAG but all partners are involved in this WP dedicating time for this activity along the whole lifetime of the project. The main objectives of the WP2 are to:

- Standardise experimentation and operation of Co-UDlabs RI and ensure consistent high-quality data collection via the use of agreed validation protocols.
- Organise an effective data management system for the data collected during the project.
- Exchange best practices and know-how among the project staff and the participants working in the RI.
- Eliminate bottlenecks by data supported assessment and provide capacity building to improve the data-literacy of the next-generation urban drainage workforce

Task 2.1. Ensuring interoperability by definition of common standards, protocols and methods (Lead EAWAG)

Efforts in WP2 Task 2.1 focused on collecting and analysing data management strategies across the Co-UDlabs Research Infrastructures (RIs). This involved distributing Data Management Plans (DMPs) to Transnational Access (TA) and Joint Research Activities (JRA) researchers and

surveying the RI sensors to gather comprehensive data descriptions. After analysing the DMP responses, it was clear that the proposed template needed revision. The original version was focused on post-publication data management and lacked consistency. WP2 proposed incorporating more balanced and clearer sections in the DMP template.

Another outcome of our data collection efforts was visualizing sensor categorization across the Co-UDlabs RIs. This categorization, shown in an interactive online chart[9], highlighted the diversity of categories and variables within the infrastructures. WP2 noticed inconsistencies in variable and sensor names, such as "flow," "flow rate," and "flow discharge," complicating data interpretation and interoperability. Task 2.1 efforts will focus on standardizing variable and sensor names to improve data integration. WP2 researched UDS glossaries, vocabularies, and relevant naming conventions to guide this harmonization process.

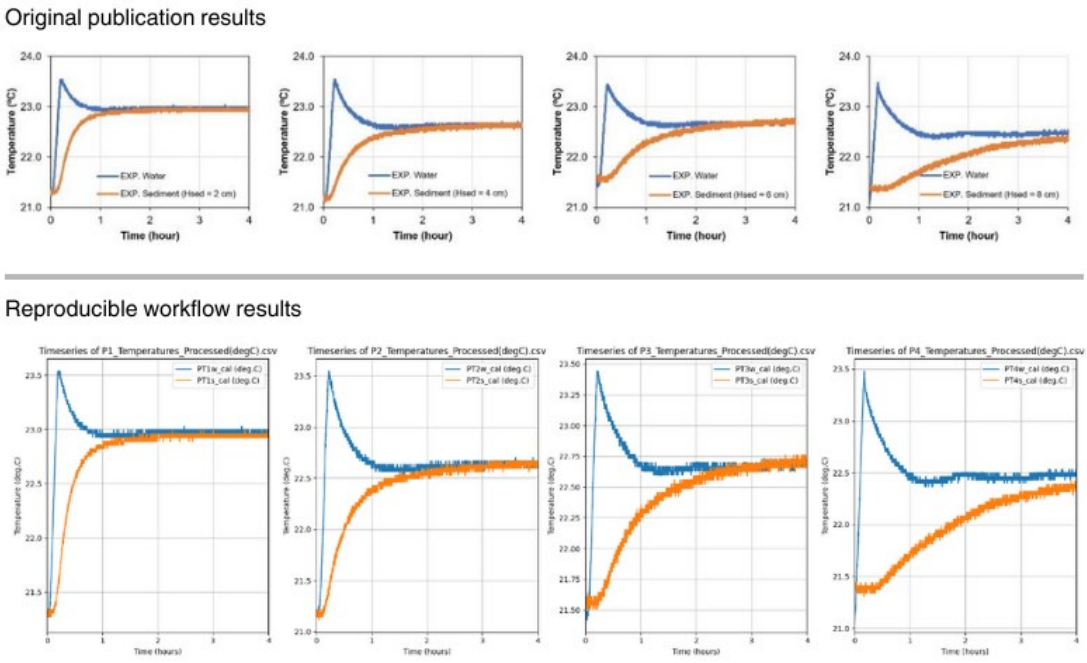

Figure 1.1. Comparison of results from the original publication and the reproducible workflow in Renku.[10]

Open Geospatial Consortium (OGC) standards were also analysed to understand how UDS data can comply with OGC's information models like O&M, WaterML, and SensorML. This process includes converting sensor data from CSV- to XML-based structures and revising data logging methods. Additionally, WP2 enriched UDS datasets with metadata, improving their quality and usability. To promote best practices, EAWAG visited the University of A Coruña in November 2023. The visit included meetings for data harmonization and presentations on OGC standards relevant to Urban Drainage Systems.

[9] Available online at: https://htmlpreview.github.io/?https://github.com/alchav06/charts_exports/blob/ab53a1015624e0c3ef2efc1d495ab19825b782c5/sunburst_chart_sensors.html

[10] See: https://zenodo.org/records/10058884.

As outlined in the first Periodic Report, Zenodo was chosen as the primary platform for data sharing despite its limitations in dataset exploration. To handle these challenges, WP2 explored the Renku platform, which supports collaborative data science and integrates with Zenodo for managing large datasets. WP2 adopted Renku to improve reproducibility in our research workflows. In a practical test, WP2 used a dataset from the Co-UDlabs TA, hosted on Zenodo. WP2 set up a Python project using Renku's web interface, imported the dataset, and corrected data errors. Each step of processing and producing output data was treated as a distinct workflow in Renku, improving reproducibility. As shown in Figure 1.1, it is possible to compare the results from the original publication and those obtained through our reproducible workflow.

Task 2.2. Development and mobility of personnel staff (Lead Euronovia)

The objective of Task 2.2 is to organise mobility for project partners to facilitate the exchange of best practices and know-how among the project staff and the participants working in Research Infrastructures. This activity is meant to build internal capacity, support the networking and trust between all partners, stimulate exchange, development and inspire new ideas for improved quality and services.

It is to be noted that, as detailed in the deliverable D2.3 submitted on April 2023, staff mobility activities and visits have been re-organised and re-scheduled to be shorter but more frequent than originally planned at proposal stage because it was decided that, in order to optimize the use of resources, some of the activities can be carried out remotely among partners after a first face-to-face meeting on site.

During the period covered by this report (November 2022 to April 2024), project partners have participated in 19 mobility sessions, for a total of 84 days. Details are available in Table 1.2.

The purpose of these missions varied from sharing experiences about specific techniques for UDS, to learning about experiment standardisation, knowledge exchange on measurement techniques for SuDS, collaborating on data or performing various experiments in the framework of JRA activities.

After completion of each mission, the assigned person wrote a report and sent it to Euronovia (task leader) detailing the scope and outcomes of his/her activities during the mission. These reports will be included in the Final report on staff development (D2.4) due at the end of the project (April 2025).

Task 2.3. Smart governance and public access to data (Lead EAWAG)

Task 2.3 is dedicated to enhancing the management of UDS by addressing data-related hurdles and facilitating public access to compliance data. Our objective is to examine the current utilization of UDS performance data and identify obstacles hindering their effective use in compliance assessment. Drawing from insights gleaned from a recent Swiss survey, WP2 seeks to refine strategies for optimizing UDS management practices. This endeavour is of paramount importance in light of the forthcoming amendments to the UWWTD, which mandates the monitoring of emissions by 2025. Recently accepted by the EU Parliament on April 11, 2024, this directive underscores the urgency of our efforts to streamline UDS management and ensure regulatory compliance.

Table 1.2. Overview of staff mobility activities within WP2

Sending partner	Hosting partner	Duration (days)	Staff #1	Staff #2	Purpose of the mission	Related WP	Start date	End date
UDC	DEL	3.5	Juan Naves		Sharing experiences about imaging techniques for UDS	WP8	22/04/2024	25/04/2024
UDC	IKT	4	Jose Anta	Joaquín Súarez	Share experiences on permeable pavement testing	WP8	12/06/2023	15/06/2023
USFD	UDC	3	Kaeli Brazier	James Shucksmith	Learn about experiment standardisation Collaboration UDC-UoS on Task 8.2	WP8	14/06/2023	16/06/2023
USFD	DEL	2	Alma Schellart	James Shucksmith	Learn more about remote sensing techniques, and relevance to spatial analysis of surface water quality and CSO performance analysis. Discuss optical sensing techniques, and coordinate WP8 activities on this topic. Learn more about facilities at Deltares	WP8	04/04/2024	05/04/2024
USFD	EAWAG	2	Alma Schellart		Collaboration on open CSO data, learn from Swiss and UK practice	WP6	09/11/2023	10/11/2023
USFD	IKT	3	Simon Tait		Discussing test setup WP7 (JRA2) and next steps. Visit IKT facilities and discuss test and measurement technique; Plan webinar "Inspection techniques" (WP3). Information exchange WPs 1, 2, 3, 4, and 9. Information exchange on challenges (e.g. climate change, aging infrastructure) for UD in GER, the UK and associated countries	WP7	13/12/2023	15/12/2023
USFD	INSA	2	Alma Schellart		Collaboration on open CSO data, learn from French and UK practice	WP6	06/11/2023	07/11/2023
DEL	USFD	4	François Clemens	Antonio Moreno; Danko Boonstra	Collaboration on open CSO data, learn from UK practice, publication on optical sewer monitoring techniques	WP6	21/05/2023	29/06/2023
EAWAG	UDC	6	Prabhat Joshi		Collaboration on green roof/ SuDS	WP8	07/05/2023	12/05/2023
EAWAG	UDC	15	Prabhat Joshi		Collaboration on green roof/ SuDS	WP8	18/09/2023	02/10/2023
EAWAG	UDC	15	Prabhat Joshi		Collaboration on Blue-Green campus at Eawag/EMPA	WP8	03/10/2023	17/10/2023
EAWAG	UDC	2	Pierre Lechevallier		Knowledge transfer spectrometry and sewer monitoring	WP6	31/01/2024	03/02/2024
EAWAG	UDC	5	Alfredo Chavarria		Data harmonization	WP2	06/11/2023	10/11/2023
IKT	UDC	4	Marcel Goerke		Collaboration on SuDS: clogging of permeable pavement and green roofs	WP8	14/11/2023	17/11/2023
IKT	INSA	3	Marcel Goerke	Frank Bersuck	Collaboration on SuDS	WP8	27/11/2023	29/11/2023
INSA	USFD	4	Frédéric Cherqui		Knowledge transfer pipe condition assessment technologies	WP7	16/04/2023	21/04/2023
INSA	IKT	0.5	Jean-Luc Bertrand-Krajewski		Mutual presentation and further collaboration.	WP6	09/01/2023	09/01/2023
INSA	IKT	3	Jean-Luc Bertrand-Krajewski		Green roof experiments and modelling (continuation of 1st visit in January 2023)	WP6	10/07/2023	12/07/2023
INSA	AAU	3	Gislain Lipeme-Kouyi		Infiltration processes	WP8	10/07/2023	12/07/2023

In conjunction with Task 6.3, focusing on space-distributed monitoring, WP2 integrated the survey with additional inquiries addressing the uncertainty of monitoring data, leveraging insights from the UDMT as outcome of Task 2.2. By collaboratively devising a comprehensive survey strategy, WP2 aims to deploy it through national wastewater associations, streamlining data collection and analysis processes.

To facilitate inquiries related to the survey, GRAIE will serve as the primary point of contact. Furthermore, with the expertise of social scientists at EAWAG, WP2 has integrated the survey into the user-friendly software LimeSurvey, ensuring accessibility and ease of use.

Figure 1.2. Left: final survey to elicit the current availability of Monitoring data in the UDS; centre: meeting to streamline T2.3 and T6.3; right: implementation of survey in Limesurvey survey platform in different languages.

Currently, partners are in the phase of refining the survey based on feedback from a group of tester utilities (see Figure 1.2). Their input primarily focuses on clarifying wording and simplifying the survey to enhance usability for practitioners. Initial tests have yielded positive results, with the first set of outcomes anticipated before August 2024.

Although WP2 had initially planned to present findings and engage with the urban drainage community at the ICUD 2024 in Delft, the conference model was ultimately not compatible with the workshop structure that had been designed for the event. Alternatively, WP2 is exploring the possibility of hosting one or two online workshops in Q4 of 2024, providing a platform for meaningful discourse and collaboration within the community.

Summary of Deliverables

Deliverables completed:	**D2.1 – Intermediate report on a framework for harmonization of Co-UDlabs sensors, technologies and data procedures. (M30)** An extension of the deliverable deadline was accepted to M30 after the revision performed in RP1. **D2.3. - Intermediate report on staff development (M24)** A Final report on staff development (D2.4) will be submitted at the end of the project (M48)
Deliverables submitted past due date:	There were no delays in the submission of deliverables in this reporting period

Summary of Milestones

Milestones completed:	M24. Submission of deliverable D2.3 M30. Submission of deliverable D2.1
Milestones submitted past due date:	None

1.2.3 Work Package 3 – Training Activities

Co-UDlabs' WP3 — which spans the whole duration of the project — works on the arrangement and performance of training, education, and awareness-raising activities in the field of UDS, water management, and sustainability. The WP's tasks address three main focal points that guide WP3's strategic approach: early-stage researchers' training; industry-oriented activities; and large-scope education activities for the broader public. WP3 leader is Deltares, but all partners have participated organically in its tasks.

Task 3.1. UD early-stage researcher activities and training events (Lead INSA)

Task 3.1's purpose is to promote training and networking activities with a specific focus on the trajectory and needs of young, junior, and early-stage researchers — a strategically key collective in the academic and practice application of UDS knowledge. An inclusive and engaged junior research group is key to establish an effective Europe-wide connection among future academic innovators and highly-specialised practitioners in a field that is quickly transitioning towards greener and more efficient technology. The Grant Agreement included two types of activities for this task:

- Two **internal Co-UDlabs early-stage researcher seminars**, targeting PhDs and early-stage researchers from partner institutions of Co-UDlabs, aiming to enhance interaction between academics, the sharing of ideas, and the promotion of common experimental protocols. These seminars have a duration of 2 days and are targeting 20 participants.
- One **open workshop and one PhD course** targeting the UD European junior research community.

In RP2, no significant activities in Task 3.1 have been carried out. Initially, a PhD course on Sewer Processes had been proposed by AAU for Q3 of 2023 but, given the unexpectedly low number of registered participants, WP3 opted to re-schedule for October 7-11, 2024, with the support of an adequate communication campaign to mobilise additional participation. Additionally, due to the success of the 25th European Junior Scientists' Workshop that INSA and Deltares co-organised with the institutional support of Co-UDlabs in 2022, the partners are involving Co-UDlabs in the organisation of the **26th EJSW** too. The event will take place on May 27-June 1, 2024, and a significant part of the organisational work behind the event — during which junior researchers will have an opportunity to discuss their research agendas in a constructive and collaborative environment — has contributed to the Task's activities in RP2.

Task 3.2. UD Industry professionals and practitioners training activities (Lead DEL)

Task 3.2 addresses a specific group of stakeholders of the activities and strategic plans of Co-UDlabs, i.e., industry representatives, regulators, professionals and practitioners of UDS, local utility managers, and policymakers. The task oversees the arrangement of free training and awareness-raising activities aimed expressly at this collective. During RP2, Task 3.2 carried out two main activities:

- **Industrial Workshop on Flow Rate Determination of Pressurized Hydraulic Pipelines and Pumping Stations (WP3.A.5)**, organized by Deltares on November 17, 2022. The

course targeted industrial practitioners who deal with the management and execution of hydraulic infrastructure and pressurized pipe networks (sewer pressurized mains): practitioners from water utilities, equipment and pump manufacturers, contractors, and engineering and consultancy firms were among the key public addressed for this activity. A total of 45 participants attended the event, which presented and discussed the latest findings on estimation and diagnostics of capacity limiting events (e.g., gas pockets, clogging, etc.) in pressurized transport systems. A recording of the workshop is available online.[11] News on the workshop is also available on Co-UDlabs' website.[12]

- **Industrial and Water Professional Workshop on Uncertainty Assessment in UD Monitoring Data (WP3.A.6)**, organized by INSA and GRAIE, on March 6-7, 2024. The workshop targeted practitioners, operators, water utilities, and stakeholders engaged in monitoring activities. The two-day workshop in Lyon, France, was attended by seven participants (4 researchers and 3 industrial water system operators) from France, Spain, and Belgium.

Task 3.3. Public webinars and education activities (Lead IKT)

Task 3.3 aimed to organise public webinars on specific and emerging monitoring techniques, providing free, online webinars to highlight different aspects of emerging technology in urban drainage metrology. Researchers and practitioners have been the main target public for these activities, which have been co-organised by various Co-UDlabs partners with the contribution of relevant speakers and experts from other academic institutions involved in the field of UD. Table 1.3 lists scheduled and completed webinars under Task 3.3.

Table 1.3. List of Co-UDlabs webinars

Webinar title	Date planned (in bold = completed)	Partners in charge [co-participants]	Link
W1 - FTIR Chemical mapping	**Sep 21, 2022**	**AAU**	**Link W1**
W2 - Acoustic turbidity measurements	**May 16, 2023**	**EAWAG, UDC**	**Link W2**
W3 - Optical and computer vision techniques for flow and processes	**March 15, 2024**	**DEL, UDC [USFD, EAWAG]**	**Link W3**
W5 - Routine uncertainty assessment (UA) in urban drainage data	**June 12, 2023**	**INSA, DEL, GRAIE**	**Link W5**
W4 - Underground infrastructure monitoring techniques	[October] 2024	IKT, USFD, DEL	N/A
W6 - Routine data validation (DV) in urban drainage	[Late] 2024	INSA, GRAIE	N/A

[11] See: https://softwaredays.deltares.nl/-/co-udlabs-course-2022.
[12] Available at: https://co-udlabs.eu/2022/11/30/lets-take-a-look-back-at-the-co-udlabs-industrial-workshop-capacity-problems-flow-rate-determination-in-pressurized-systems/.

Within RP2, three public webinars (W2, W3, and W5 in Table 1.3) were successfully set up and advertised extensively via Co-UDlabs' key communication channels. All Webinars were recorded and made available on Co-UDlabs' public YouTube channel. W2 and W3 elicited the participation and contribution of up to ten external researchers from universities and sensor manufacturers not directly involved in Co-UDlabs: their views and experience on these topics have been an interesting and original contribution for the community. Figures 1.3-1.5 below provide an overview of the events' agendas and contributors.

Start	End	Topic	Speaker	Institute
13:00	13:05	Welcome and introduction	Jörg Rieckermann	Eawag, CH
13:05	13:20	Relevance of particles (and Turbidity Monitoring) in Urban drainage systems	Peter Vanrolleghem	Université Laval, CA
13:20	13:35	Acoustic scattering from different particles - theory and scientific instruments	Stephane Fischer	UBERTONE, F
13:35	13:50	Experimental evaluation of hydro-acoustic models and inversion methods in rivers	Celine Berni	INRAE, F
13:50	14:25	Discussion		
14:25	15:00	Coffee break		
15:00	15:15	Monitoring suspended solids with acoustic turbidity in Sewers	Asmorom Kibrom	NIVUS, F
15:15	15:30	Lab-scale characterization of total suspended solids using acoustic backscattering	Manuel Regueiro	Universidad A Coruña, ES
15:30	15:45	Experiences with acoustic monitoring of TSS_fine for stormwater treatment	Daniela Böckmann	Pecher AG, D
15:45	16:00	Time Resolved Optical Turbidity and comparison to existing methods	Anne Palares	Univ. Strasbourg, F
16:00	16:30	Discussions		

Figure 1.3. Agenda of webinar W2 – Acoustics.

9:30	**Welcome and introduction** Dr. Antonio Moreno-Rodenas, Deltares	10:45	**Deep-learning for hydro-environmental applications** Dr. Antonio Moreno-Rodenas, Deltares
9:35	**Large-scale PIV in urban structures** Dr. Juan Naves, Universidadeda Coruña	11:00	**Deep-learning for sewer pipeline defect classification** Prof. Simon Tait, University of Sheffield
9:50	**Open source image-based velocimetry in rivers** Dr. Hessel Winsemius, Deltares/Rainbow Sensing	11:15	**Estimation of flood water-depth from social media imagery** Ass Prof. Joao Leitao, EAWAG/ETH
10:05	**Image-based discharge measurements in sewers** Dr. Salvador Peña-Haro, Photrack		
10:20	**Using water surface waves for discharge monitoring in rivers** Dr. Giulio Dolcetti, University of Trento	11:30	**An introduction to non-contact wastewater quality monitoring with hyperspectral camera** Pierre Lechevallier / Dr. Jorg Rieckermann EAWAG
10:35	Coffee-Break		
		11:45	**Discussion and Closure**

Figure 1.4. Agenda of webinar W3 - Optical computer vision.

Agenda:

- 14:00 – Welcome and introduction (Jean-Luc Bertrand-Krajewski & Elodie Brelot)
- 14:10 – Importance of Uncertainty Assessment (UA) in Urban Drainage monitoring and necessity to develop its systematic application (François Clemens)
- 14:30 – Basics of UA and brief introduction to the methods applied in the UDMT (Jean-Luc Bertrand-Krajewski)
- 15:00 – Presentation of the UDMT: how it works, user interface, etc. (Mathieu Lepot)
- 15:20 – Coffee break
- 15:40 – Exemples of application (Jean-Luc Bertrand-Krajewski & Mathieu Lepot)
- 16:20 – Q&A

Figure 1.5. Agenda of webinar W5 - Uncertainty analysis.

Summary of Deliverables

Deliverables completed:	**D3.1 - 1st Report on training and educational activities (M34)** An updated version of this document will be submitted at M44
Deliverables submitted past due date:	There were no delays in the submission of deliverables in this reporting period

Summary of Milestones

Milestones completed:	None
Milestones submitted past due date:	None

1.2.4 Work Package 4 - Communication, dissemination and exploitation of results

Work Package 4 (WP4) is focused on coordinating communication, dissemination, and exploitation activities. It also aims to effectively interface with stakeholders and the urban drainage community. The objectives of WP4 are as follows:

- Create a network across Europe for urban drainage practice and research.
- Identify various routes for innovation and exploitation of project results to maximize the project's impact on a wide range of stakeholders.
- Share information about the project with stakeholders, the scientific community, and non-academic actors. This will help engage the community with the project and facilitate knowledge transfer.
- Carry out tailored communication activities to ensure maximum visibility of the project. This will raise awareness about the potential of Co-UDlabs and demonstrate its impact and benefits to society.
- Ensure all data used within the project are available in accordance with the H2020 Open Access Data Policy. This will enhance the exploitation of results through direct access to project data.
- Implement actions to enhance coordination and synergies with relevant EU projects. This will exponentially widen the dissemination of project results.

WP4 is led by Euronovia, but all partners are involved in this work package and dedicate time to its activities throughout the project's lifetime.

Task 4.1. Plan for exploitation and dissemination of the project results - PEDR (Lead Euro)

During RP2, the deliverable D4.2 was updated twice: in December 2022 (M20) and in April 2024 (M36). In addition, a mid-term report on dissemination and communication activities, including KPIs reports has been submitted in April 2023 (M24). The PEDR is composed of 2 main parts:

1) Communication and dissemination strategy including a description of the target audiences, messages, rules, communication tools and dissemination actions planned during the project lifetime. It also includes a section on impact assessment and KPIs.

2) Exploitation strategy including an overview of the preliminary list of exploitable results, the actions planned to achieve the exploitation of the project results and increase the impact of the project, as well as a section on open access and intellectual property.

All versions of the PEDR are available on Zenodo.[13] The final update on communication and dissemination will be provided at the end of the project in the "Final report on the project exploitation initiatives and related impacts on innovation, including dissemination and communication activities" (D4.4, due on M48, April 2025).

Task 4.2. Dissemination actions to engage the community behind the project (Lead Euro)

During this second reporting period the Co-UDlabs consortium performed several dissemination actions:

- The list of stakeholders created in the first months after the launch of the project has been expanded with new contacts. At the end of RP2 (M36), 169 stakeholders had filled out GRAIE's contact form to join the project community and 481 people have subscribed to the Newsletter mailing list.
- The consortium **organised 10 events** with different formats:
    - Co-UDlabs workshop on "Capacity problems and flow rate determination in pressurized systems", organized by Deltares on November 17, 2022 (online); -
    - Co-UDlabs webinar on the principles and applications of acoustic backscattering to monitor suspended solids in natural and engineered systems organized by EAWAG on May 16, 2023;
    - Co-UDlabs webinar on "routine uncertainty assessment", organized by INSA and Deltares on June 12, 2023 (online);
    - Co-UDlabs webinar to present the 2nd Co-UDlabs call on Transnational Access on June 20, 2023 (online);
    - Co-UDlabs workshop to launch the 2nd TA call during the Novatech 2023 conference taking place in July 2023 in Lyon (France);
    - Co-UDlabs hackathon for participants in the 2nd TA call to connect, team up, share ideas and discuss early proposals, on September 6, 2023.
    - Co-UDlabs workshop on Uncertainty assessment in UD monitoring data (in French) to present the UDMT toolbox to a technical audience, on October 10, 2023 in Lyon (France).
    - Co-UDlabs UDMT workshop at the 7th edition of the Spanish water engineering days (VII Jornadas De Ingeniería Del Agua, Jia) on October 18, 2023 in Cartagena (Spain).

[13] Resource accessible online at: https://zenodo.org/doi/10.5281/zenodo.7261592.

- Co-UDlabs workshop on Uncertainty assessment in UD monitoring data, organized by GRAIE and INSA on March 6-7, 2024
- Co-UDlabs webinar on optical and computer vision techniques for flow and processes measurements, organized by UDC and Deltares on March 15, 2024.

The consortium participated in several external events for scientific dissemination where partners presented the work done within the project with an oral or poster presentation:

- Seven scientific conferences:
  - An oral presentation by IKT at the Water Networking event "Water in an international context 2022" on November 8, 2022, Mulheim (Germany)
  - A poster presentation by EAWAG at the Aqua Urbanica 2022 "Grün Statt Grau" - German speaking urban drainage community on November 13-15, 2022, Glattfelden (Switzerland)
  - An oral presentation by USFD at the 3rd IAHR Young Water Professionals Conference 2022 on November 29, 2022, online.
  - Two presentations by IKT at the EUR-SAM Sewer asset management workshop held at Lulea university (Sweden) on February 15-16, 2023, (i) a deep learning-based framework for automated detection of in-pipe defects in CCTV sewer survey, (ii) machine learning for prediction of failures in sewer networks.
  - Two oral presentations by USFD with EAWAG, INSA at the Novatech 2023 conference on July 3-4, 2023 in Lyon (France)
  - Oral presentation on “Annular flume studies to test the effect on antibiotic resistant genes and use of crispr-cas in E. Coli from sediments affected by sewage pollution” by USFD-UPC Barcelonatech at the "Modern aspects of microbiology, virology and biotechnology in wartime and post-war period" conference on November 15-16, 2023 in Kyiv (Ukraine).
  - An oral presentation by IKT at the Water in an International Context - Climate Change In North Rhine-Westfalia, Great Britain and the Commonwealth Conference on December 13, 2023 in Gelsenkirchen (Germany – hybrid).
- Six national technical events:
  - Participation of IKT with a small exhibition stand at the Oldenburg pipeline forum on March 30-31, 2023, in Oldenburg (Germany), where Co-UDlabs flyers were distributed to visitors;
  - Participation of IKT with an exhibition stand at the Rokatech Kassel 2023 on May 9-12, 2023, in Kassel (Germany), where Co-UDlabs flyers were distributed to visitors;
  - An oral presentation by INSA at the Journées Techniques EPNAC 2023 on October 3, 2023, in Angoulême (France)

  - An oral presentation by IKT at Kennis - En netwerkdag professioneel afvalwatertransport on December 6, 2023, in Amersfoort (The Netherlands)
  - An oral presentation by USFD at the Advances in flood modelling and forecasting event on February 1-2, 2024, in Sheffield (United Kingdom)
  - A poster presentation by IKT during the Jubiläumsfeier "10 jahre johannes-rau-forschungsgemeinschaft", mit grussworten, podiumsdiskussion, begleitausstellung und empfang (anniversary celebration "10 years Johannes-Rau-research association") on April 8, 2024.

- One Exhibition trade: Booth organized by Euronovia and UDC at the NOVATECH 2023 conference on July 3-4, 2023, in Lyon (France)
- Two Open Science events:
  - Visit of the INSA research infrastructure and other urban drainage infrastructures for schools during the “Fête de la Science” 2023 on October 9-13, 2023, in Villeurbanne (France).
  - Presentation by USFD of “Autonomous Sensing in Urban Drainage Systems” on February 12, 2024, at the University of the 3rd Age association in Sheffield (United Kingdom).
- Five other events:
  - One panel discussion by Deltares at the Blue Planet online conference "Artificial intelligence: reshaping the water industry" on November 22, 2022, Berlin (Germany) and online.
  - Oral presentation by UDC at Barcove - Bluegreen innovation challenge hackathon on September 14, 2023, online
  - UDMT presentation by INSA during a seminar at the Delta Water Institute on October 23, 2023, in Nanjing, China
  - Oral presentation by GRAIE at an information exchange/coffee morning at CEREMA (France) on March 25, 2024, in Clermont Ferrand, France. Presentation of: Co-UDlabs overview, RI mapping/cataloguing goal (get involved), data/ protocol harmonisation (get involved), JCUD new UDRAIN group (get involved), presentation of UDMT tool and sharing of supporting documents, discussion of the optical observation techniques being developed in Co-UDlabs.
  - Presentation of findings from JRA8 (gully pot sediments monitoring) by Deltares at the Global Webinar on Best Practices And Innovations In Water Sensing Of The Swig (sensors for water interest group) on April 23, 2024.

Partners have published **seven conference papers**:

- "Monitoring sediment accumulation in urban drainage systems with temperature measurements”, M. Regueiro-Picallo, A, Moreno-Rodenas, F. Clemens-Meyer, J. Rieckermann, Proceedings of Novatech 2023

- "Co-UDlabs: una red europea de grandes instalaciones de investigación en drenaje urbano", Jose Anta, Jerónimo Puertas, Luis Cea, Joaquín Suárez, Juan Naves, Daniel Carreres and Andrea Ciambra, VII Jornadas De Ingeniería Del Agua
- "Aplicaciones de visión artificial para la monitorización de sistemas de drenaje urbano", Juan Naves, Daniel Carreres, Antonio Moreno-Rodenas, Jesper E. Nielsen, Jose Anta, VII Jornadas De Ingeniería Del Agua
- "Efecto de almacenamiento de los edificios durante inundaciones urbanas. Un acceso trasnacional del proyecto Co-UDlabs", Jose Anta, Jerónimo Puertas, Luis Cea, Juan Naves, VII Jornadas De Ingeniería Del Agua
- "Houses as reservoirs in urban flood modelling", Jose Anta, Jerónimo Puertas, Luis Cea, Juan Naves, Proceedings of the Novatech 2023
- "Visions et besoins des parties prenantes européennes pour les futurs systèmes de gestion des eaux pluviales urbaines", Katharina Tondera, Frederic Cherqui, Simon Tait, Elodie Brelot, Fanny Fontanel, Jesper Ellerbaek Nielsen, José Anta, Thomas Brüggemann, Iain Naismith, Marcel Goerke, Joaquin Suárez López, Jörg Rieckermann, João Paulo Leitão, François Clemens-Meyer, Antonio Moreno-Rodenas, Proceedings of Novatech 2023
- "Montse: Monitorización De Las Temperaturas De Sedimentos Para Evaluar Su Acumulación En Sistemas De Drenaje Urbano", M. Regueiro-Picallo, A, Moreno-Rodenas, F. Clemens-Meyer, J. Rieckermann, VII Jornadas De Ingeniería Del Agua

Partners have also issued **five scientific publications**:

- "Towards urban drainage sediment accumulation monitoring using temperature sensors", M. Regueiro-Picallo, J. Anta, A. Naves, A. Figueroa, J. Rieckermann, Environmental Science Water Research & Technology, 2023
- "European stakeholders' visions and needs for stormwater in future urban drainage systems", Katharina Tondera, Elodie Brelot, Fanny Fontanel, Frederic Cherqui, Jesper E. Nielsen, Thomas Brüggemann, Iain Naismith, Marcel Goerke, Joaquín Suárez-López, Jörg Rieckermann, João P. Leitão, François H.L.R. Clemens-Meyer, Antonio Moreno Rodenas, Simon Tait, & José Anta, Urban Water Journal, 2023
- "Low-cost monitoring systems for urban water management: Lessons from the field", [...] Frederic Cherqui, Nicolas Walcker, Jean-Luc Bertrand-Krajewski [...], Water Research X, 2024
- "Combining a daily temperature pattern analysis and a heat-pulse system to estimate sediment depths in sewer systems", M. Regueiro-Picallo, J. Langeveld, H. Wei, J.-L. Bertrand-Krajewski, J. Rieckermann, Environmental Science Water Research & Technology, 2024
- "Towards non-contact pollution monitoring in sewers with hyperspectral imaging", P. Lechevallier, C. Felsheim, Villez, K., J. Rieckermann, Environmental Science Water Research & Technology, 2024

All open access deliverables submitted during this second reporting period are available for download in the dedicated page of the Co-UDlabs website,[14] as well as on the project community on Zenodo.[15] The full list of Key Performance Indicators (KPIs) and the report on communication and dissemination activities are provided in Annex I.

Task 4.3. Exploitation plan of the project results (Lead Euronovia)

The exploitation strategy outlined in the Grant Agreement has been further developed and outlined in the PEDR (D4.2) submitted at M36. The preliminary list of project results included in the Grant Agreement was updated under the lead of Euronovia in the second half of 2023: WP leaders were asked to update this initial list taking into consideration all the knowledge outputs developed or to be developed within each WP. It is to be noted that this list will be further refined by project partners until the end of the project, adding new relevant outcomes, as needed.

Among these results with potential for exploitation, the consortium selected three which were regarded as the most relevant ones, i.e., Key Exploitable Results (KERs).[16] For each of these KERs, partners involved in its creation or interested in its exploitation, worked together to jointly define exploitation intentions and roles, characterisation table, risk assessment and priority map, use options and exploitation roadmap. This information served as a guide for discussions during the exploitation seminar organised within Module C of the Horizon Results Booster in February 2024.

During the seminar, the consortium received guidance from two assigned experts to improve the existing project strategies towards effective exploitation of Key Exploitable Results. The main outcome of this seminar is a series of tools and guidelines for the consortium to make the most out of the exploitation activities of the project as well as a final report which will be provided by the experts of the Booster in the next weeks, including KERs analysis and recommendations for partners. This report will be included in the final deliverable on exploitation (D4.4) due at M48. Other modules of this service will also be considered for some of the results (e.g., Business Plan Development).

Task 4.4. Communication activities (Lead Euronovia)

Several communication actions have been realised by Co-UDlabs partners during this second reporting period:

- Co-UDlabs' **LinkedIn and Twitter accounts**,[17] as well as the project's website,[18] are being constantly updated with news, events announcements and new documents. At M36, the project LinkedIn group hits 482 followers and the Twitter account has 205 followers. Concerning the website, during RP2 32 news have been published and 78 users visited the website on average each month. More information on the content, structure and impact of the website and social media channels can be found in Deliverable D4.2.

[14] Online at this link: https://co-udlabs.eu/dissemination/deliverables/.
[15] Available online at: https://zenodo.org/communities/coudlabs/.
[16] Please refer to Deliverable D4.2 online for more details: https://zenodo.org/records/11071095.
[17] Co-UDlabs is on LinkedIn at this link: https://www.linkedin.com/company/74284316/, and on Twitter at this link: https://twitter.com/CoUDlabs.
[18] Online at: https://co-udlabs.eu/.

- A **16-pages brochure focused on Transnational Access**, with information useful to launch the second TA call (July 2023), a description of the RIs available within Co-UDlabs, modalities of access, and a short summary of projects selected during the first TA call, was prepared in May 2023.[19] It was made available online on the Co-UDlabs website and printed for distribution at national and international conferences with the aim of reaching potential users of our research infrastructures (academia, industry, and water operators) and encourage them to apply for the second call for transnational access, which was launched in July 2023 at a Co-UDlabs workshop within the Novatech 2023 conference, taking place in Lyon (France).
- In addition, **a factsheet focused on the first Co-UDlabs Transnational Access call**'s participants and results was prepared at M25, featuring the description of 7 out of the 13 projects selected during the 1st Co-UDlabs TA campaign, with pictures and testimonials from the RI users involved. The factsheet was made available online[20] on the project website and in print for distribution at the Novatech 2023 conference in July 2023. The factsheet is in the process of being updated with the missing projects from the 1st TA call and successively with other projects of the 2nd and 3rd Calls to showcase the type of experiments conducted at the Co-UDlabs RIs. Two infographics were also created and distributed online to communicate the results of the three calls for Transnational Access on the project website and social media.
- **Two newsletters were designed** in March 2023 and December 2023 and sent out to the project mailing list and disseminated through social media and the project partners network to maximise its dissemination.[21] Some additional mailing campaigns were sent out before the launch of each TA call to specifically promote the events preceding the calls (hackathon, webinar) and the calls itself, including to a list of stakeholders in the Eastern European Countries to increase their participation in the 2nd TA call.
- **Two entries about Co-UDlabs** were published in the newsletter of the IAHR/IWA's JCUD in March 2023[22] and March 2024.[23]
- A **motion-design video** was created at M20 (December 2022) to present Co-UDlabs' objectives, activities, and expected impact in a more publicly attractive and dynamic way. The video is available on the Co-UDlabs website, as well as on the project's YouTube channel — a resource established back in M12 as a dynamic repository of all project videos.[24] At M36, the YouTube channel contained 21 videos (including recordings of project webinars, Deltares' courses, the motion-design video, and several interviews with partners from the consortium), with an overall 1,235 views.

[19] The document is archived online at: https://co-udlabs.eu/brochure_transnational_access/.
[20] Available at: https://co-udlabs.eu/wp-content/uploads/2023/07/TA_call_factsheet_testimonials.pdf.
[21] Past newsletters are available on the Co-UDlabs website: https://coudlabs.eu/dissemination/newsletter/.
[22] Online at https://iahr.oss-accelerate.aliyuncs.com/upload/file/20240124/1706067576157206.pdf.
[23] Available at: https://iahr.oss-accelerate.aliyuncs.com/upload/file/20240402/1712023100505828.pdf.
[24] The channel can be accessed online at: https://www.youtube.com/watch?v=KjgBKppROVk.

- Several **news articles** were published by project partners on their institutional websites to give updates on the different activities taking place within the project (events, transnational access calls, etc.).
- During RP2, the following articles have been published in national press:
    - An article has been published by the project coordinator (UDC) in the Spanish national press to inform and update the Spanish UD community about the project and its outcomes.
    - EAWAG also contributed to raise awareness of the project at national level in Swiss national websites, news outlets, and journals.
- In terms of **synergies with other projects**, Co-UDlabs has interacted with a few different EU-funded projects (e.g., B-WaterSmart;[25] FutureDiverCities;[26] REGILIENCE;[27] MOSBRI;[28] etc.) on social media, for example by sharing content or reposting valuable information and activities. Below is a list of the synergies that WP4 put in place with other EU projects and initiatives in RP2:
    - Keynote at the 3rd IAHR Young Water Professionals Conference 2022 on *Managing ageing urban drainage systems, challenges and opportunities*, where Co-UDlabs, alongside two similar projects in QUICS[29] and CENTAUR,[30] were presented by USFD.
    - UDC took part in a Hackathon event hosted by the BARCOVE project on September 14, 2023. BARCOVE (Building an Applied Research facility into COVE) Erasmus+ Project is conducting applied research in Vocational Education and Training (VET) on urban greening.[31]
    - Co-UDlabs took part in the Water4All Partnership Workshop on research infrastructures, on April 8-10, 2024, in Orléans, France.[32] GRAIE prompted a discussion on a potential collaboration with Co-UDlabs on mapping available research infrastructures and harmonising data and protocols.

Task 4.5. Data management plan (Lead: Euronovia)

During RP2, the DMP was updated at M20 (December 2022) and at M36 (April 2024), thus including the latest project datasets and a slightly revised data management strategy, following internal discussions during the first (A Coruña, June 27-July 1, 2022) and third (Zürich, January

[25] On CORDIS: https://cordis.europa.eu/project/id/869171.
[26] Online at: https://future-divercities.eu/.
[27] On CORDIS: https://cordis.europa.eu/project/id/101036560.
[28] On CORDIS: https://cordis.europa.eu/project/id/101004806.
[29] On CORDIS: https://cordis.europa.eu/project/id/607000.
[30] On CORDIS: https://cordis.europa.eu/project/id/641931.
[31] More information online at: https://www.povewater.eu/barcove.
[32] Additional information on Water4All: https://www.water4all-partnership.eu/.

22-24, 2024) General Assemblies. All versions of the DMP are available on the project's Zenodo repository.[33]

By April 30, 2024 (M36), 30 datasets had been produced by the Co-UDlabs project in the framework of its Networking Activities (20), Joint Research Activities (8), and Transnational Access activities (2). Datasets related to Networking Activities include lists of participants in Co-UDlabs initiatives and other relevant participation and diffusion data, as well as the updated database of Co-UDlabs stakeholders. Accordingly, these are being considered as confidential and access has been limited to the consortium.

The remaining ten datasets related to JRAs and TA activities, on the other hand, are openly available on Zenodo.[34]

A final update of the DMP is planned at the end of the project (M48).

Summary of Deliverables

Deliverables completed:	**D4.1 – Data Management Plan (M6)** **D4.2 – Plan for exploitation and dissemination of the project results (M6)** Updated versions of these two documents were submitted at M20 and at the end of the RP2 (M36). **D4.3 – Mid-term report on dissemination and communication activities, including KPIs reports (M24)**
Deliverables submitted past due date:	There were no delays in the submission of deliverables in this reporting period

Summary of Milestones

Milestones completed:	**MS9 - Mid-term assessment of communication and dissemination actions (M24)**
Milestones submitted past due date:	None

1.2.5 Work Package 5 - Management of the TA

WP5 organises and manages the Transnational Access framework for external user-groups to access Co-UDlabs' research infrastructure. During RP2, these tasks mostly included development and organisation of Co-UDlabs' 2nd and 3rd Calls for TA proposals. Across both calls, proposals were admitted for 16 of the 17 large research facilities available in the Co-UDlabs programme.[35] WP5 was also in charge of engagement and advertisement activities (in collaboration with WP4) to attract multi-sectoral user-groups. WP5 also managed and coordinated the evaluation and selection procedures for both Calls. Following the 2nd and 3rd Calls, Co-UDlabs' facility providers have met all expected outcomes in terms of facility availability: therefore, WP5 implementation can be considered successfully concluded after the

[33] Online at: https://zenodo.org/records/11091173.
[34] See: https://zenodo.org/communities/coudlabs.
[35] IKT's Large Test Facility could not be advertised for the 2nd and 3rd Calls because the installation — whose set-up is especially time and resource consuming — had no available slots in the calls' time range.

publication of the last call's results and the official approval of the results by the project's Steering Committee on March 19, 2024. All TAs are performed as part of WP9 tasks. All information on WP5 work on the 2nd and 3rd TA Calls is included in detail in Deliverable D5.3, 'Report on evaluation procedure 2nd Call'.[36]

Task 5.1. Launch of the access call and outreach to users (Lead UDC)

The second call for proposals for the Co-UDlabs Transnational Access programme was officially launched on July 3, 2023 (M27), at a side-event organized by the Co-UDlabs consortium during the Novatech 2023 international conference in Lyon, France. This launch coincided with Co-UDlabs' 2nd General Assembly, which was also included in the Novatech 2023 agenda. The initial submission deadline was October 6, 2023, but due to high demand, it was extended to October 13, 2023 (M30). As with the first TA call, partners and facility providers organized additional events to inform interested parties about the TA programme, the 2nd Call, and participation requirements. These events included:

- **Co-UDlabs 2nd TA Call Introductory Webinar**: Following the success of a similar initiative for the first TA call, this webinar was held on June 20, 2023 (M20). It aimed to engage a broader audience, particularly those new to Co-UDlabs or from countries where Co-UDlabs had limited visibility. The webinar covered the TA programme, rules, submission procedures, and conducting transnational access at Co-UDlabs facilities. It attracted 51 participants and is available on the project's YouTube channel.
- **Co-UDlabs TA Workshop at Novatech 2023**: This workshop detailed the Call's features, rules, and timeline and presented preliminary results from projects funded during the first call. It was attended by 33 participants, including several facility providers, with more information available on the project's website.
- **2nd Co-UDlabs TA Hackathon**: Co-UDlabs held its second Hackathon event on September 6, 2023 (M29). This online event provided a platform for user groups to receive feedback and support on their proposal ideas from other teams, academics, industry representatives and facility providers. The Hackathon achieve reaching new participants from countries such as Belgium, Canada, Estonia, Germany, Serbia, and Sweden. The team with the most promising presentation, from Germany's Technische Universität Darmstadt, won a visit to the STREET facility at UDC on September 26-27, 2023, to discuss and finetune their proposals according to the characteristics of the facility.

At the end of the first and second call, INSA Lyon and Aalborg University were still one access below the agreed minimum. Consequently, WP5 leaders, facility providers, and the Project Advisor decided to establish an extraordinary 3rd TA Call, with applications limited to the FREJLEV and OTHU-DRB facilities. This 3rd TA Call opened on December 15, 2023 (M32), and officially closed on January 5, 2024. The deadline was extended then by two weeks to January 19, 2024 (M33) due to an issue with

[36] The Deliverable is also publicly available online: https://co-udlabs.eu/wp-content/uploads/2024/05/Attachment_0.pdf.

the submission procedure by one institution. This last call was disseminated through website, social media, mail list and personal contacts to the increasing UD community.

Task 5.2. Review of access proposals (Lead UDC)

Nine members of the EEP who participated in the assessment of the 1st TA Call agreed to join the panel for a second round of evaluations. Following the closure of the 2nd TA Call on October 13, 2023, all eligible and feasible proposals (21 out of 24) were evaluated by WP5 leaders and facility providers and then distributed to the EEP members. The distribution was based on specific expertise and aligned with both the proposal content and facility characteristics. The EEP received the proposals on October 16, 2023. To ensure at least four weeks for their assessment, a joint EEP-SC meeting was scheduled for November 14, 2023 (M31). This meeting included EEP representatives and at least one representative from each Co-UDlabs partner offering a facility for the TA programme. The agenda covered an overview of the evaluations for each eligible and feasible proposal and a joint ratification of the evaluation results. In borderline cases, both EEP members and facility providers were consulted:

- When the final average score was just below the 13-point threshold, but one evaluator had awarded more than 13 points.
- When the final average score was above 13 points, but at least one evaluator had recommended rejection.

Based on these criteria, out of the 21 eligible and feasible proposals, 13 were accepted, 4 were rejected, and 4 were returned to applicants for revision and resubmission. These revised proposals were reviewed again by their respective evaluators finalizing the evaluating procedure. Official notifications of acceptance were sent to all user groups on November 30, 2023, with public announcement made on December 11, 2023 (M32), officially closing Co-UDlabs' 2nd TA Call.

Two proposals, one for each available facility, were received by the end of the 3rd TA Call. These proposals were evaluated by two EEP members each, and the results were presented to Co-UDlabs' Steering Committee on February 8, 2024 (M34). Both projects passed positively the evaluation and the outcomes were simultaneously communicated to the user-group leaders, allowing them to start planning with the facility providers their experiments.

The projects awarded with free Transnational Access in the 2nd and 3rd calls of the Co-UDlabs TA programme are listed in Table 1.4. With 31 proposals accepted in the three TA Calls combined, all partners have met the minimum access requirements listed in the Grant Agreement.

Task 5.3. Organisation of the TA access period (Lead UDC)

Given the close timing and similar methods used in processing both the 2nd and 3rd Calls, and the early stages of logistics for the 2nd Call when the 3rd Call was finalised, the Steering Committee decided to treat the projects from both calls as part of the same logistical and administrative process. Accordingly, following the official announcement of the outcomes for the 2nd and 3rd TA Calls in early February 2024, all user groups were instructed to begin communication with their selected facility providers as soon as possible to arrange their visits, safety requirements, and training activities.

Table 1.4. Selected proposal by the External Evaluation Panel to be awarded with Transnational Access of Co-UDlabs' 2nd and 3rd TA Call.

Provider	Facility	TA Call	Proposal Title	Group leader institution	Group leader country
01. UDC	BLOCK	2	Inception of Transport of Litter Under Pluvial Conditions (IT-LUP)	Karlsruher Institute for Technology (KIT)	Germany
01. UDC	BLOCK	2	Soil moisture supply and green roof plant requirements incorporating drainage and energy functions	University of Coventry	United Kingdom
01. UDC	STREET	2	Hydraulic Characterization of Permeable Pavement Bonded with A Novel Polyurethane Binder	RWTH University Aachen	Germany
01. UDC	STREET	2	Active Building Materials: Integration of Visible Light-Driven TiO2-based Carbon Nanotubes for Enhanced Degradation of Micropollutants in Rainwater Runoff	Technical University of Darmstadt	Germany
02. USFD	A/B FLUME	2	Understanding the transport and fate of ejected sewer sediments during urban flood events	University of Aveiro	Portugal
02. USFD	BURIED	2	Stormwater Conveyance System Performance Enhancement with Passive Control of Flow (SPEC-FLOW)	Toronto Metropolitan University	Canada
02. USFD	RTC-RIG	2	Measurement Uncertainty in Real Time Control and CSO quantification	Delft UT	Netherlands
02. USFD	RTC-RIG	2	Evaluation of uncertainties linked to different methods of CSO's estimation	ICRA	Spain
03. DELTARES	B-LOOP	2	Dynamic Behaviour of Air Pockets in Urban Drainage Systems (DAirUDS)	University of Leeds	United Kingdom
03. DELTARES	B-LOOP	2	Advancing Urban Drainage: Testing Distributed Acoustic Sensing (DAS) for Efficient Wastewater Transportation	Silixa Ltd.	United Kingdom
04. EAWAG	UWO	2	Maximising the Benefits of Sewer Heat Recovery through Computational Optimisation and Practicality Consideration	University of Exeter	United Kingdom
04. EAWAG	UWO	2	STARR-ING - Spatio-temporally advanced resolution of rainfall data for ingenious urban hydrological applications	Univ. Kaiserslautern-Landau	Germany
05. IKT	IKT-TEST	2	A novel manhole design improving the hydraulic performance of separate sewer systems	Liverpool John Moores University	United Kingdom
05. IKT	IKT-TEST	2	Standard development for stormwater management in Sweden	RISE Research Institutes of Sweden	Sweden
06. INSA	GROOF	2	Intercomparison of the hydrological Response of Green Roofs Across Scales, sites and experimental setups (INDOOR-GRASP)	HSWT	Germany
06. INSA	OTHU-SuDS	2	NBS pRECision cONdition Assessment (NBS-RECON)	University of Belgrade	Serbia
07. AAU	FREJLEV	3	Air-water stratified flow in a poorly ventilated sewer main	Tallinn University of Technology	Estonia
06. INSA	OTHU-DRB	3	OSRAI'Level - Monitoring Tool for Smart Sewage Systems	IJINUS	Italy

As with the 1st Call, the facility provider and the user-group agree on a User Facility Agreement (UFA) before the TA begins, which includes the TA dates, responsibilities, and duties of both the user group and the facility provider, covered expenses, and applicable laws. Each UFA must also include a User Project Plan (UPP), detailing the agreed experimental setup, procedures, test programme, access plan, and visitor dates. Co-UDlabs' General Assembly also agreed — in a dedicated session at the 3rd General Assembly in Zürich, in January 2024 — to include a new annex to the UFA for an initial Data Management Plan (DMP) for each TA. This new annex, resulting from the General Assembly held in Zurich in January 2024, was based on feedback from 1st Call user-group surveys and WP2 discussions. It was designed to generate clearer DMPs that could be useful for organising and publishing open datasets after the TA project.

A joint WP5-WP9 meeting was held in February 2024 to mark the transition of TA-related tasks from arrangement to actual access provision, and to review the progress in setting up the TAs. Facility providers positively assessed the initial contacts made with awarded user groups, which have all committed to finalise arrangements and begin TA operations in the coming weeks. Finally, UDC offered facility providers private SharePoint environments on the Teams platform for coordination and communication between user groups and facility providers, as well as for the secure storage of data generated during the TA.

All information related to the implementation of the different TAs in RP2 is detailed in the WP9 report and Section 1.4

Summary of Deliverables

Deliverables completed:	**D5.3 - Report on evaluation procedure 2nd call (M33)** In order to include the results of the extraordinary 3rd call in the reporting the deadline of the Deliverable was extended with the approval of PA office.
Deliverables submitted past due date:	There were no delays in the submission of deliverables in this reporting period

Summary of Milestones

Milestones completed:	**MS12 - 2nd call proposals launched and evaluated (M33)** News on Co-UDlabs website and D5.3 support the completion of the MS. The original deadline of the MS was extended to M33 after the revision performed in RP1.
Milestones submitted past due date:	None

1.2.6 Work Package 6 - JRA 1. Smart sensing and monitoring in urban drainage

The Joint Research Activity "Smart sensing and monitoring in urban drainage" is developed in the framework of WP6. The objectives of this WP are to: i) foster a paradigm shift in UDS management, transitioning from current inefficient approaches towards a digitised, informed, shared, evidence-based decision process based on truly smart monitoring; ii) identify and evaluate new sensors and technologies for hydrological and hydraulic variables, pollutant load monitoring and UD underground asset inspection; iii) define and evaluate new methods and tools to improve evidence base for reliable and validated urban drainage monitoring data; and iv) define and evaluate new methods to analyse and interpret urban drainage space and distributed

data. WP6 is led by INSA and most of the TA facility providers are involved in their development (UDC, USFD, DEL, EAWAG).

Task 6.1. Evaluation of sensor and new data sources for hydraulics, pollutant load monitoring and asset inspection (Lead EAWAG)

The goal of Task 6.1. is to assess promising sensor technology for UDS (Sub-Task 6.1.1, completed in RP1) by means of in-depth testing in full-scale (Sub-Task 6.1.2). Out of 55 reviewed technologies, WP6 selected eight sensors with different technological readiness levels (TRL) for in-depth performance assessment. The eight selected technologies were distributed to the different WP6 members (Deltares, EAWAG, INSA, UDC, and USFD; see Table 1.5).

Table 1.5. Name, description and testing leader for each sensor, shaded cells indicate insufficient performance for UDS applications.

#	Sensor name and manufacturer	Description	Testing leader	Completion
6	Coliform (Proteus Instruments)	Fluorescence-based total coliforms and E. coli concentration measurement	University of Sheffield	100%
7	LPICM (in-house, EAWAG)	Ultra-low power sensor for the measurement of conductivity, including LoRaWanN transmission	EAWAG	80%
12	DischargeKeeper (Photrack)	Camera for image-based flow measurement	University of A Coruna	100%
24	ISA (Go-Systemelektronik)	UV-visible spectrophotometer for multi-parameter measurement	EAWAG	75%
27	MV.X. (Headwall Photonics)/ Pollutionkeeper (Photrack)	Hyperspectral imaging system for non-contact multi-parameter measurement	EAWAG	90%
31	PAH (Aquams)	Fluorescence-based PAH concentration measurement	INSA	100%
33	Pipe mapping FSB (in-house, Deltares)	Low-cost platform equipped with IMUS and top view LIDAR	Deltares	40%
43	Lidar Sediment Mapping (in-house, INSA)	Lidar for sediment mapping	INSA	60%

The testing of each sensor was organised into two phases. Initially, the respective testing leader evaluated the sensor through a preliminary measurement campaign. This first series of tests concluded at the end of 2023. Data from four out of the eight sensors have been analysed, while the analysis for sensors 7, 24, 27, and 43 is still ongoing. The Coliform and PAH sensors yielded insufficient results in the first series of tests, leading us to discontinue their further evaluation. The remaining six sensors underwent additional testing.

In the final months of 2023, the second phase of testing for these six sensors started. After testing at EAWAG, ISA was shipped to UDC for a three-month experiment scheduled from May 2024 to July 2024. The MV.X sensor was supplemented with custom hardware from the Pollutionkeeper

project,[37] a similar spectral camera, in agreement with the WP6 core group. The Lidar for sediment mapping was field-tested, and a series of measurements were taken. Data processing of the extensive point clouds necessitates specific computations on a high-performance computing server, which has not yet been accomplished. The repeated departure of key staff members (see 5.2.1) has resulted in exacerbated delays in testing sensor 43. Work on sensor 33 has been delayed due to the lingering impacts of the COVID-19 pandemic, particularly Long-Covid fatigue among key personnel, which disrupted project timelines and led to logistical challenges such as delays in experimental work.

In summary, the sensor testing is progressing as expected, with successful results for some sensors (12 and 7), mixed results and delays for others (24, 27, 43, and 33), and even unsuccessful results for some, as monitoring in UDS, e.g., raw wastewater, is fundamentally challenging.

For dissemination, the results obtained during the testing of the eight sensor technologies in Deliverable D6.2 will be reported. For the data analysis, WP6 plans to use the toolbox developed in Task 6.2 (or parts thereof). The deadline for this deliverable was shifted to M44 during the third general assembly in January 2024, to provide sufficient time for sensor testing. At this deadline, each dataset collected within the framework of Task 6.1 will be made available in our Zenodo community. In addition to Deliverable D6.2, the most promising sensor experiments will be reported in conference papers or peer-reviewed publications. As of now, the Coliform sensor results were part of a PhD thesis. Given the current results, publications are planned for the LPICM, DischargeKeeper, MV.X, and Lidar Sediment Mapping.

Task 6.2. Smart methods and tools to improve the evidence base for reliable and validated monitoring data (Lead INSA)

Initially, the objective of Task 6.2 was to propose a list of codes to apply the selected methods and protocols. However, during the course of Sub-Task 6.2.1, the WP partners decided that a free online web app with an easy-to-use interface would be more beneficial than a collection of open-source codes. This decision was made to facilitate the use of the selected methods by the highest number of users, particularly practitioners, as it requires fewer skills. Consequently, a web application was developed based on Matlab codes to avoid the need for each user to install codes locally and to facilitate the use and maintenance of the software. The first official release, UDMT 2022a, was published in October 2022 (M18), with some functions not completely implemented. Since then, all planned functions have been fully implemented and a number of improvements have been made, notably to optimise access for multiple users, memory management, and operational fluidity. The current version (2023b) was released in December 2023. The user manual is continuously updated and improved (the last version is 2023b5, dated December 2023), according to feedback and comments collected during seminars and workshops. The UDMT web app can be accessed by any user, free of charge and without any registration or sign-in requirement. As initially planned, the UDMT Toolbox is available on the project's website section on the Research Tools developed through project activities. It is also

[37] More information available online: https://www.photrack.ch/pollutionkeeper.html.

freely available online as a stand-alone application (exe versions), as seminars and workshops revealed that some users do not wish or are not allowed to transfer their data on the internet. Except for corrections of possible bugs to be detected in the future, the UDMT is considered a terminated task.

Collaborative work is currently underway between Task 6.2 and Task 2.1 to port the UDMT to the open science platform RENKU (Figure 1.6, right).

The UDMT was introduced to a wider audience via a dedicated webinar on June 12, 2023. It was also presented at the EPNAC conference in Angoulême, France on October 3, 2023, in training courses in Lyon, France on October 10, 2023, and in Cartagena, Spain on October 17, 2023, in a seminar in Nanjing, China on October 23, 2023. Additionally, an on-site training session was organised on March 6-7, 2024, in Lyon by GRAIE and INSA. During this session, the uncertainty assessment in urban drainage as well as the UDMT was discussed with experienced wastewater professionals based on their own examples and case studies.

Figure 1.6. Left: Dissemination of the Urban Drainage Metrology Toolbox via webinar and recording on the Co-UDLabs YouTube channel; middle: Training wastewater professionals on the UDMT toolbox (March 2024, Lyon); right: Collaborative work with WP2 to implement UDMT in RENKU.

Task 6.3. Space distributed monitoring and data interpretation (Lead USFD)

The aim of this task was to explore the information that can be gained from space-distributed monitoring data in both centralised and decentralised urban drainage systems, and the potential impact of such datasets on regulatory policy and water utility behaviour. The task will specifically analyse the openly available CSO event duration monitoring (EDM) dataset from England and Wales and draw lessons from these. The task aims to compare and contrast data collected for CSO performance with those collected for SuDS performance.

An initial analysis of the CSO EDM dataset from England was carried out by research assistants in Sheffield in Q3 of 2023, and initial lessons learned and potential wider implications were written as an abstract ('How to Monitor and Regulate Combined Sewer Overflows?') presented at Novatech 2023, in a session on 'national strategies' attended by French practitioners. The presentation visualised the extent of CSO spill duration and compared this with wastewater treatment plant capacity in several areas in England (see Figure 1.7 below).

Several meetings were held in 2023 to discuss linkages between Task 6.3 and Task 2.3, and a synopsis was written for a combined output paper from both tasks. Several experts were consulted for a comparison of CSO monitoring, regulation, and compliance assessment in

several European countries. An abstract titled 'The Role of Open Data in Regulating Combined Sewer Overflows' was accepted for oral presentation at the 16th ICUD 2024.

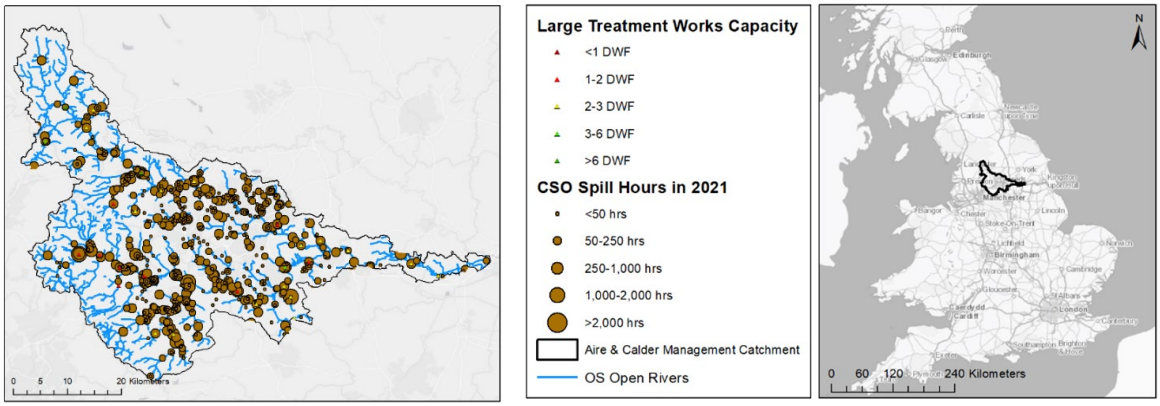

Figure 1.7. Illustration used in Novatech 2023 presentation. Example of visualisation of CSO spill hours in 2021 for the Aire and Calder catchment, compared to large treatment works capacity (treatment works capacity as estimated by Giakoumis and Voulvoulis, 2023).[38]

This work showed a move to more complex regulation of CSOs in Europe, but also that CSO monitoring is not widely done. The work indicated compliance assessment with CSO regulation is mostly made based on model simulations. In some countries, there is no definition of what constitutes an 'illegal' CSO spill, and in general, there tends to be limited follow-up of illegal or 'unintentional' spills due to the difficulty of making a clear legal case against polluters, due to a lack of suitable CSO monitored data. Where there is open CSO data, citizen groups and river custodian NGOs are making use of the open data, and CSOs are entering a more public scrutiny and debate about water quality and costs of solutions.

Further spatial analysis of the England and Wales CSO EDM data was carried out by a Master's student placed at Deltares and supervised by Deltares and the USFD. Their abstract, titled 'Spatial Analysis of the Combined Sewer Overflow Durations in England and Wales,' was accepted for oral presentation at ICUD 2024 too. This work showed significant correlations between CSO durations and regional climate and topography at the scale of local area districts (for example, see Figure 1.8), but also a lot of noise in the data. A postdoc at USFD is currently working on higher-resolution spatial correlation analysis between rainfall statistics, catchment steepness, built-up area, population, as well as socio-economic factors and CSO EDM data at the smaller sewer catchment scale.

A start has been made on the structure of the deliverable D6.4, which will summarise the lessons learned from the analysis of CSO data and compare and contrast these with the data currently collected for SuDS structures. WP6 aims to utilise the lessons learned from CSO data analysis to advise on SuDS data collection.

[38] Giakoumis, T., and N. Voulvoulis. 2023. 'Combined Sewer Overflows: Relating Event Duration Monitoring Data to Wastewater Systems' Capacity in England'. Environmental Science: Water Research & Technology 9 (3): 707–22. https://doi.org/10.1039/D2EW00637E.

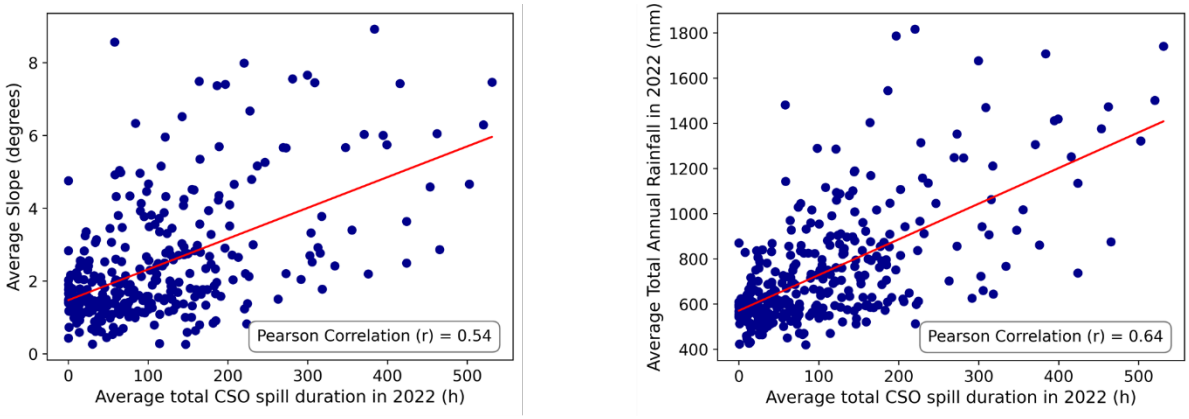

Figure 1.8. Correlation between CSO spill durations versus annual rainfall and average slope, C de Vito, internal Deltares placement report 'assessing CSO spills in the United Kingdom: a spatial and statistical analysis of the EDM dataset.

The ICUD abstract on 'The Role of Open Data in Regulating Combined Sewer Overflows' was invited by the conference organisers to be extended to a full manuscript and submitted for the ICUD special issue in the peer-reviewed journal, *Water Science and Technology*. Collaborative work is currently underway between Task 6.3 and Task 2.3 to prepare this manuscript.

Summary of Deliverables

Deliverables completed:	**D6.3 – User toolbox package for i) sensor calibration, ii) data validation and iii) uncertainty assessment. (M24)** This deliverable is available on Zenodo[39]
Deliverables submitted past due date:	None.

Summary of Milestones

Milestones completed:	**MS15 - Review of methods and tools after internal testing in T6.2 (M24).** Milestone achieved via the updated UDMT user manual (version 2023b5).
Milestones submitted past due date:	None.

1.2.7 Work Package 7 - JRA 2. Evaluation of asset deterioration in urban drainage systems

The core objectives of WP7 include the following:

1) To evaluate current in-pipe defect identification protocols by examining uncertainty associated with defect identification and characterisation.
2) To understand how knowledge on individual pipe defects can be used to estimate pipe condition that can be mapped onto system performance.
3) To propose a new common framework that use reliable knowledge of pipe condition to make robust decisions on renewal, renovation and repair.

[39] Document available online at: https://zenodo.org/records/7876543.

4) To identify technology development needs for in-pipe inspection and defect deterioration processes that can be led to more robust renewal, rehabilitation and repair actions at a European level.

Task 7.1. Inspection data to system knowledge (Lead USFD)

The final activities in this task were completed. Deliverable 7.2 was submitted on time, and this contained a review of the current methods for pipe condition assessment and used the results of recent work in EU countries to highlight weaknesses in the current approaches. It found that condition grading was subject to bias, and the use of multiple external parameters found that the objective identification of assets that had severely deteriorated and had a high probability of failure. It was noted that some studies using Machine Learning (ML)-based approaches showed promise in using condition data to predict asset failure, as it used historical failure data to train the ML classifiers used to predict failure. Although this approach showed promise it did require considerable amounts of condition and failure data that was rarely available. It was recommended that with improved inspection technologies that were now close to being market ready that a defect based rather than a condition-based approach should be used. This will be the approach pursued in the activities in Task 7.3.

As part of D7.2, a github repository containing Deep Learning (DL)-based image analysis software and an open access database of in-pipe defect images for training and validation was made available online,[40] also through a link on Co-UDlabs' website.[41] The list of defects for which the python code was trained to identify is listed in Table 1.6 and some examples the use of the software on unseen defects is shown in Figure 1.9. The code is written in Python with supporting documentation and testing data so that the code can be used and changed by end users free of charge. The software was presented in a Co-UDlabs webinar (March 2024) organised by Deltares.

Table 1.6. List of defects that the DL software has been trained to identify

Label	Label Name	Map to classifications in Table 1.
Obstacle – Block	ObsPlc	Measure size of obstacle after DL detection
Obstacle – Tree Root	ObsRot	Measure size of obstacle after DL detection
Obstacle – Sediment Deposition	ObsDep	Measure size of obstacle after DL detection
Joint	Jnt	Measure thickness of joint after DL detection
Crack	Crk	After DL detection, count number of cracks in the image and measure size and position of them
Damage – Hole	DmgSev	Directly mapped
Damage – Severe (Broken, Collapsed)	DmgSev	Measure/compare cross-section of pipe after DL detection

[40] The repository is online at this address: https://github.com/Co-UDlabs/sewer_defects.
[41] The website's Tools and Outputs section has been added to start disseminating and advertising the project's results: https://co-udlabs.eu/research/tools-and-outputs/.

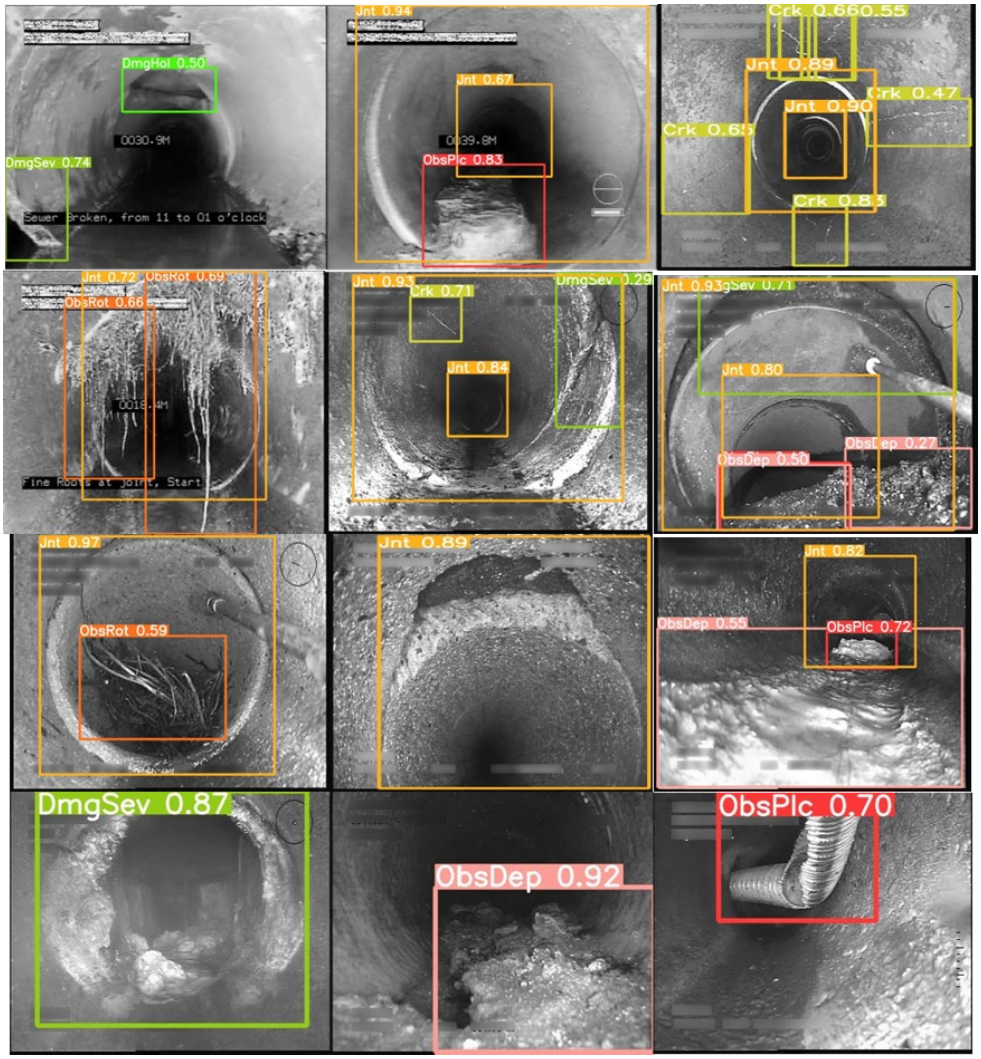

Figure 1.9. Some examples of the DL image software identifying in-pipe defects.

Task 7.2. Developing failure scenarios for defects (Lead IKT)

Sub-task 7.2.1 Tests on external loading to urban assets: In this sub-task the first activity was to observe the failure mechanisms of a limited number of failures to better understand the physical causes of asset failure. This is work that is being carried out at IKT and Sheffield. The mechanisms selected to be studied were joint rotation and displacement due to pipe soil interaction. These mechanisms were selected as infiltration, created by displaced joints is a major failure in the United Kingdom and Germany. Interest in the actual geometry of displace joints is high as manufacturers of interventions such as cured in place liners could use information of typical joint deformations to improve their repair technology. This activity has involved the preparation of tests both at IKT and Sheffield, the development of new measuring equipment to measure joint displacement and rotation of jointed drainage and sewer pipes.

The measurement technique selected to measure the pipe joint displacements is Digital Image Correlation (DIC) is an optical technique enabling accurate non-contact deformation, displacement, and strain measurement in materials and structures. It is based on the analysis of changes between images taken before, during and after deformation of a target material from cameras of known spatial and optical characteristics. Depending on the multiple cameras, they

must take repeated simultaneous images from which a deformation or strain field can be achieved. DIC provides a Full-Field Measurement unlike point-based techniques such as strain gauges and therefore provides a more comprehensive view of deformation and strain over the entire visible surface of the specimen to measure the displacement and rotation of a pipe joint. DIC is material agnostic and can be performed on any material or system capable of carrying the required speckle overlay. Normal DIC systems cost many thousands of euros, in Co-UDlabs WP7 wanted to create a DIC based system that could be used to provide the in-pipe displacement measurements to quantify pipe joint displacement at a fraction of the cost so that it could be deployed in both IKT and Sheffield's labs.

A four-camera system, based around a low-cost Raspberry Pi (4B 8GB Ram) and a Arducam 1MP*4 Quadrascopic Monochrome Camera Kit, with integrated lighting and power has been developed (see Figure 1.10) and is currently in IKT being evaluated in their test setup. Custom Python scripts for calibration and measurement image acquisition and post processing of images for analysis have been developed. Once evaluated these will be made open access along with the specifications for others to manufacture the system.

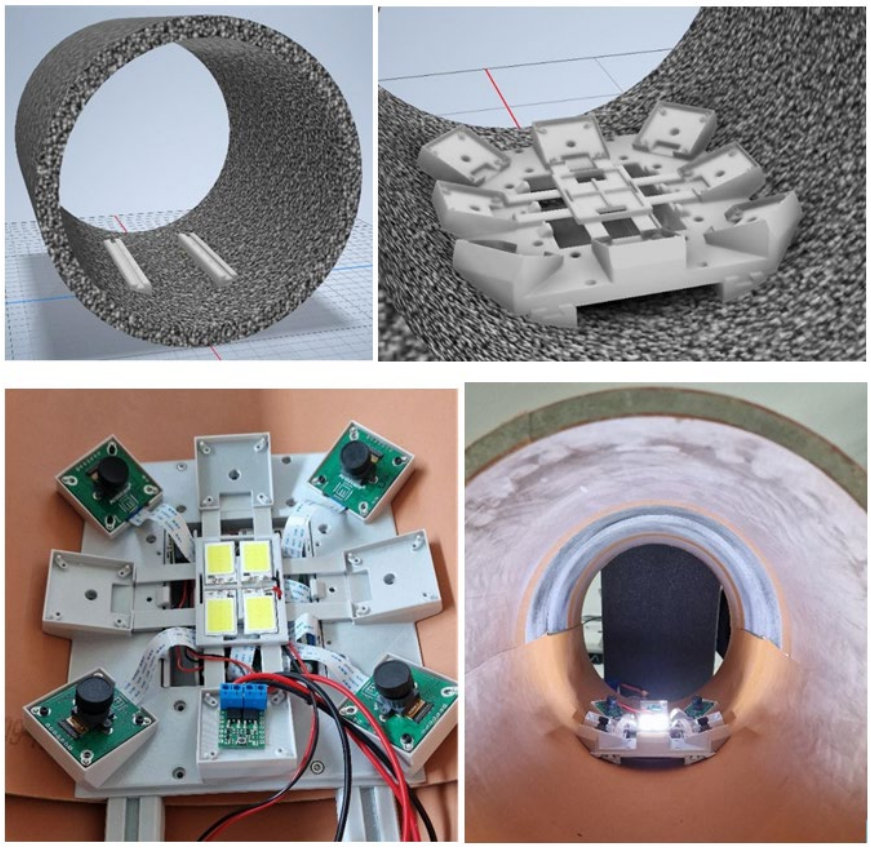

Figure 1.10. Low cost DIC equipment developed for in-pipe joint displacement measurements in a 300mm diameter pipe.

Whilst the DIC equipment has been developed In Sheffield, IKT prepared a test setup that will allow 300mm pipes to be rotated. The joint displacement/deformation will then be measured using the low cost DIC system and then the exfiltration of the displaced joint using technology developed by IKT. The current test setup is shown in Figure 1.11.

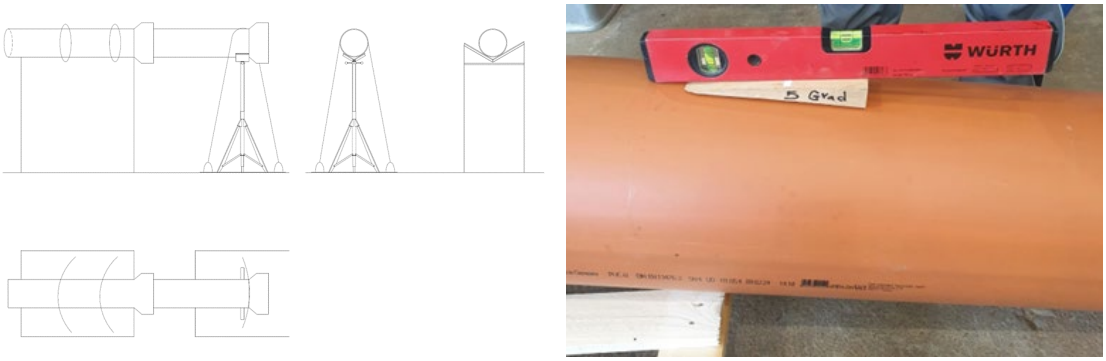

Figure 1.11. Top: Drawing showing the potential articulation of the IKT pipe; bottom: photograph with pipe showing maximum articulation.

This project is being supported by a Bachelor's engineering student carrying out his dissertation. The tests will be carried out over summer 2024. The variables to be examined are pipe material/joint type, pipe rotation (2°-5°) and whether the joint seal is damaged or not and exfiltration rate at various pressure heads. This data set will provide the researchers at IKT and Sheffield with sufficient data to model pipe exfiltration rates based on a range of damage scenarios – joint damage, articulation and groundwater depth. A small number of tests will be carried out in the ICAIR facilities with a buried 300mm concrete pipe to assess the impact of burial on exfiltration rates. This will use the low cost DIC system described above so that the results can be objectively compared with the earlier tests at IKT.

In Sub-task 7.2.2. combination of tests results with conceptual models this will be accomplished by the Bachelor's student at IKT and a Masters student at the USFD, who is carrying out a literature review of previous work. The Master's student at USFD is also developing simple mechanistic models currently in anticipation of the laboratory data.

Task 7.3. Application of proposed defect deterioration models to real systems (Lead USFD)

Task 7.3 aims to link the use of hydrodynamic network models with other defect data or if defect data is not available to provide prediction of system performance degradation when defects are present in the system. This approach follows the work of Wu (2023), a researcher working on this project. This task is to report in M44, so much of the work to date has been focused on code development and model validation.

Storm Water Management Model (SWMM) hydrodynamic models are to be used to assess hydraulic capacity of assets. The impact of the defects on the hydraulic performance of the system will be tested using an integrated model of hydraulic performance model and asset deterioration model. The integrated model will be built in Matlab. The observed or forecasted asset condition changes are simultaneously reflected in the hydraulic model by automatically changing the asset characteristic parameters. A similar model has been built for the United Kingdom railway drainage systems in a previous study.[42] The model's practicality was shown with a case study of a drainage system in the United Kingdom known to be historically flooded. The

[42] See: Wu, Y. (2023) *Whole Life Cost Modelling for Railway Drainage Systems Including Uncertainty*. EngD thesis, University of Sheffield.

results showed that the effect of forecasted asset deterioration can increase the flood risk of a network considerably.

Three case studies have been identified, all have hydrodynamic network models in the SWMM format, or WP7 is converting these models now. The three case studies come from the United Kingdom, Belgium, and Switzerland. The water utility in the United Kingdom has requested anonymity. The Belgian network has been supplied by Aquafin, who have requested that they are able to see and discuss the results before dissemination. The Swiss utility is a small city utility and are more comfortable with the dissemination of results. WP7 described progress made with preparing these models for the analysis of defects. The case studies are described as follows.

United Kingdom Network. The United Kingdom sewerage network is primarily combined with a wastewater treatment works (WwTW) to the north of a town, which also receive flows from several large villages. The network has a calibrated hydrodynamic model which covers all catchments draining to the WwTW. The modelled catchments have a population equivalent of 20,000 persons, with around 3,200 conduits with a total length of 132 km, two thirds of these conduits (totaling 88 km) are combined or foul. The model also includes 21 pumps and has 720 Ha of contributing area from 1,851 sub-catchments. The model calibration data was collected in 2018 and the process used 31 flow (depth and velocity) monitors and 17 rain gauges.

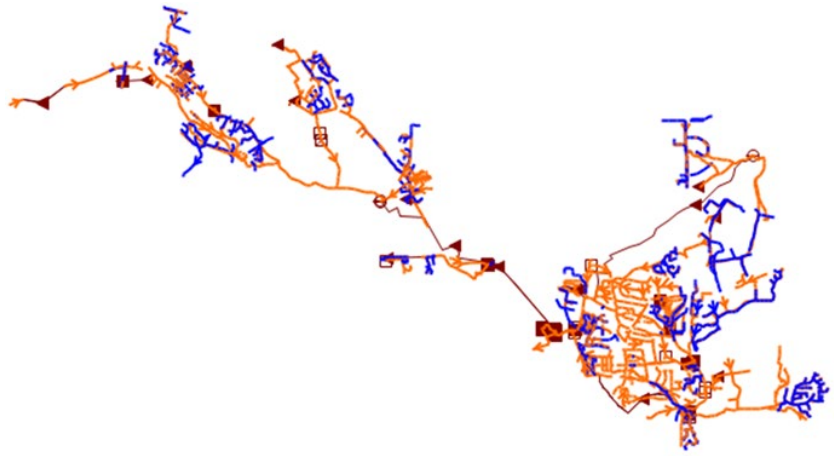

Figure 1.12. ICM hydrodynamic network model of the United Kingdom network.

The model is built in the proprietary InfoWorks ICM software. While ICM is a powerful software, it has limitations for research purposes where it is useful to batch simulations with parameter changes and scenarios involving changes such as adding a blockage. The decision was therefore made to convert the model to the open source SWMM platform for the Co-UD labs project. Limited instructions and advice for such a conversion are available, especially because United Kingdom specific rainfall-runoff and routing models are used in the ICM model which are not available in SWMM, thus parameters cannot be directly mapped. One of the villages in the north part of the catchment has been selected to develop the conversion process. The sewerage network from this area is easily cut from the main model because of a long, steep pipe downstream of the village meaning that there are no downstream backwater effects. The selected section of the model has 193 conduits with a total length of 8.4 km, of which 125 (5.8 km) are foul or combined. The population equivalent is 1,600 and the runoff area totals 42 Ha from 131 sub-catchments. The model includes three pumps with fixed flow rates of between 1

and 15 l/s. The conversion of this part of the main model has been converted into SWMM in preparation for its use in Task 7.3.

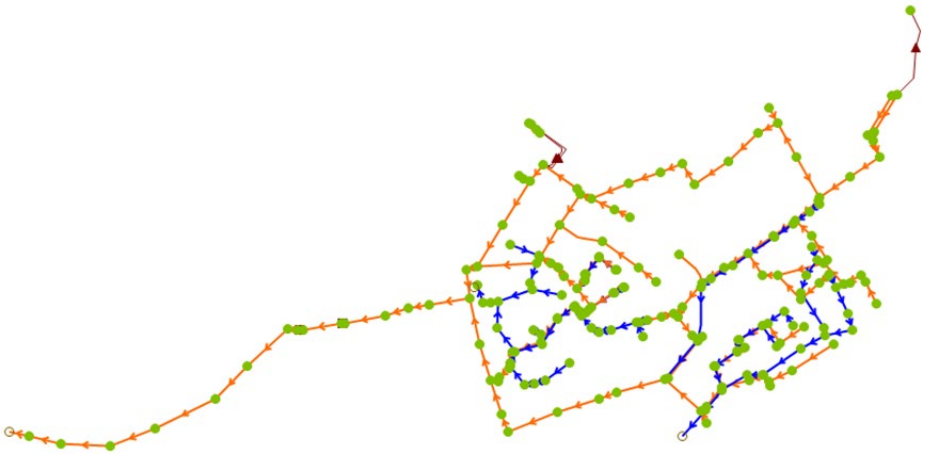

Figure 1.13. Newton section of ICM model converted into SWMM format

Belgium network. The hydrodynamic model used in this study was a subsystem of the sewer network of the municipality of Herent in Belgium. It serves around 2,100 inhabitants with a total contributing area of about 87 ha. The sewer system is gravity driven with 60% of its pipes having a slope from 0 to 2%. A small number of pipes (around 3% of the total number of pipes) had a slope of 10% or higher. The catchment was selected for this study because it has been used for a number of other studies and water company Aquafin have a good understanding of this network and have confidence in the model.

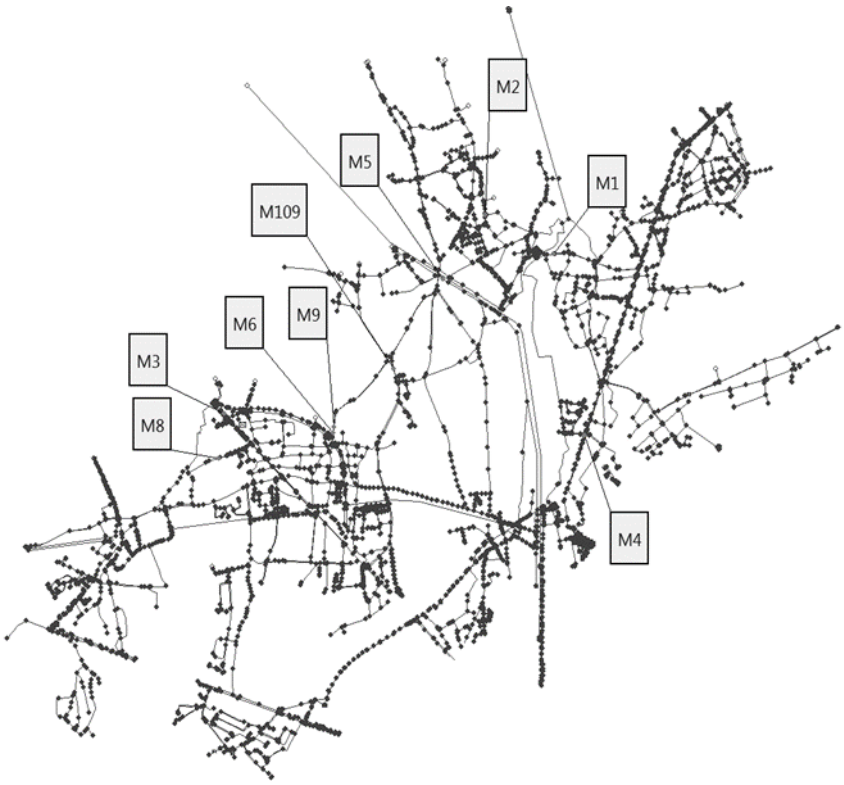

Figure 1.14. Layout of modelled subsystem of Herent catchment.

Swiss network. EAWAG is collecting the necessary formal authorizations for the use of a hydrodynamic catchment model for the city of Schaffhausen. This city is currently in the process of updating its general drainage plan and wishes to test methods that allow it to assess the impact of new and emerging defects on the performance of its sewer systems. They wish to assess how the degradation of sewer conditions increases the roughness and hydraulic resistance within the pipes. Increased roughness, in turn, reduces the runoff capacity of the sewers, potentially leading to higher incidences of urban flooding. They are currently employing a SME, Pallon,[43] who provide a service that uses AI to report defects. They have a potential business interest in applying the technology developed by USFD to supply their customers not only with condition classes of their assets, but also estimates to have more realistic capacity analyses. Currently, EAWAG is collecting the necessary authorizations so Pallon can provide USFD with a login to their portal to access the asset data of Schaffhausen. USFD will then compute the update roughness values to run updated hydraulic simulations. This work will be performed in the scope of updating the Schaffhausen's Drainage Plan at no cost for Co-UDlabs. The current hydrodynamic model is in the MIKE software tool, and this will need to be converted into the SWMM tool to be compatible with the Python-based defect assessment tools that have been developed at the University of Sheffield.

Summary of Deliverables

Deliverables completed:	**D7.2 - Assessment of current pipe condition assessment approaches and proposals for improvement (M24)** **D7.3 - Report on how to create common European in-pipe defect scenarios (M24)**
Deliverables submitted past due date:	None.

Summary of Milestones

Milestones completed:	None
Milestones submitted past due date:	**MS16 - Transnational Database of In-Pipe Defect Images (expected on M18, delivered on M27)** Milestone due date postponement processed and accepted by the PA office. ZeMUS project partners and other water utilities were involved to obtain additional CCTV images. The transnational database contains labelled images and DL based code to identify defects. Interim progress report has been available since M18. Milestone fully achieved on M27.

1.2.8 Work Package 8 - JRA 3. Improving resilience and sustainability in urban drainage solutions

Joint Research Activity "Improving resilience and sustainability in urban drainage solutions" is developed in the framework of WP8. The objectives of this WP are to: i) develop consensus on methodologies needed to provide high resolution data to assess the performance of urban

[43] See online: https://www.pallon.com.

drainage technologies; ii) demonstrate how the urban flood resilience and pollution transport/retention properties of urban drainage technologies can be evaluated; and iii) demonstrate and propose a methodology for the evaluation of the sustainability of new and emerging urban drainage technologies. WP8 is led by UDC and all the TA facility providers are involved in their development USFD, DEL, EAWAG, IKT, INSA, and AAU.

Task 8.1. Development of Consensus on Measurement of Hydraulic and Water Quality Performance of Urban Drainage technologies (Lead UDC)

The goal of **Task 8.1**. was the development of scalable hydrodynamic performance protocols (Sub-Task 8.1.1.) and development of scalable measurement protocols to assess the pollutant retention and release potentials of Urban Drainage Structures (Sub-Task 8.1.2), both during M1-M30 of the project. The original planned date for the end of Task 8.1 in the proposal was M24, although an extension was approved to M30 by the PA's office.

Three main activities were carried out during RP2 within **SubTask 8.1.1**, summed up as follows. The full description of the activities can be found at Deliverable 8.1 Report on determined Scalable Hydrodynamic Performance Protocols.

Analysis and assessment of new techniques to build-up the topography/geometry of Urban Drainage infrastructure with high resolution. This activity started at the beginning of the project and consisted of the analysis of the suitability of using three different imaging techniques as source of elevation data in comparison to a topographic manual survey: i) Structure from Motion (SfM) photogrammetric technique, ii) Intel® RealSense™ LiDAR Camera L515 and iii) Depth camera Intel d435i. During RP2, the initial Digital Elevation Models recorded at the BLOCK facility of UDC with LiDAR and SfM techniques, were complemented with an additional sensor (Intel d435i depth camera) and including the survey of the STREET facility surface as seen in Figure 1.15 The results are explained in detail in the Deliverable 8.1 and in the open dataset available on Zenodo.[44] By the combination of the these results and those from the next activity, related with the measurement of runoff velocities using imaging techniques, the UDC is working on a journal paper aiming to assess the influence of the different elevation models in the simulation of runoff flows, water depths and surface velocities using an dual drainage numerical model of the facility.[45]

Application of imaging velocimetry techniques for urban drainage applications. During RP2 period, UDC finalised the installation and optimization of a low-cost camera system to determine the runoff velocities in the BLOCK rainfall simulator (Figure 1.19). The objective was to develop a methodology to complement the hydraulic characterization in the experiments that are being conducted at the facility, as is the case of the TA projects being hosted (UDC-02-BLOCK-Zafra and forthcoming UDC-04-BLOCK-Franca), and to complement the assessment of the different elevation data sources of the previous activity of WP8. Other capabilities of imaging techniques have been also explored such as runoff pollutant determination during rainy events.

[44] Online at: https://doi.org/10.5281/zenodo.10371819.
[45] Available online at: https://doi.org/10.1002/hyp.15068.

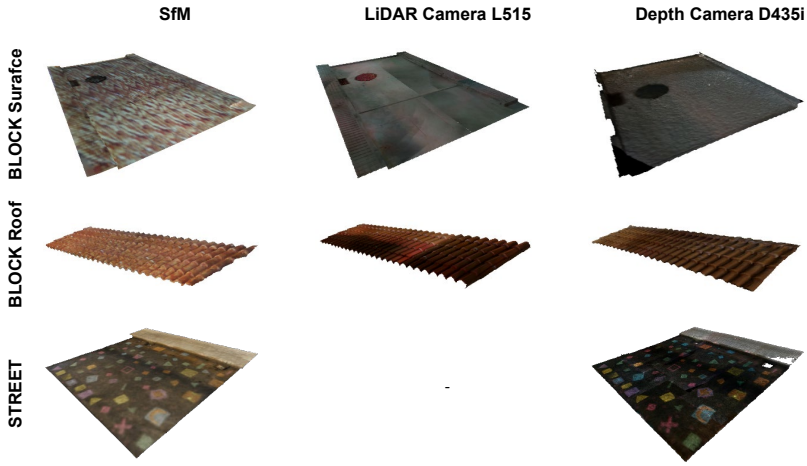

Figure 1.15: 3D models resulted from the three techniques (SfM, LiDAR and depth camera) for each studied model (BLOCK surface, BLOCK roof and STREET) and fit to manual survey using RMSE as statistic.

Three UDC MSc students were involved in these activities as a part of the training programme of their respective graduate studies. The methodology and the results from the work developed by UDC at the BLOCK facility are described in detail in Deliverable 8.1 and in the open dataset published on Zenodo.[46] In the framework of this activity, a collaboration with Deltares team has been established to improve the application of imaging techniques to real applications in UDS. This came up during the capacity building visit of Juan Naves to Deltares on late April 2024. Thus, a new field experimental campaign on optical velocimetry was planned for the end of 2024 as continuation of this research line.

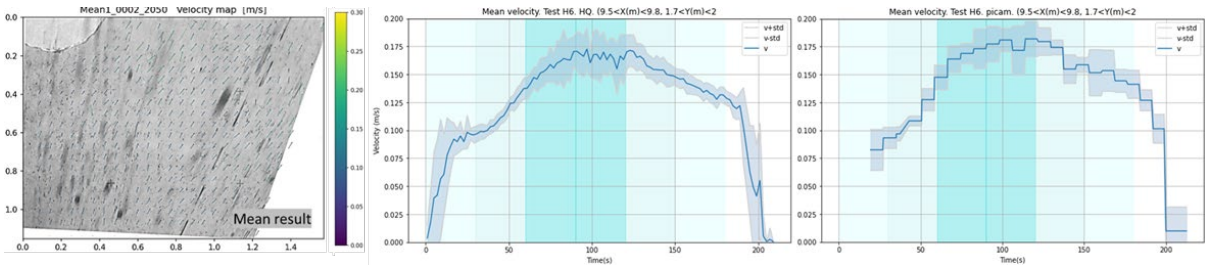

Figure 1.16: Example of runoff velocities measured at the vicinities of a manhole in BLOCK and comparison of velocity timeseries measured by two different low-cost camera and raspberry sets.

Review paper on "Optical imaging for process monitoring in urban drainage". The review paper on "Optical Imaging for Process Monitoring in Urban Drainage," initiated in RP1, is still in progress. This review aims to identify the state-of-the-art in optical hardware and processing techniques, compile known applications in the urban drainage field, and discuss future field demands and techniques. At the General Assembly held in Lyon in July 2023, the authors agreed on the scope of the review, focusing on i) measurement of flows, ii) optical-based mapping and inspection of urban water infrastructure, and iii) water quality. Additionally, the review addresses practical aspects of installing, operating, and maintaining optical sensors in urban drainage, where protocols are still largely unstandardized. The details of the scope were summarized in

[46] See: https://doi.org/10.5281/zenodo.10371731.

Deliverable 8.1. Deltares, as the leader of the paper, has received the first round of contributions from partners (UDC, USFD, EAWAG, IKT and INSA), organized a preliminary reference literature and is now aggregating and structuring these contributions towards the first draft of the review. Initially, the paper was intended to be submitted within RP2; however, due to delays in drafting the paper and receiving contributions from the partners, the submission has been postponed to RP3. This delay does not affect any other project activities.

Investigating geometrical effects on hydraulic energy losses during sewer to surface flow interactions during urban floods. In the activity, conducted by USFD, the A/B Flume facility was used to consider the relationship between grate geometry and hydraulic energy loss coefficients in urban flood conditions. The aim of the work is to improve the hydraulic representation sewer surcharge events within flood modelling tools by providing datasets describing this phenomenon for future model validation. Six different lid types (Figure 1.17) were investigated together with fully open configurations with two different diameters. A range of flow conditions were considered, representing different severities of sewer surcharge event, combined with shallow surface runoff. Pressure and flow measurements were used to derive total hydraulic energy losses through the system and findings were then related to geometrical properties of the system and the grate type. Over 450 tests were conducted in total, and the full results are described in deliverable 8.1 and the resulting open access dataset has been made available on Co-UDlabs' Zenodo repository.[47] The work has also been accepted for oral presentation at the upcoming ICUD conference in Delft. Follow up work on this activity will utilise Particle tracking velocimetry (PTV) measurements to consider the detailed flow structure in the manhole under a selection of manhole lid types to investigate the relationship between the turbulent flow structure and energy losses.

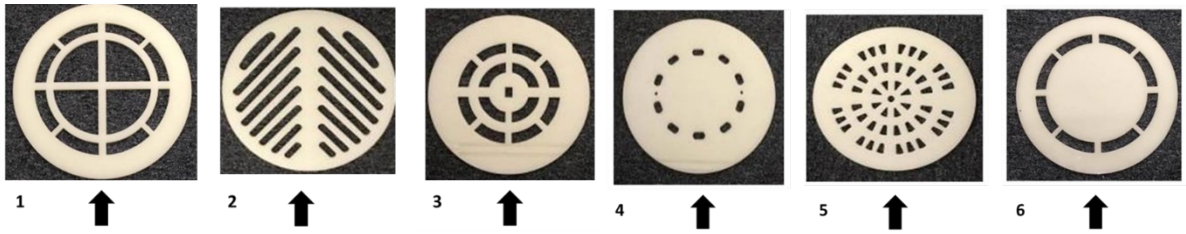

Figure 1.17. Grates applied on top of manhole with the orientation of each grate (Rubinato et al. 2018[48]).

At the end of RP2, the main activities carried out in **SubTask 8.1.2** were as follows.

Measuring the transport of pollution from sewers to surface. The Above Below flume facility at USFD has been used to consider the movement of pollution from sewer networks to surface flows during urban flood tests during the TA project 'Pollutant Transport in Urban Floodwaters'. Tests focused on the evaluation of measurement techniques to quantify the mass transport and mixing of soluble material in shallow surface flows have been developed in RP2 as continuation of preliminary results stated in RP1. Three methods were tested and compared: 1) use of a saline tracer and point measurements at discrete locations; 2) use of a hot water tracer and evaluation

[47] See: https://doi.org/10.5281/zenodo.10683906.
[48] See: https://agupubs.onlinelibrary.wiley.com/doi/10.1029/2018WR022782

of spatial distribution of tracer with a thermal camera; and 3) use of dye as a tracer and evaluation of spatial distribution of tracer with optical techniques. The outputs of this work are currently being prepared for publication, and all datasets will be made open access on the project Zenodo site. Work on pollutant transport using the A/B flume facility has now been extended to cover the movement of fine sediments under urban flood conditions. This testing, which will be contribute to Task 8.2, is currently ongoing.

Measuring sediment deposits in urban drainage infrastructure from high-resolution temperature signals. After the sets of experiments performed at UDC in RP1, a physical laboratory model was prepared in Deltares to simulate heat transfer processes in gully pots when rainfall-runoff events occur (Figure 1.18, left). The objective was to estimate sediment accumulation in these infrastructures using temperature sensors. Four temperature gradients, 3 inflow hydrographs, 3 sediment types, and 5 sediment depths were tested introducing a heat pulse into the gully pot. In addition to the laboratory experimental campaign, simplified versions of the temperature measurement system were developed and installed in six gully pots located in Delft, The Hague and Rotterdam (Figure 1.18, right) for monitoring of sediment build-up processes. The methodology and results of this work are detailed in Deliverable D8.1 and various conference proceedings at Novatech 2023,[49] JIA 2023,[50] and ICUD 2024, as well as in the open dataset published on Zenodo.[51] A paper has been submitted to a scientific journal for publication. In addition, a collaboration between Deltares and UDC researchers for the development of tools to optimize the performance of urban drainage systems has been stablished starting a line of research on the transport of plastics in gully pots and leading to the co-direction of a Master Thesis.[52]

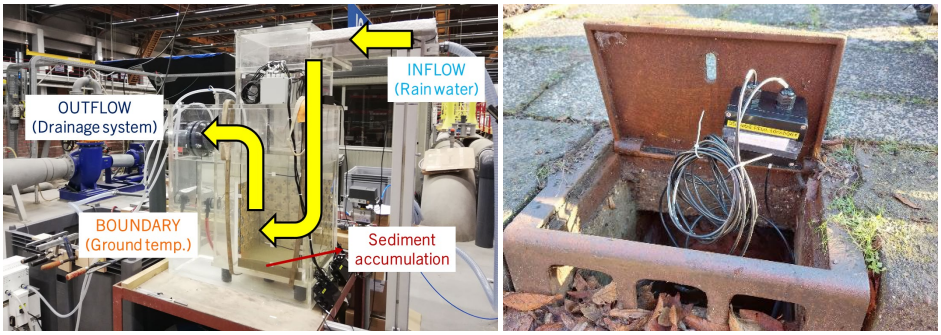

Figure 1.18. Physical laboratory model (left), and temperature-based system for field measurements (right).

Assessing the transportability of macro-plastic elements through gully pot structures. The academic literature characterizes relatively well the trapping efficiency of gully pot structures when dealing with sediment loads. In fact, these structures deploy a "sand-trap" designed to collect most of the sediment fluxes from street runoff. On the other hand, the performance of these structures to retain floating materials is still largely unaddressed. These structures deploy inlet grates (Figure 1.18), to limit the size of solids that can enter. However, macro-plastic

[49] Online at: 10.5281/zenodo.10715029.
[50] See: 10.5281/zenodo.10697575.
[51] Online at: 10.5281/zenodo.10226224.
[52] Online at: 10.25831/06j6-2a59.

elements (5–100 mm) can still ingress the gully pot. The retention efficiency of these structures for this type of solids is not well understood or described yet. To that effect, during RP2, Deltares utilized a modified version of the Gully pot physical model to create a new dataset on the transportability/retention of macro plastic elements in inlet structures. Four families of commonly found litter in urban areas were tested (i.e. cigarette buts, food wrappings, bottles and cups), with different geometries, densities and behaviours (Figure 1.19). A new experimental protocol was devised to test the transport of these elements under varying flows and system configurations. Currently a journal scientific article is in preparation, and the dataset will be published in Zenodo at the end of 2024.

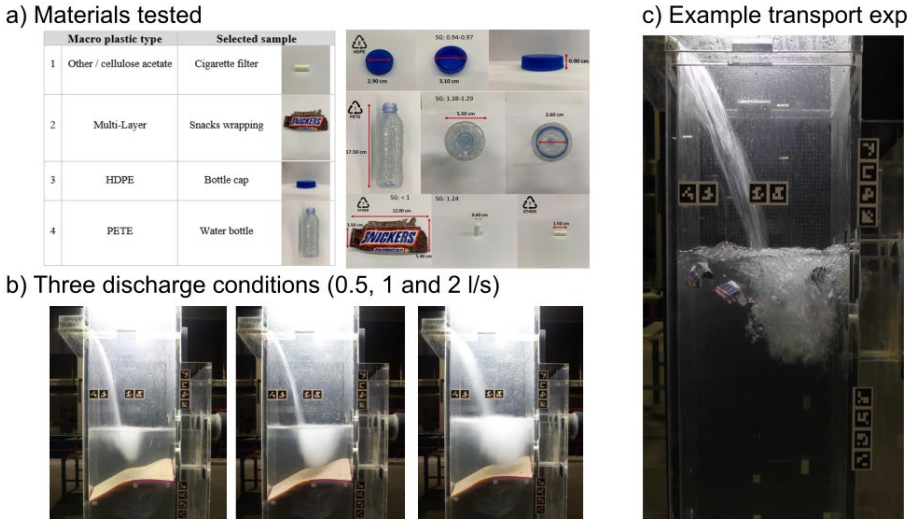

Figure 1.19. Scheme of materials tested (a), flow conditions (b) and transport experiment for multi-layer food wrapping transport (c).

Definition of standard methods to assess permeable pavement performance. During RP1, UDC carried out an experimental campaign on the long-term performance of permeable pavements analysing the clogging process of a porous asphalt for sediments with different granulometries. In RP2, this line of research has been followed up with a series of tests on the IKT rainfall simulator coordinated during the visit of Joaquín Suárez and Jose Anta to IKT following the capacity building strategy of WP2. The tests, which follow the German DIBt institute approval procedure for permeable pavement testing, consisted of the analysis of three different sediments: i) a fine standard sediment (Millisil), ii) the synthetic street dust used in the previous tests at UDC, and iii) tyre dust (Figure 1.20). The results of the tests, available at Deliverable 8.2 and as dataset on Zenodo,[53] show the influence of the nature of the sediment in the long-term performance of permeable pavements and give insights towards defining a standard method for permeable pavement assessment. UDC and IKT are working on a joint publication addressing the laboratory testing of permeable pavements from a hydrological long-term performance perspective. Moreover, UDC continued with the analysis of the clogging tests performed at STREET facility and aims to publish a paper and dataset within RP3.

[53] Online at this address: https://zenodo.org/records/10370890.

Figure 1.20. IKT irrigation system and different sediments tested over the permeable pavement surface.

Task 8.2. Quantifying the resilience of urban drainage infrastructure (Lead USFD)

Task 8.2 begun on M30 of the project and will be extended to M42, following a positive response to a request to the office of the Project Advisor. The goal of this task is to better understand some urban drainage assets after intense rainfall events to consider options to improve their resilience. The task is leaded by USFD, and UDC and EAWAG are involved in the activities and consists of two main activities.

Road sediment mobilization on sewer to surface flow interactions during urban floods. Re-scheduling work at USFD was required due to the need to reconfigure the experimental apparatus in one of the USFD facilities (A/B FLUME). This has now enabled experiments using road sediments for Task 8.2 (linked to the fulfilment of Deliverable D8.3) — specifically the mobilization and transport of such sediments from urban drainage pipes to surface flows during flood events after intense rainfall. This is relevant to understanding the risk to public health caused by contaminated sediments during urban floods. The A/B FLUME facility required the installation of new settling/collection tanks such that the sediments can be safely contained within the facility and not returned to the main laboratory sump. This lab modification has taken longer than initially planned due to higher than anticipated technical support and access/testing time needed for other Task 8.2 activities, as well as additional technical support required for the preparation and running of TA projects on both the A/B FLUME and other facilities at USFD. This delayed the start date for the construction of the sediment tanks for Task 8.2 until late 2023. The tanks have now been completed and further measurement instrumentation has been installed and tested on the facility (PTV lights and cameras as well as turbidity probes for monitoring sediment movement, Figure 1.21). Testing is currently ongoing to quantify both the velocity vectors within the manhole and sediment transport characteristics under a range of hydraulic manhole surcharge conditions. The current extension will allow time for the completion of all planned tests and the final deliverable materials.

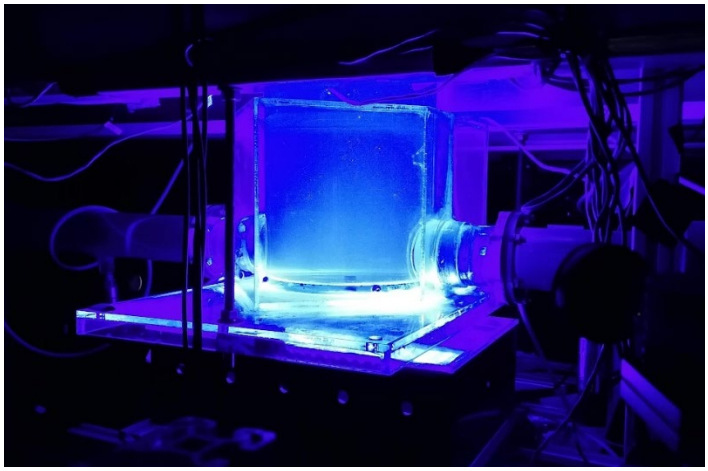

Figure 1.21. A/B FLUME manhole at USFD fitted with illumination and cameras for Particle Tracking Velocimetry (PTV) tests.

Green roof operation under increasing pressures and failure conditions. This activity consists of the development of an experimental campaign at BLOCK facility at UDC by Prabhat Joshi (EAWAG). The tests aim to determine the dynamic hydrological performance of green roofs over time. Different experiments were conducted to simulate the behaviour of soil clogging and vegetation roots development for different rainfall scenarios. The scenarios considered in the experiments aimed to mimic surface sealing by accumulation of leaves and soil logging by sand deposition, adding incremental amounts of sand and leaf litter to the two roofs (Figure 1.22). Experiments to reproduce vegetation root development were also conducted by artificially creating macropores in the soil. The underdrain flow and the content of water of the soil for the different conditions was measured using tipping buckets and moisture sensors, observing changes in water balances with each scenario. The experiments, planned for the last quarter of 2023, had to be postponed by approximately four months, due to issues with the setup and the reliability of the measurement techniques. Experimental work was finished by the end of April 2024 (M36), but additional work will be required to analyse the collected data in the next few months. Conclusions on this work will be part of Deliverable D8.3. A dataset with the results will be also made available before the end of the project. An initial communication of the activity will be presented at ICUD 2024, and a full journal paper is planned in the framework of Prabhat Joshi PhD studies.

It is noticeable that this activity was not originally included in the Grant Agreement's Description of Action (DoA) of Co-UDlabs project, but UDC and EAWAG decided to perform the tests as these additions to the original plan positively impact implementation of the project and they will also allow Co-UDlabs to improve analysis of resilience and sustainability of UD nature-based solutions – as recommended by the Project Advisor's office and independent reviews of project implementation during the RP1. These additions imply no additional costs or resource requirements for WP8 or the project altogether.

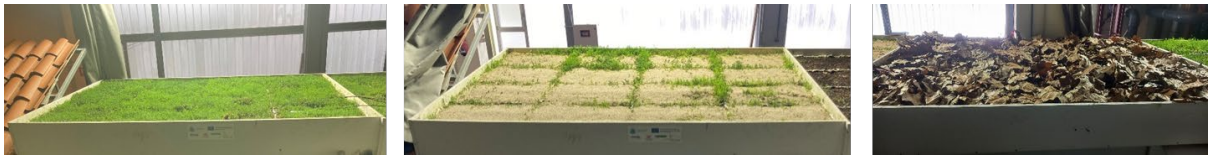

Figure 1.22. Initial configuration of the green roof used as reference and green roofs with accumulation of sand and leaves.

Task 8.3. Improving the sustainability of urban drainage infrastructure (Lead INSA)

The goal of Task 8.3 was to demonstrate and propose a methodology for the evaluation of the sustainability of new and emerging urban drainage technologies. In Sub-Task 8.3.1 the hydrodynamic design for stormwater detention ponds was analysed to optimise cost-efficient maintenance and in Sub-Task 8.3.2 designer soils for Sustainable Urban Drainage Systems is being proposed.

As of the end of RP2, the main activities carried out in **SubTask 8.3.1** were referred to the Experimental SuDS facility at AAU and were reported in Deliverable D8.4. The conducted activities led to valuable insights into the design and management of detention ponds with specific attention to the separation of xenobiotic compound. Considering the EU's recent UWWTD, the management of detention ponds has gained increased significance. This research demonstrates that optimizing the design and operation of detention ponds can effectively reduce the release of xenobiotics into the environment. The referred activities were:

Sediment transport and load from the catchment. The general ability to transport sediments in the catchment contributing to the Experimental SuDS facility has been investigated to identify if sediments are expected to be transported by the system to the SuDS facility and/or if first flush effects are to be expected. The self-cleaning capacity was evaluated by examine the modelled shear stresses of the system and first flush effects was measured experimentally by analysing the TSS content of water samples sampled automatically during rainfall events.

Characterisation of the sediment in the main basin. The main basin of the retention tank has a porous wall installed that is 1 m thick and is extending across the entire width and depth of the basin to disrupt the force of the inlet jet. Sediments samples have been taken from different places of the bed sediment to be characterised and analysed for heavy metals, finding that the porous wall segregates the sediment into different fractions with different particle sizes. By separating the sediment into distinct sizes, it facilitates the possibility to address and manage the specific pollutant-bound particles in the basin, being the sediment before the porous wall dominated by coarse particles and low content of organic matter, while the sediments trapped further down the facility, are finer and with higher content of organic matter and pollutants such as heavy metals.

Computational Fluid Dynamics (CFD) modelling of the facility. The Hydrodynamic design of the Experimental SuDS facility has been investigated using Computational Fluid Dynamics modelling. Different configurations of the facility have been tested and the effect on the hydro dynamics was evaluated in terms of flow-patterns, residence time and bottom shear stresses during filling. Furthermore, strategies for the design of the outlet-section of the facility were investigated. The outlet-section is the last part facility the stormwater is flowing before it is

released into the receiving water. The outlet configurations must, therefore, ensure that the bottom shear stresses are minimized as much as possible, to secure that sedimented particles are not resuspended, but retained in the facility when the main basin is emptied.

LSPIV installation and test at the facility. The installation of Large-Scale Particle Image Velocimetry (LSPIV) equipment in the SuDS facility was a milestone within the Joint Research Activities in RP1. This activity was carried out during the visit of Juan Naves (UDC) to Aalborg University (AAU) Co-UDlabs team in the scope of the Networking Activity WP2 (Capacity building). The results of the LSPIV tests were analysed in this RP2 obtaining promising results that will be used for calibration and validation of the numerical CFD models and generating a dataset published on Zenodo[54] that may be used to assess imaging techniques in real urban environments. Further experiments with the cameras installed are being planned, and the collaboration between AAU and UDC will continue within the scope of Co-UDlabs on this research line.

As regards **SubTask 8.3.2**, following the development of three physically-based infiltration models (Asry et al., 2023)[55], an improvement has been done by means of a double permeability modeling approach of a bioretention basin, based on modified Green Ampt equations. The model was tested for three saturation scenarios (dry, wet, medium) and compared to the numerical model using Hydrus. The results demonstrated that the model effectively represented the double permeability approach, particularly for dry and medium initial saturated soils. Subsequently, the model was inverted for six infiltration experiments using a specific large-ring infiltration device.

The results confirmed that the dual permeability modeling proposed in this study accurately represented infiltration through the calibration of two parameters (hydraulic conductivity in matrix and macropores). The simplified physically based infiltration model showed its capability to account for complex aspects of infiltration, including the position of the wetting front during the infiltration process and the influence of preferential flow.

Within the collaboration in subtask 8.3.2, AAU has developed a preliminary version of a user-friendly model, LAZE (Local-Area-Zero-Emission), for designing filter soil under basins for local area infiltration (LAI) or sustainable urban drainage systems (SuDS). This 1D model, run in MATLAB, simulates water and chemical processes in soil using a numerical Moving Mean Slope model with evapotranspiration and an analytical solution to the advection-convection-reaction equation. The main design criteria are sufficient water infiltration to prevent flooding and adequate residence time and retardation of selected environmental impact chemicals. These criteria are counteracting, as rapid water transport for infiltration conflicts with slow transport for chemical retardation. The LAZE model optimizes filter media parameters to satisfy both criteria. Inputs to the LAZE model include particle size distribution, compaction level (dry bulk density), depth, water retention properties, saturated hydraulic conductivity, basin size, organic matter content (for hydrophobic chemicals like PAHs), and precipitation time series. Outputs include hydrographs of water depth and chemical breakthrough times. If the initial design

[54] Online at: https://doi.org/10.5281/zenodo.10371665.
[55] Online at: https://doi.org/10.1016/j.jhydrol.2023.129477

doesn't meet criteria, the model iterates with adjusted parameters. For testing, a fine sandy site at St. Restrup Fælled near Aalborg was used, where a SuDS system for a planned residential area is being designed. The LAZE model successfully identified filter media parameters that met both criteria by adding organic matter to the existing subsoil. This model will be further tested and improved as a promising tool for designing soils for SuDS systems.

Summary of Deliverables

Deliverables completed:	**Deliverables 8.1- Report on determined Scalable Hydrodynamic Performance Protocols of Task 8.1.1. (M30)** **Deliverable 8.2 - Report on determined Scalable Measurement Protocols to Assess the Pollutant Retention and Release potentials of Urban Drainage Structures of Task 8.1.2. (M30)** Deliverable 8.1 and 8.2 due date postponement processed to M30 and accepted by the PA office after RP1 review. **Deliverable 8.4 - Report on hydrodynamic design for stormwater detention ponds optimized for cost-efficient maintenance**
Deliverables passed due date:	None

Summary of Milestones

Milestones completed:	**MS19 - Completion of Task 8.1 to prepare protocols for Scalable Measurements required for Task 8.2 (M30)** The MS was achieved on M30 after the submission of Deliverables 8.1 and 8.2.
Milestones passed due date:	None

1.2.9 Work Package 9 – TA provision

The work of WP9 is essential for the viability and success of Co-UDlabs' Transnational Access programme as a whole. The key goal of the WP is to provide coordinated free-of-charge TA across the Co-UDlabs' RI to as many researchers and institutions as possible, in a bid to make UD large-scale research more open, inclusive, transparent, and affordable. WP9 works in close contact with WP5. While the latter establishes the regulatory and administrative framework for the TAs to actually take place, WP9 delegates to facility providers all the tasks and efforts required to make the programme work and actually provide the opportunity to access the RI to applicants from all over the world.

WP9's main achievement during RP2 has been the successful arrangement and completion of all the 13 TA projects that had been accepted via the 1st TA Call in RP1. During RP2, in other words, all facility providers whose installations hosted projects for the 1st TA Call had to actually provide the access. This implied a significant organisational, scientific, and administrative challenge that partners approached collaboratively, with effective support from both Co-UDlabs and the hosted user-groups too. All details on the provision of access in WP9 are available in Deliverable D9.1 (which, having been published on M30, October 2023, already collected information on nearly all

completed TAs).[56] A complete overview of TA implementation is also available in Section 1.4 below, which is entirely dedicated to the Transnational Access programme.

As explained in detail in Section 1.2.5, WP5 has been working extensively on the arrangements of the 2nd and 3rd TA Calls. WP9 will oversee the actual implementation of the selected TA projects from these calls. In fact, at least four TA projects have already begun execution during RP2. More information is provided in Section 1.4.

Minor deviations from the expected WP9 workplan, such as marginal delays in TA execution or the inclusion of unforeseen tasks and experiments in the schedule of specific installations, are addressed in detail in Section 5. By the end of RP3, WP9 will have overseen the administrative, practical, and scientific execution of 31 TA projects (two more than the expected results agreed on in the Grant Agreement) across all 17 research facilities of Co-UDlabs' infrastructure. WP9 has collaborated on the NAs carried out by WPs 1, 2, 3, and 4 to assist in promoting the Calls and disseminating the initial results of what has so far been an extremely successful TA programme — with results going well beyond scientific or technical output, and positively affecting the establishment of a truly collaborative research network across Europe and around the world.

Summary of Deliverables

Deliverables completed:	**Deliverable 9.1- 1st report on TA provision (M30)**
Deliverables passed due date:	None

Summary of Milestones

Milestones completed:	**MS12 - 2nd call proposals launched and evaluated (M33)** News on Co-UDlabs website and D5.3 support the completion of the MS. The original deadline of the MS (M27) was extended to M33 after the revision performed in RP1. This milestone is shared with WP5.
Milestones passed due date:	None

1.2.10 Work Package 10 – Management and Co-ordination

WP10 oversees project coordination for Co-UDlabs, ensuring timely execution of the project's workplan and objectives while optimizing available resources. The key goals of this Work Package include: (i) coordinating participant actions and monitoring progress in workplan implementation; (ii) managing financial and administrative aspects for the entire consortium; (iii) facilitating effective collaboration and information exchange among partners; (iv) serving as the primary contact point with the European Commission; (v) maintaining high-quality project outcomes; (vi) addressing relevant gender considerations; and (vii) proactively managing project risks. WP 10, led by UDC, involves all partners in its development.

[56] D9.1 is available online: https://co-udlabs.eu/wp-content/uploads/2024/05/Attachment_0-1.pdf.

Task 10.1. Technical and administrative coordination (Lead UDC)

Since the project's inception in May 2021, UDC has managed the day-to-day operations of Co-UDlabs. As also reported in PR1, UDC as project coordinator established a Management and Support Team (MST) responsible for coordinating project activities and communication. Andrea Ciambra, Co-UDlabs' Project Manager, who had been on a part-time post since the beginning of the project, has been upgraded to a full-time position since June 2023, because of the volume of work that the post was required. This change in the structure of the WP and the use of resources — mostly linked to the need to provide additional coordination work as the project's Transnational Access programme entered its busiest stage — is explained in detail in Section 5 on project deviations from its DoA.

Consistent with the Grant Agreement provisions, the MST has supervised the correct and timely implementation of the workplan across all project WPs. Accordingly, the MST has:

- provided maintenance and effectiveness of the SharePoint platform — membership, online availability of documents and templates, safekeeping of all relevant records, Deliverables, and output — that Co-UDlabs uses as the main repository of information, files, research and working materials;
- overseen the internal communication flow, so that all consortium-wide announcements, requests, and deadlines could effectively reach the whole group of project contributors and participants;
- assisted, whenever necessary, specific WPs or partner groups with guidance in the development of several Deliverables and the achievement of several Milestones throughout Reporting Period 2: since the delivery of the Project Management Handbook in M4, the MST was formally included as a the last-step reviewer in the process of delivery and submission of all 24 Deliverables submitted (12 of which were submitted during RP2) and all 22 Milestones achieved (11 of which in RP2) to date;
- identified potential deviations from and risks for the project's workplan and assisted all involved partners in the definition of effective mitigation and solution action;
- maintained all official communications and relationships with the European Commission and the office of the Project Advisor (PA) assigned to Co-UDlabs — both to consult the PA on technical and management issues with the day-to-day functioning of the process and to submit specific requests for deadline extensions, alternative uses of allocated resources, improvement or modification of expected workplans, among several other tasks;
- provided support in the organisation of Co-UDlabs' Transnational Access programme, by contributing to the setup of the two global TA calls that the consortium has carried out during RP2; convening the TA's External Evaluation Panel and ensuring effective and fair procedures for proposal selection; and assisting Co-UDlabs facility providers with management and cooperation in the realisation of the 13 TA experiments that were carried out in 10 Co-UDlabs installations during RP2.

Task 10.2. Organisation of consortium meetings (Lead UDC)

Acting as project coordinator, UDC has also been in charge of ensuring a consortium-wide venue for all partners to meet (either in person or virtually) and communicate about the implementation of project objectives. More formally, UDC has also been in charge of arranging the meetings and proceedings of the project's main institution — as agreed in both the Grant Agreement and the Consortium Agreement.[57] In RP2, the MST was tasked with coordinating and setting up:

- Co-UDlabs' 2nd and 3rd General Assemblies;
- Co-UDlabs' Steering Committee meetings
- Co-UDlabs' International Advisory Board meetings;
- the executive meetings of Co-UDlabs' External Evaluation Panel as part of the TA process.

Co-UDlabs convened its 2nd General Assembly in Lyon, France, on July 3, 2023. The Assembly was hosted by partners at GRAIE, in the larger framework of the Novatech 2023 international conference that GRAIE was co-hosting in collaboration with OTHU and Métropole Grand Lyon.[58] With support from hosts at GRAIE, WP10 contributed to the definition of the Assembly's agenda — the event was integrated within Novatech's overall programme and coordinated with a Co-UDlabs session to officially launch the consortium's 2nd TA Call — and provided assistance with the logistics arrangements for the half-day event (including making the Assembly accessible remotely for partners that could not attend in person).[59] UDC as project coordinator led and moderated the discussion during the Assembly, took care of note-taking and the circulation of all required materials (including minutes and a summary of key decisions) after the Assembly. Considering the specificity of a General Assembly organised within the larger framework of an international conference, WP10 assisted WP4 leaders Euronovia and the other partners involved in the setup and management of a communication booth in the exhibition venue of Novatech, as well as coordination among all partners that were involved as panelists and/or poster presenters during the conference. The key focus of the General Assembly was the preparation and official launch of Co-UDlabs' 2nd TA Call, as well as the opportunity to check on progress with each WP's workplan and results. Minutes are officially stored for safekeeping on the project's SharePoint and are available upon request. 19 attendees — including partners and collaborators — participated in the Assembly, plus EAWAG representatives connecting remotely.

Co-UDlabs also convened its 3rd General Assembly during RP2, hosted by EAWAG in Dübendorf, Zürich, on January 22-23, 2024. The consortium agreed to organise the 3rd Assembly relatively close to the second one for two key reasons:

- Co-UDlabs had to set up a 3rd TA Call for all facility providers to meet the requirements that had been set out in the Grant Agreement. The 3rd General Assembly was thus organised as

[57] The overall structure of Co-UDlabs' governance is regulated by Section 6 (Governance Structure) of the project's Consortium Agreement and is described in detail in Part B of the Grant Agreement (Section 3.2, Management structure, milestones and procedures).
[58] Information on the Novatech 2023 conference is available online: https://www.novatech2023.org/en/.
[59] The agenda of the 2nd General Assembly is privately accessible online at: https://co-udlabs.eu/wp-content/uploads/2024/06/20230612_GA_DraftAgenda_Novatech.pdf.

close as possible to the finalisation of the 3rd TA Call, so that all partners could coordinate as the TA process went from the organisation of the call to the actual beginning of TA provision and coordination with the selected user-groups (more details are available in Section 1.2.5 on WP5 and Section 1.2.9 on WP9 above).

- The 3rd General Assembly was a key event in preparation of all documentation, data, information, and output ahead of the conclusion of Reporting Period 2 on April 30, 2024. The Assembly in Zürich was a valuable venue for all project partners to begin task distribution for the 2nd Periodic Report and organising internal resources for both the technical and financial reporting requirements.

The 3rd General Assembly's agenda included an overview of progress in the implementation of joint research activities, networking activities, and the TA programme — the consortium formally approving the list of 16 selected TA projects for the 2nd TA Call. The proceedings of the Assembly also included a presentation by the project's Project Advisor, connecting remotely from Brussels, a special session by Euronovia and WP4 on Co-UDlabs' Plan for the Exploitation and Dissemination of Results (PEDR), and an internal meeting on the project's Data Management Plan (WP2, WP4, and WP6). 19 participants attended the first day of the 3rd General Assembly, whereas 17 attendees were present on the second day. News of the Assembly was published on the project's website,[60] and the minutes are stored for safekeeping on the project's SharePoint and are available upon request.

Another key Co-UDlabs institution, the project's Steering Committee (SC) is expected to meet at least quarterly.[61] During Reporting Period 2, the Co-UDlabs Steering Committee met five times:

- **December 15, 2022.** The SC was convened to finalise consortium work on the 1st Periodic Report, which was then due on December 31, 2022. Besides the ordinary review of project implementation status, the SC focused on task distribution to guarantee the timely completion of PR1. An additional SC session was scheduled on January 15, 2023, to coordinate work on the first.
- **January 15, 2023.** This extraordinary SC was convened after the successful submission of PR1 to distribute tasks, agree on deadlines, and finetune the agenda of the first Project Review Meeting (PRM) of February 1, 2023.
- **June 9, 2023.** This SC addressed the preparation of the 2nd Co-UDlabs General Assembly at Novatech 2023 as well as the organisation of the 2nd TA Call, so that the TA workshop and official call launch events at Novatech could be timely arranged. This SC, in particular, formally approved the calendar of the 2nd TA Call, which was launched on July 3 and open until October 13, 2023.
- **November 23, 2023.** The period's fourth SC was convened to formalise and sanction the results of the 2nd TA Call, confirming the outcomes of both the feasibility assessments

[60] See online: https://co-udlabs.eu/2024/01/29/co-udlabs-partners-met-for-the-3rd-general-assembly-of-the-project/.
[61] As regulated by Article 6.2.2.1 of the Consortium Agreement.

performed by all involved facility providers as well as the final results of the evaluation carried out by the External Evaluation Panel. This SC also oversaw the organisation and logistics of the 3rd General Assembly at EAWAG, in Zürich.

- **March 19, 2024.** The final SC convened in RP2 was the final consortium-wide meeting before the end of the period. It was essential to agree on reporting duties, process, and deadlines. The SC also formalised the outcomes of the extraordinary 3rd TA Call, which closed officially on January 15, 2023.

For all Steering Committees, WP10 has been in charge of circulating save-the-dates, preliminary agendas, and presentation templates. It managed the Teams platform that hosted the meetings and has been in charge of note-taking during the meetings and the elaboration of the official minutes. These are stored for safekeeping by UDC and are available upon request. The next Steering Committee, the first of RP3, will be scheduled at the beginning of July 2024 for the preparation of Co-UDlabs' second PRM (scheduled on July 23, 2024).

Additionally, WP10 also held a joint Steering Committee-International Advisory Board meeting on September 26, 2023. The meeting was an opportunity for the consortium to present to IAB members an overview of the results and achievements of Co-UDlabs' JRAs and NAs, while also introducing them to the 2nd TA Call. The IAB supported the Call by advertising it to their networks and partners and offered guidance to increase the visibility and attractiveness of the TA framework, especially among practitioners and the private sector.

As part of its coordination duties, WP10 organised and moderated the joint Steering Committee-External Evaluation Panel meeting in which the results of the 2nd TA Call were definitively agreed (November 14, 2023) and managed communication and coordination with the EEP members that contributed to the selection process for the 3rd TA Call in December 2023-January 2024.

During RP2, since April 2023, WP10 and the MST suspended Co-UDlabs' routinary monthly Regular Meetings, in compliance with a decision that the Steering Committee had made by consensus. The consortium had questioned the usefulness of Regular Meetings (which were deemed to be too lengthy and dispersive in terms of information) and agreed to enable more sectorial meetings through enhanced proactiveness of WP leaders: WP meetings and activity-based meetings (i.e., JRA, NA, and TA-meetings) have become the basic tool for swifter, more practical exchange of information among consortium members in RP2.

Task 10.3. Reporting (Lead UDC)

WP10 oversees project-wide informal and formal internal reporting, as well as the activities for official reporting to external stakeholders and, in particular, the European Commission.

Informal internal reporting tasks for UDC as project coordinator included guaranteeing coordination in internal WP-based meetings; consortium-wide involvement in the definition of project agendas and calendars; and publicity and accessibility of meetings' minutes and results.

Formal internal reporting tasks were carried out by streamlining internal communication among partners in the preparation of Deliverables and the achievement of Milestones. Following the

rules and processes originally set out in the Project Management Handbook,[62] WP10 made sure that templates, drafts, and final versions of relevant project documents were adequately circulated and made available within deadlines.

WP10 is also coordinating the process of official external reporting to the European Commission. The MST has been in charge of all submissions and input to the EC portal for the Co-UDlabs' Continuous Reporting, overseeing timely submission of Deliverables and the upload of all required indicators, information, and data (e.g., all submitted reports, data on dissemination and communication, key performance indicators, etc.). The MST was also responsible for coordination and submission of the 1st Periodic Report after M18 (the two months available for the creation of the report overlapped with the first two months of RP2) and is being tasked with coordinating the work on the 2nd Periodic Report until the June 30, 2024, deadline. Expected tasks for PR2 include:

- Collecting, checking, and submitting all requested data for the Continuous Report on the EC SyGMa portal;
- Checking information on each partner's Certificate of Financial Statements (CFS) before approving submitted CFS drafts on the SyGMa portal;
- Creating Part B of the Technical Report thanks to the WP reports submitted by WP leaders.

WP10 has agreed with the office of the Project Advisor to schedule the project's 2nd Project Review Meeting on July 23, 2024.

Task 10.4. Financial administration (Lead UDC)

UDC as project coordination manages, under WP10, the transfer of funds from the European Commission and then to the individual partners of the consortium. While all beneficiaries remain responsible for the financial fitness of their actions in the framework of Co-UDlabs, WP10 has also provided guidance for financial administrators and is working as a helpdesk to address outstanding financial issues related to Co-UDlabs funding under the rules agreed in the Grant Agreement.

Under WP10, UDC as project coordinator also provides guidance or support to partners in the realisation of their CFS — the document summing up all expenses and costs of implementation action that all partners must submit as part of the consortium's Financial Report. UDC is overseeing cost calculations and justifications, accessibility of information on the SyGMa portal, as well as the availability of all signatory parties for each of the beneficiaries.

Summary of Deliverables

Deliverables completed:	**D10.1 - 1st periodic report (M18)** Originally scheduled on M18, D10.1 could not be submitted on time because the consortium is given two months after the end of RP1 to prepare and submit the report. It was submitted on time and as agreed with the PA office on M20.

[62] The document, which is also Deliverable D10.4, is available online at: https://zenodo.org/records/7261699.

Deliverables submitted past due date:	**D10.2 – 2nd periodic report (M36)** Similarly, D10.2 was not available at expected time of delivery (M36, the end of RP2) and it has been agreed that it will be delivered upon completion of the report in M38.

Summary of Milestones

Milestones completed:	**MS25 – Second Intermediate GA – (M24)** Co-UDlabs convened its 2nd General Assembly in Lyon, on July 3, 2023, as part of the programme of the Novatech 2023 international conference. Co-UDlabs also organised its 3rd General Assembly within RP2, in Zürich, on January 22-23, 2024.
Milestones submitted past due date:	None

1.2.11 Work Package 11 - Ethics Requirements

The objective of WP11 was to ensure compliance with the 'ethics requirements' set out in the Grant Agreement. All requested deliverables about Protection of Personal Data (POPD) and EPQ requirements were correctly submitted to the SyGMa portal on M4 of the project, so the workplan of WP11 is considered as finalised.

1.2.12 Short description of the next steps to be achieved after the second Reporting Period in the different WPs

In this section the next steps of the implementation of Co-UDlabs for the coming months are presented in brief. The main tasks to the develop within Co-UDlabs Networking Activities are:

- In WP1, Co-UDlabs is going to concentrate on analysing the surveys to consolidate the success stories of the Co-UDlabs partners and open to other experiences, to consolidate the recommendations. Co-UDlabs is pleased to have embarked on the UDRAIN project, which will also enable us to widen the circle of contributors and incorporate their visions and proposals into Task 1.3.

  Co-UDlabs will also promote the creation of a new Working Group (WG) on Large Research Infrastructures of the JCUD of IWA/IAHR. The initial tasks are the creation of the WG (which was launched officially in ICUD congress in June 2024) and the preparation of a catalogue of UDS RIs based on the worldwide contributions of different RI owners. A survey was prepared, and the group consolidation is expected for the end of 2024. Finally, WP1 is still working on the preparation of a white paper with the results of the IWA Congress (September 2022).

- As Co-UDlabs moves forward in WP2, the WP plans to standardize variable and sensor names across Co-UDlabs Research Infrastructures (RIs) to improve data integration and interoperability. Metadata is crucial for providing context to the collected data. Inconsistencies or incomplete metadata can lead to misinterpretations when analysing datasets. This effort will also address gaps in metadata to ensure it is comprehensive and coherent, covering content, structure, methodology, and associated resources to mitigate potential misinterpretations. WP2 will implement changes to simplify the DMPs

for upcoming calls of Transnational Access (TA) and Joint Research Activities (JRA), focusing on balancing the different content areas and enhancing pre-publication data management. Following the proposal of the survey to understand what Urban Drainage Systems (UDS) performance data are available at utilities, WP2 has integrated additional inquiries to address uncertainties in monitoring data. WP2 is currently refining the survey based on feedback from tester utilities, and the refined survey is set to be deployed through national wastewater associations, with the first set of outcomes expected before August 2024. After the planned workshop could not ultimately be organised at ICUD 2024, WP2 is planning to disseminate our results in online workshops in Q4 of 2024. These workshops will provide a platform for discourse and collaboration within the urban drainage community, furthering the impact and reach of our findings. Concerning staff mobility, 20 mobilities are planned to take place during the third reporting period (May 2024 to April 2025), even if the dates and scope of certain mobilities are yet to be defined by partners in line with their ongoing activities.

- In WP3, there are several actions under planning:
    - Within Taks 3.1, the EJSW 26th edition will take place (29 May until 1st June 2024), a course on Sewer processes will be organized by UAA (October 7-11, 2024), and a seminar for PhD students will be organized by USFD (September 2024).
    - Within Task 3.2, IKT will organize a industry seminar in 2025. And UDC will organize a course on UD metrology targeting practitioners and water utilities interested in monitoring the main hydraulic and water quality parameters of sewers and drainage networks (July 2024).
    - Within Task 3.3, two new webinars are planned:
        - Underground infrastructure monitoring techniques (October 2024)
        - Routine data validation DV in urban drainage (late-2024 or early 2025)
- In WP4, the next communication and dissemination activities will be carried out in line with the Grant Agreement and the Plan for the Exploitation and Dissemination of project Results (D4.2). During RP3, the consortium will focus efforts on disseminating project results through new **scientific publications**, **technical articles** in national and international journals and other articles in specialised magazines. The project **website** and the online presence on **social media** as well as two new issues of the **newsletter** will continue to ensure visibility of project activities and active dissemination of project results. A **media press kit** and a **press release** will be created and distributed at the end of the project to inform the urban drainage community and the public of the project achievements. One **open infoday** targeted for a wide range of stakeholders will be organised at the end of the project. Regarding exploitation, the list of potential exploitable results of the project will be further updated. Key exploitable results will be published in the Horizon Results Platform towards the end of the project.

- In WP9 work will focus on providing access and technical support to the 2nd and 3rd call projects by each of the facility providers. Within WP5 Follow-up meetings of all partners will be developed to monitor progress in the implementation of the TA programme.
- In WP6, over the remaining months, our primary focus will be on completing our activities related to sensor testing and spatial monitoring, as well as achieving seamless integration with WP2. We **will finalize long-term monitoring and analyze results from real wastewater and utilities**. Given varying success in sensor testing, we will explore use cases and business opportunities for UDS-appropriate sensors. Peer-reviewed publications are scheduled for LPICM, DischargeKeeper, MV.X, and Lidar Sediment Mapping. Discussions with stakeholders, including CleanTech venture capital firms like Emerald Ventures, sensor manufacturers such as Endress+Hauser, and global consultants like Suez, are ongoing. **Regarding uncertainty assessment**, we have already completed the planned activities. We see very promising opportunities for collaboration with WP2 and plan to port (parts of) the UDMT into Python code, making it available on the RENKU open science platform. This will facilitate integration with Smart Sensing activities and enable robust future collaborative developments by the UDS community. For **spatial monitoring**, we will finalize the ongoing data analysis based on the United Kingdom spill database. We will also integrate results from the Smart Governance survey and assess which countries have consistent ordinances and guidelines to support the implementation of the EU Urban Wastewater Treatment Directive. Additionally, we will deepen our analysis of the impact of citizen groups and river custodian NGOs, particularly in **their use of open data from UDS.** With the discussions on pollution from UDS tied to the **2024 Paris Olympic games**, we anticipate heightened public discourse on this issue. We are confident that our findings will play a crucial role in informing and supporting effective decision-making processes.
- In WP7 the focus on the last period will be on completing Task 7.2 and Task 7.3. In task 7.2 the on-going tests at IKT and the subsequent test at UFSD examining the movement of pipe joints and their impact on infiltration and exfiltration will be completed and the data used for some simple mechanistic modelling – this will provide the information and analysis for D7.4 (M42). The three network models provided by water utilities will have a series of defects and patterns of defects inserted in to assess the performance impact of deterioration networks. This will provide the information and analysis for D7.5 (M44). The results of the laboratory testing in T7.2 and the modelling work in T7.3 will be organised and used in at least 2 publications, on instrument development and laboratory results and the impact of defects on system performance.
- In WP8 most of the work of Task 8.1 has been finished although we are currently working on the preparation of a review paper of imaging techniques for urban drainage systems and in the final development of a camara system to track velocities in different assets. Another review paper on permeable pavement clogging experimental assessment is on progress. In Task 8.2 we plan to finish the experimental work related with sediment transport and green roof assessment. Lastly, in the Task 8.3 we are planning the experiments of soil designer and the associated numerical tool.

- In Reporting Period 3, WP10 will coordinate communication and interactions among partners, with particular attention to: a) the finalisation of the TA programme and the correct implementation of all TA projects and activities; b) the organisation of internal reporting meetings, including topic-based meetings among JRA, NA, and TA Work Packages, and the scheduling of all Steering Committee events required for the adequate monitoring of project development; c) the provision of support to other WPs for communication and dissemination of emerging project results and output; d) the required institutional communication with the office of the Project Advisor for both the organisation of the 2nd Project Review Meeting and the process of revision for all the documentation uploaded for the 2nd Periodic Report; e) the organisation of Co-UDlabs final General Assemblies event (the 4th General Assembly is already scheduled for December 2024), the final review events, and the institutional conclusion of the project; f) the coordination of all monitoring and reporting work for Periodic Report 3.

1.3 Impact

The primary objective of Co-UDlabs as an INFRAIA Starting Community is to establish and sustain a European-level, user-based network for Urban Drainage — addressing the complexity and diversity of its impact on environmental, social, and economic sustainability for cities and territories. During RP2, work on the definition of a consistent community of scientists, academics, technicians, practitioners, younger students, local regulators and utility managers, the private sector, and civil society stakeholders has been essential to get Co-UDlabs as close as possible to this outcome. Since its inception, Co-UDlabs has worked as a platform for closer collaboration among partners and has surveyed its network to extract valuable information to adapt and improve the current UD research infrastructure, technology, and methods.

Co-UDlabs has also grown into a reference — in European UD studies and practice — for training and dissemination activities, with events addressed specifically at industry and early-stage researchers and technicians, while also starting to present early outcomes and results of its activities at the most relevant international events. Co-UDlabs has been active at 8th edition of the European Sewer Asset Management (EURO-SAM) workshop, on February 5-16, 2023, in Luleå; it has co-led a workshop and its own TA Call official launch at Novatech 2023 in July 2023, in Lyon; it has brought presenters, posters, a TA special session, and a Working Group launch event at IWA's 16th International Conference on Urban Drainage (ICUD), in Delft, in June 2023, among many other efforts and initiatives that have been detailed above.

RP2 for Co-UDlabs has also been key for the full establishment of its TA programme. While RP1 had laid the groundwork for TA activities and had enhanced collective work and collaboration on the preparation of Co-UDlabs' 17-facility network to host innovative approaches and ideas, RP2 were 18 months of implementation, with 13 proposals in 10 facilities being arranged, carried out, and finalised, with over 100 participants from nearly 30 countries involved in the process. TA progress in RP2 effectively led Co-UDlabs a lot nearer to its expected impact of making Europe's large-scale research infrastructure on urban drainage wider, easier to access, open to all disciplines, and more inclusive and efficient.

During RP2, several tasks from the project's Joint Research Activities were completed, with the more research-oriented workplans of Co-UDlabs either finalised or nearing completion in the next few months. With the practical support of consistent TA selection, the JRAs have helped Co-UDlabs partners achieve more consistently their goals of a more tightly-knit UD research community — with stronger ties to the technological sector, businesses active in the field, and public regulators looking for increased efficiency and more reliable solutions when facing urban environmental and infrastructural challenges. The following sub-sections report on the current status of implementation and accomplishment of project impacts as defined in Co-UDlabs Description of Action — with an overview of the key actions and tools undertaken and key indicators and figures as evidence of progress made.

1.3.1 Expected impacts included in the H2020-INFRAIA-02-2020 call

Table 1.7 presents a summary of the main contributions and indicators of the project as stated in the DoA. At the end of RP2 in M36, Co-UDlabs had reached 75% of its lifetime — while this is a useful baseline value to monitor progress in project implementation, it should also be noted that most project tasks are not scheduled to be developed linearly, as some Work Packages foresee peaks of activity in specific segments of their timeline.

This has been specifically important with WP9 and the establishment and functioning of the TA programme. TA provision activities formally began in May 2022 (M13 of the project), right after the results of the selection process of the 1st TA Call were made public and available to applicants. In RP2 (M19-M36), facility providers granted access days to all 13 accepted proposals. Within RP2, 11 of these projects were formally completed and 4 proposals out of the 18 that have been accepted for the 2nd and 3rd TA Calls had already begun operations. During RP2, user-groups from the remaining 14 accesses have already established contact with facility providers and in most cases already agreed on and signed their respective User-Facility Agreements and User Project Plans — which are a formal commitment to initiate the TA projects that will be developed and finalised during RP3. In this regard, TA-related indicators will reach full performance during RP3, when all of them will have started and will be completed.

A similar disclaimer applies to the activities of JRAs and NAs: while the indicators for their performance have tangibly improved in RP2, most WPs have still activities to be carried out in RP3. It is finally to be expected that indicators and metrics related to the emergence, consolidation, and dissemination of scientific and technical results of JRAs and TAs will reach their formal threshold at a later stage of project implementation — considering that time will be needed for the user-groups and Co-UDlabs staff to obtain and work on their results.

Table 1.7. Co-UDlabs contributions and indicators to measure the success of the impacts mentioned in the INFRAIA 02-2020 call.

Expected Impact	Co-UDlabs contributions from the DoA Contributions – Indicators in RP2 (Target at the end of Co-UDlabs)
Wider, simplified, and more efficient access to the Research Infrastructure	• Co-UDlabs catalogue of RI and facilities covers the full Urban Drainage System spectrum • Two online events will stimulate the creation of multi-sectorial TA groups. • Two open calls will be launched • An external independent evaluation panel will select access proposals **Contributions and Indicators in RP2** • A comprehensive guide to apply to call is available in the project website, including a description of the facilities • Co-UDlabs holds two hackathon (23-25 November 2021 and 6 September 2023) and a Market place allowing to different actors join to the call and prepare joint projects (e.g., industry+academia, experimentalists+modelers). 2 online webinar events + 2 online hackathon events (Target: 2) • Two calls plus an extraordinary call. Overall, in the 3 calls 41 user projects received and 31 accepted (Target: 29) • Involvement of 63 invited researchers were hosted in the facilities in RP2 (Target: 140) • 1 paper published related with the TA projects and 2 datasets (Target: 10 and 20)
New or more advanced RI services are made available to a wider community	• Co-UDlabs will expand the capabilities European RIs ecosystem by providing a set of leading-edge complementary infrastructures for UDS research community and EU water sector. • JRA actions (WP6,7,8) will provide new services to RI users, the UD research community and EU water sector. **Contributions and Indicators in RP2** • The first online Industrial Workshop allowed industry and operators to share research problems and how they could benefit from Co-UDlabs TA and JRA activities. An industrial course on flow determination was also celebrated online. • In WP6 the Urban Drainage Metrology Toolbox (UDMT) was released on M18 and update with the Deliverable 6.3. It has 65 downloads in Zenodo (Target: 400 downloads). • The UDMT was presented in the Routine uncertainty assessment webinar (June, 2023 – 35 participants), in the Industrial and water professional workshop of UA in UD monitoring data (Marh, 2024 in France – 8 participants), and in the workshop celebrated in Angoulême (October 2023, France), in training courses in Lyon (October 2023, France), Cartagena (October 17, Spain) and in a seminar in Nanjing (October 2023, China). • The Open database of CCTV inspections from WP7 was released in July 2023 with a GitHub repository with the tools to asses CCTV images. It has 57 downloads in Zenodo (Target: 400 downloads). • New monitoring technologies and scalable hydrodynamic performance and protocols to assess pollution and stormwater ponds reports are available at Zenodo in D6.1, D8.1, D8.2 and D8.4. The total number of downloads are 142 (Target: 400 downloads)

Expected Impact	Co-UDlabs contributions from the DoA Contributions – Indicators in RP2 (Target at the end of Co-UDlabs)
TA providers develop synergies to improve their common services. Less duplication of efforts and improved used of efforts is achieved.	• The implementation of NA seeks to develop the complementary capacities of the RIs participating in the project, to lift multiple synergies and to strengthen the European research community • In addition, the coordination of the JRAs will fine-tune the synergies and highlight the complementarities of the involved RIs. ***Contributions and Indicators in RP2*** • Outcomes from the expected harmonisation procedure will help to share and reuse data much easier. In Deliverable 2.1 some prominent challenges in data harmonisation were highlighted. The main outcomes of this processes will be released during RP3 with the final report on Data harmonisation. • Mobility and training actions for Co-UDlabs staff: 1 Early-Stage Researcher course celebrated in A Coruña (Target: 2) and 19 capacity building mobility actions (Target: 25) • Joint open datasets related with JRA and harmonisation: 8 (Target: 8) • Number joint reports with JRA actions and data harmonisation procedures: 9 Deliverables D6.1, D6.3, D7.1, D7.2, D7.3, MS16, D8.1, D8.2 and D8.4 (Target: 8) • Number joint publication related to the improvements of services provided by the JRA: 1 available related with WP8 although at least 4 more are planned (Target 4).

Innovation is fostered through a reinforced partnership of research infrastructures with industry.	• International Advisory Board will give advice to reinforce partnerships in Co-UDlabs
	• Co-UDlabs hackathon will promote the participation of industry and SME
	• Co-UDlabs will also disseminate the project in trade fairs and national level non-academic congresses.
	Contributions and Indicators in RP2
	• The IAB was established from the beginning of the project. Four meetings were held during RP1 and RP2.
	• Attendees to Industrial Courses (Target 40)
	  ○ Workshop on Urban Drainage Practice and Research Needs: 59 attendees
	  ○ Attendees to Industrial and water professional workshop of UA in UD monitoring: 8 attendees
	  ○ Attendees to Industrial workshop on flow rate determination of pumping stations and hydraulic structures: 59 attendees
	• Number of TA projects leading by non-academia: 33% (10/31)
	• Number of Access days from user groups leading by non-academia:
	  ○ 150 days/590 days – 25% in the first TA Call (Target 30%)
	  ○ 116 days/524 days – 22 % in the second and third call (Target 30%)
	• Number of industrial organisations and SMEs attending to webinars promoting RI call: 20 in the presentation of the project, 28 in the Urban Drainage Practice and Research Needs, 5 in the 1st hackathon and 2 in the 2nd hackathon, 8 in the webinar to present the second call. Total: 63 (Target: 60)
	• Number of dissemination events in trade fairs and other technical events: 4 (Target: 3)
	• Creation of Co-UDlabs marketplace (not foreseen in the DoA). More than 15 proposals were presented in the marketplace in both 1st and 2nd call for access.

A new generation of researchers is trained and educated.	• Researchers supporting Co-UDlabs are PhD students and early-stage researchers • Creation of open tools and training programme within WP3 and JRA framework ***Contributions and Indicators in RP2***

Expected Impact	Co-UDlabs contributions from the DoA Contributions – Indicators in RP2 (Target at the end of Co-UDlabs)

	• Number of PhD students and early-stage researcher who attended to Co-UDlabs internal events: 8 early-stage participants in the 1st internal seminar organised on June 29, 2022 (target 40)
	• Number of PhD students and early-stage researcher who attended to Co-UDlabs external events: 22 participants in the 25th EJSW on Monitoring Urban Drainage Systems and Rivers (Target 40)
	• For the last reporting period three events are planned to engage PhD students and early-stage researchers.
	• Number of downloads of tutorials, visits to webinar sessions and YouTube channel (Target 2000):
	  ○ 18 participants in the Webinar on Fourier transform infrared spectroscopy (FTIR) chemical mapping - 64 views
	  ○ 50 participants in the Webinar on Acoustic monitoring – 121 views
	  ○ 80 participants in the Webinar on UDMT toolbox: Routine Uncertainty Assessment – 17 views
	  ○ 25 participants in the Webinar on Optical observations in urban water systems and rivers – 54 views

Closer interactions between researchers around Co-UDlabs RIs facilitate cross-disciplinary and a wider sharing of information, knowledge and technologies, between academia and non-academic UD actors.	• Close interaction between a large number of researchers from academia and industry. • This number will be increased by the participation of researchers in training, harmonisation, JRA and TA activities. ***Contributions and Indicators in RP2*** • Number of joint scientific and technical publications: 5 scientific publication, 10 datasets aand 0 technical articles (Target: 18) • Percentage of multi-sectorial User groups in the first and second call: 40% (35% Target)
The integration of Co-UDlabs RI instruments leads to better management of the data-sets collected in the facilities	• The major RI in UDS has never developed a common data sharing framework in Europe. The results of the TA and JRA carried out in these will be available at Zenodo. • The harmonisation and data management actions will allow to define a common framework to implement FAIR principles to increase data availability for the UD community. ***Contributions and Indicators in RP2*** • Number of visits f data-set to Co-UDlabs Zenodo data-sets: 2717 views at the end of RP2 (3000 target) • Number of unique downloads of tutorials, webinars views and open-data sets and project reports related with JRA and data harmonisation: 1180 downloads from the the dataset placed at zenodo and 1200 from project deliverables(Target 500)
Integrated and harmonised access to Co-UDlabs contributes to evidence-based policy making.	• TA providers research groups already work together with the policy-makers in their respective countries and as international consultants. • Currently, UDS challenges include the analysis of runoff water pollution, intermittent spills from CSOs, and how new emerging strategies such SuDS can improve system performance. This is being included in the regulations, but there is a lack of technical knowledge about the real performance of these new techniques and some of the process. ***Contributions and Indicators in RP2*** • Water utilities and network operators participate and/or benefit from the development of "early adopters' group" launched at SPN 10 congress (2) and IWA WWC&E congress (8) (Target 10) • Survey to understand performance of UDS data and their purpose (RP3 within WP2 Task 2.3) • Participation in national level events for non-scientific UD actors: 3 (Target: 10)

1.3.2 Other relevant impacts

The project's Description of Action in the Grant Agreement considers several impacts that are not explicitly outlined in the INFRAIA framework (like, for instance, the establishment of multi-disciplinary, multi-national user-groups to access the partners' facilities with more competitive and transversal proposals) but were regarded as instrumental for the definition of innovative and ambitious tasks within the project's workplan — especially because of their reach with a larger public outside of academia and the policy implications of the knowledge, technology, and methods developed within Co-UDlabs.

As the TA programme is still about halfway its completion and with various JRA tasks still open, it is technically early to quantify socio-economic, environmental, or policy governance impacts of Co-UDlabs' activities. However, it is still possible to highlight some major impact and output at this stage of project implementation:

- **Involvement of non-academic stakeholders.** Considering the results of all three Co-UDlabs TA Calls, one-third of accepted research proposals have been led by non-academic institutions, including several small and medium enterprises (SMEs) — involved, in particular, in tests of novel monitoring solutions for urban drainage systems — and water utilities, which have explored innovative methods for pipe rehabilitation and asset inspection.
- **Cutting-edge innovation in methods.** The collaborative research approach brought forward by Co-UDlabs has made way to various innovative solutions that are including artificial vision techniques, low-cost sensors, and spectrometers to assess pollution parameters in the toolkit of a discipline that has a strong reliance on knowledge and technology development. Some of these solutions have enabled consortium partners, alongside industry and the private sector, to further develop ideas and expertise in the field. Additionally, a specialised digital and open tool has been created for analysing and validating monitoring data using uncertainty analysis techniques, which fits with the demand of stakeholders academically involvement in the improvement of these toolkits. Co-UDlabs partners have been using this tool to evaluate sensor performance, and its inclusion is planned in the data harmonisation process currently under development as part of WP2.
- **Knowledge-based policy development.** The project has contributed to better, more effective, and efficient public policy on urban drainage through the creation of updated databases of CSOs in relevant national contexts — e.g., the United Kingdom's. These initiatives are consistent with European Union's new policy developments, embodied especially by the revision of the UWWTD.
- **Standardisation and systematisation.** The JRA and TA activities of the process have also contributed to an ongoing effort to standardise measurement and management methods for sustainable drainage system assets — e.g., clogging of permeable pavements and enhancing stormwater ponds' performance.

1.4 Access provisions to Research Infrastructures

1.4.1 Trans-national Access Activities (TA)

Transnational Access to the 17 facilities included in Co-UDlabs' consortium has been a substantial part of project implementation. The TA is a key added value of the INFRAIA framework and has been a significant opportunity for all Co-UDlabs facility providers. The TAs have allowed the providers and the whole consortium to establish new and otherwise unavailable connections with stakeholders, academic partners, and the private and technological sectors in UD studies in Europe and worldwide — and an opportunity to showcase world-level installations that have been made accessible to students, experts, and technicians from a variety of scientific backgrounds.

In RP2, TA activities — mainly in Work Package 9 on TA provision — focused essentially on the performance and completion of the 13 TA projects that had been accepted after the 1st TA Call. At the same time, in RP2 Co-UDlabs also set up the administrative and logistical framework for the organisation of the 2nd and 3rd TA Calls, which have added 18 more projects to the TA programme — for an overall 31 TA projects accepted throughout the project's lifetime, two more than what the minimum amount planned out in Co-UDlabs' Grant Agreement. Since most of these newly accepted TAs will be performed in RP3, activities for the 2nd and 3rd TA Calls have mostly concentrated in WP5 on Transnational Access arrangements.

Description of the publicity concerning the new opportunities for access

TA projects selected in the first Co-UDlabs TA Call were expected to be finalised no later than July 31, 2023. Accordingly, the consortium began organising a new call for TA proposals in the second quarter of 2023. The preparation of the 2nd Call and the actual selection process, therefore, were all carried out and completed during RP2.

All the information and documentation related to the 2nd Call was published online on Co-UDlabs' website, where standalone pages for the details of the TA Call,[63] the Marketplace of Ideas for the exchange of potential proposal collaborations, and all the templates required for proposal submissions were publicly accessible until the formal completion of the Call and its application process.

The 2nd Call was announced on Co-UDlabs social media;[64] on Co-UDlabs' newsletter (which by the time the Call was advertised reached approximately 460 partners and stakeholders); on the JCUD official mailing list, among other several outlets and communication tools. Co-UDlabs partners also used their professional networks and contacts for more direct and personal contact with potentially interested users and stakeholders.

The second call for proposals of the Co-UDlabs Transnational Access was officially launched on July 3, 2023, in a side-event organised by the Co-UDlabs consortium within the agenda of the Novatech 2023 international conference, in Lyon, France. Novatech was organised by Co-

[63] A description of the TA selection process is permanently online at: https://co-udlabs.eu/access/ta-call/.
[64] See for instance: https://www.linkedin.com/feed/update/urn:li:activity:7081615336885645314.

UDlabs members at GRAIE with the collaboration of INSA Lyon. The deadline for the submission of proposals was originally set for October 6, 2023. Due to high demand from various interested user groups, the deadline was extended by one week, until October 13, 2023.

Co-UDlabs' partners and facility providers collaborated for the 2nd Call too to advertise this opportunity via a few communication events. These initiatives were useful to share information on the TA programme, the 2nd Call, and the requirements to participate even among networks or publics that Co-UDlabs had not adequately addressed for the 1st Call. In the project's first Review Meeting in February 2023, in fact, the consortium had been invited to expand its outreach — especially as far as scientific and TA collaborations were concerned — to more relevant areas in Europe, especially in Southern, Central, and Eastern European countries. When circulating information about the TA Call preparatory meetings, Co-UDlabs got in contact with various organisations (e.g., the European Water Association, EWA) and networks to reach academic institutions, the private sector, and public regulators and utility managers in these areas too. Promotion events included:

- **Co-UDlabs' 2nd TA Call Introductory Webinar.** Co-UDlabs replicated its Introductory Webinar for the second call too, on June 20, 2023, with the aim to engage an even larger audience and attract potential applicants that had not previously had the opportunity to learn about the project and its TA programme. The Webinar provided a comprehensive review of the TA programme, the rules and conditions, the submission procedure, and the technicalities of conducting a transnational access in one of the Co-UDlabs' facilities. 51 people attended the session online. The full Webinar is online on the project's YouTube channel.[65]
- **Co-UDlabs' TA Workshop at Novatech 2023.** The 2nd TA Call was officially presented at a technical workshop (on July 3, 2023) within the Novatech 2023 conference. The workshop illustrated the features and purposes of the Call, while also giving a thorough overview of the preliminary results collected by the projects that had been accepted and funded during the 1st call. Besides providing key information and guidelines for proposal submission, the Workshop also featured first-hand accounts on both the practical and academic perspectives of conducting a TA in Co-UDlabs facilities by several members of the 1st Call projects. 33 people, including several facility providers, attended the workshop. More information is available online on the project's website.[66]
- **2nd Co-UDlabs TA Hackathon event.** On September 6, 2023, one month before the official end of the 2nd TA Call, Co-UDlabs arranged its 2nd Hackathon event linked to its TA programme. As in its first edition, the Hackathon was designed to be a key meeting point for user groups already in an advanced stage of their proposal definition to receive feedback on their ideas and support from other users, academics, and/or representatives of industry and business.

[65] Accessible online at: https://www.youtube.com/watch?v=1cK5AHIODtM.
[66] Accessible online at: https://co-udlabs.eu/2023/05/04/co-udlabs-workshop-at-novatech-2023/.

The event's attendance was a testament to the growing demand in the UD community for access to large-scale installations across Europe. The team whose presentation was voted as the most promising was 'awarded' a short reconnaissance visit at the facility of their choice to discuss and their proposals with facility providers and make it more consistent with the specificities of the installations. A team from Germany's Technische Universität Darmstadt were thus invited to visit the STREET facility at UDC, after their successful presentation on *Advancing Sustainable Urban Infrastructure: Visible Light-Driven TiO2-based Carbon Nanotubes for Enhanced Degradation of Micropollutants in Rainwater Runoff*. The 'award' visit took place on September 26-27, 2023.

Description of the selection procedure

After Co-UDlabs' 1st TA Call had concluded successfully in 2022, the consortium agreed to replicate the process for the 2nd TA Call too. The common User Selection Procedure was put into place:

- For proposals to be considered for selections, they had to pass an eligibility and feasibility assessment. Eligibility means that the proposal and the applying user-group must comply with all EU regulations underpinning the INFRAIA framework and the rules defining the TA mechanisms. Feasibility means that proposals can only be considered if the facility providers deem them viable to be reasonably performed within the expected and available timeframe. Eligibility is assessed by project coordination in collaboration with facility providers; feasibility is assessed by facility providers. Feasibility reports submitted by the providers were also shared (upon request) with selected user-groups as an initial step for the improvement of the proposals.
- The consortium convened the EEP that had assisted Co-UDlabs with the evaluation process of the 1st TA Call. Expression of interest was opened again for all the members of the EEP. Nine members accepted to be part of the EEP again (see Table 1.8) and it was ascertained that no conflict of interest was identified between evaluators and the proposals that were assigned to them.

Table 1.8. Composition of Co-UDlabs' External Evaluation Panel for the 2nd TA Call.

Name	Affiliation	Country
Arthur Scott	Heriot Watt University (Edinburgh)	United Kingdom
Antonio Lastra	Canal Isabel II	Spain
Caroline Wadsworth	Isle Utilities Ltd.	United Kingdom
Emmanuel Berthier	CEREMA	France
Frank Blumensaat	Landesdirektion Sachsen	Germany
Franz Tscheikner-Gratl	NTNU	Norway
Johan Van Assel	Aquafin	Belgium
Philipp Staufer	Municipality of Zürich	Switzerland
Sophie Duchesne	INRS	Canada

When the 2nd TA Call closed on October 13, 2023, WP5 had received 24 submissions for 12 Co-UDlabs' research facilities. Overall figures from submitted applications are as follows:

- User-group leaders were based in 11 different countries, 4 of which were non-EU.
- User-group members were based in 25 different countries, 13 of which were non-EU.
- A total of 160 users were included in all submitted proposals, from 75 different institutions.
- Out of these 160 users:
    - 32 (20.0%) were from non-EU countries;
    - 48 (30.0%) were female;
    - 23 (14.4%) were PhD students or enrolled for a lower academic qualification;
    - 49 (30.6%) were from institutions outside of academia.

Following the preliminary eligibility and feasibility assessments, three proposals had to be discarded because they did not meet the feasibility requirements expected by facility providers:

- Tallinn University of Technology (Estonia) at A-LOOP, Deltares (The Netherlands)
- Afyon Kocatepe University (Turkey) at GROOF, INSA Lyon (France)
- University of Oviedo (Spain) at GROOF, INSA Lyon (France)

The remaining 21 proposals when then distributed to the members of the EEP for their assessment. The EEP and Co-UDlabs' Steering Committee (SC) met on November 14, 2023, to review the evaluation results and determine the TA proposals accepted for the 2nd TA Call. All proposals were assessed by at least two evaluators (who did not know who else was assigned the same proposals), and all evaluators had to assess at least three proposals. Evaluators were asked to assess each proposal's overall excellence and quality (on a 0-10 scale); the potential impact of their results (0-5); and the potential for academic/industrial innovation (0-5). Details on the evaluation criteria are available in Deliverable 5.3. Following the EEP's assessment, 13 proposals were accepted, 4 were rejected, and 4 more were sent back to the applying user-group for revision following a set of recommendations and remarks by the evaluators.

Proposals were re-submitted before November 22, 2023, and shared with a few evaluators that had accepted to contribute to this part of the process. One of the re-evaluated proposals was withdrawn by the applicants; the three remaining proposals were all accepted after revision. The official outcomes of the 2nd TA Call were officially delivered to the applicants on December 11, 2023.

Following the results of the 2nd TA Call, 13 facilities out of 17 had reached the required minimum granted accesses as established in the regulations of the Grant Agreement's Description of Action. After consultation with the office of the Project Advisor, facility providers were allowed to compensate a deficit in granted accesses in one of their facilities if any of the others had a surplus of accesses.[67] OTHU-DRB at INSA and FREJLEV at Aalborg, however, still presented a deficit of one access below the required per-provider minimum. Accordingly, WP5 and the

[67] This was the case of UDC (surplus for STREET and BLOCK facilities compensating a deficit at BENS) and Deltares (surplus at B-LOOP compensating a deficit at A-LOOP).

Project Advisor agreed to set up an extraordinary 3rd TA Call in which only the FREJLEV and OTHU-DRB facilities were available for applications.

The 3rd TA Call opened on December 15, 2023, and closed on January 5, 2024. Two proposals — one per facility — were submitted and, after the feasibility and eligibility assessments, shared with the two members of the EEP who agreed to be included in this third stage of evaluation. Both proposals were accepted. A Steering Committee meeting on February 8, 2024, formally adopted the outcomes of the evaluation and closed the 3rd TA Call, as well as the application process for the Co-UDlabs TA Programme altogether. Table 1.9 shows the balance of accepted proposals per facility in the 1st, 2nd, and 3rd TA Calls.

Table 1.9. Balance between minimum required and granted TAs per facility and per provider.

Provider	Facility	GA expected projects	1st Call TAs	2nd + 3rd Call TAs	Facility access balance	Provider access balance
UDC	STREET	2	1	2	**+1**	**+1**
	BLOCK	2	1	2	**+1**	
	BENS	2	1	0	**-1**	
USFD	RTC RIG	1	0	2	**+1**	**+2**
	BURIED INF.	1	1	1	**+1**	
	ANNULAR	2	2	0	**0**	
	A/B FLUME	2	1	1	**0**	
DEL	B-LOOP	1	0	2	**+1**	**0**
	A-LOOP	1	0	0	**-1**	
EAWAG	HALL	2	2	0	**0**	**0**
	UWO	3	1	2	**0**	
IKT	IKT LTF	2	2	0	**0**	**0**
	IKT TEST	2	0	2	**0**	
INSA	OTHU DRB	1	0	1	**0**	**0**
	OTHU SuDS	2	1	1	**0**	
	GROOF	2	0	2	**0**	
AAU	FREJLEV	1	0	1	**0**	**0**

Figure 1.23 shows the country of origin of all 2nd and 3rd TA Calls accepted proposals' leading and member institutions. As the overall selection process for the 2nd and 3rd TA Calls ended in February 2024, there was only a limited amount of time within RP2 for facility providers to negotiate the projects' User-Facility Agreements and User Project Plans — i.e., the required documents to plan and set out the activities of a user-group at their facility of choice – and begun with the projects. The following proposals from the 2nd and 3rd Calls have actually begun operations before April 30, 2024: UDC-07-STREET-Lutze (at the University of A Coruña), USFD-05-ABFLUME-Martins (at the University of Sheffield), DEL-01-BLOOP-Besharat (at Deltares) and EAWAG-04-UWO-Abdelaal (at EAWAG). All the remaining users project has achieved a commitment with the facility providers to perform their activities during the project duration.

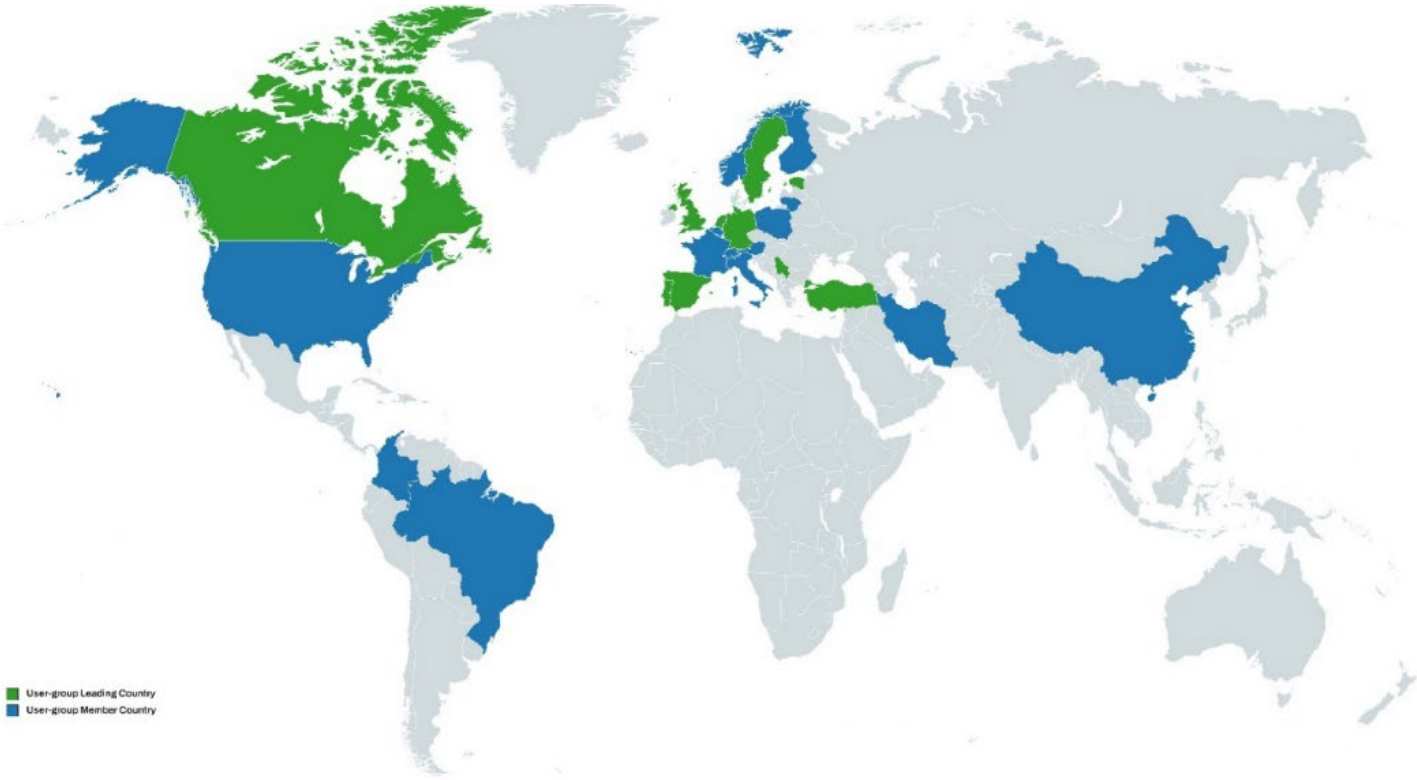

Figure 1.23. Countries of 2nd and 3rd TA Call's user-group leading institutions highlighted in green; countries of user-group members in blue.

Description of the Trans-national Access activity

The EEP and the SC met to consolidate the results of the 1st TA Call in March 2022. Accepted user-groups began negotiating their UFAs and UPPs over the following few months. The first TA visit took place in August 2022, and the first long-term stay at an installation began in October 2022. Consequently, the largest part of the actual implementation of the TA programme and most TA activities so far took place throughout RP2 — which began on November 1, 2022: all of the 1st Call's 13 accepted proposals have, in fact, been completed in RP2.

This section compiles brief descriptions of the work that facility providers and hosted user-groups have carried out together for the arrangement, performance, and completion of their TA projects. Further information (e.g., procedures, tests setup, results) can be found in Deliverable 9.1 on TA provision for the 1st TA Call.

Table 1.10. Full list of projects (from any of the three TA Calls) in which costs have been incurred in RP2.

Host Institution	Project Acronym	TA Call	Objectives	Resources provided for project preparation and implementation	Units of access provided in RP2
UDC	UDC-01-BENS-Peña	1	To adapt and validate new monitoring flow and quality technologies for sewers	YES	71
UDC	UDC-02-BLOCK-Zafra	1	To investigate the mobilisation of heavy metals (HM) associated with urban diffuse pollution that is generated and accumulated in the streets and roads	YES	66
UDC	UDC-03-STREET-Bellos	1	To investigate the impact of the potential storage of flooded houses acting like reservoirs in a pluvial flood hitting an idealised city	YES	29
UDC	UDC-04-BLOCK-Franca	2	To investigate the onset on motion of large macroplastics by urban stormwater runoff and rainfall	YES	0
USFD	UDC-05-BLOCK-Coupe	2	To analyse the hydrological performance of different typologies of green roofs and its potential heat recovery	YES	0
USFD	UDC-06-STREET-Linnemann	2	To investigate new permeable asphalt pavement clogging and pollutant release	YES	0
UDC	UDC-07-STREET-Lutze	2	To explore a photocatalytic option to adsorb and degrade micropollutants found in building materials, preventing their emission in rainwater	YES	26
USFD	USFD-01-ABFLUME-Mignot	1	To compare different measurement techniques to characterise transport of soluble pollutants and conduct a series of benchmarks tests under different geometrical and flow conditions	YES	27
USFD	USFD-02-ANNULAR-Regueiro	1	To test innovative thermal probes to measure to monitor sediment bed thickness, under temperature-controlled conditions at the annular flume	YES	60
USFD	USFD-03-ANNULAR-Morato	1	To evaluate the role of riverine biofilms, affected by wastewater discharges, in the spread of antibiotic resistance in the environment and to evaluate the use of CRISPRCas9 as a mitigation technique	YES	50
USFD	USFD-04-BURIED-Li	1	To investigate a novel stormwater sewer infiltration system at full-scale	YES	60
USFD	USFD-05-ABFLUME-Martins	2	To investigate the transport of particulate pollutants from sewer networks to surface flows during urban flood conditions.	YES	12
USFD	USFD-06-BURIED-Joksimovic	2	To study the use of fixed hydraulic controls to enhance infiltration via a slotted drainage pipe into a well-drained soil.	YES	0
USFD	USFD-07-RTCRIG Vanderverf	2	To investigate RTC operation of a constructed sewer model	YES	0
USFD	USFD-08-RTCRIG-Gutierrez	2	To investigate flow and volume measurements in a constructed sewer model	YES	0

Host Institution	Project Acronym	TA Call	Objectives	Resources provided for project preparation and implementation	Units of access provided in RP2
DEL	DEL-01-BLOOP-Besharat	2	Generate data on the dynamics of gas pocket transport through pressurized pipe systems	YES	3
DEL	DEL-02-BLOOP-Farhadiroushan	2	Evaluate the use of Fibre-Optic Distributed Acoustic Sensing (DAS) to retrieve information on the flow of highly-concentrated slurry flows for wastewater transport.	YES	0
EAWAG	EAWAG-01-HALL-Bares	1	To assess the feasibility of non-contact water quality monitoring methods with hyperspectral imaging	YES	18
EAWAG	EAWAG-02-HALL-Langeveld	1	To stablish the optimal configuration of thermal sensors distribution to determine sewer sediment thermal properties and thickness	YES	12
EAWAG	EAWAG-03-UWO-Dittmer	1	Improve the reliability of Urban Drainage Modelling with probabilistic Machine Learning-methods	YES	39
EAWAG	EAWAG-04-UWO-Abdel	2	To investigate the impact of heat recovery on mitigating the formation of H2S in sewer buried structure, through computational modelling	YES	3
EAWAG	EAWAG-05-UWO-Dittmer	2	To investigate uses the UWO dataset to assess the required spatio-temporal resolution of precipitation for rainfall-runoff modelling in urban hydrology	YES	0
IKT	IKT-01-LTF-Verhulst	1	To test sewer rehabilitation relining solutions for sewage pressure pipes	YES	95
IKT	IKT-02-LTF-Beenen	1	To test innovative inspection techniques that provide meaningful results on the condition of the sewage pressure pipes	YES	40
IKT	IKT-03-TEST-Carnacina	2	To test an innovative manhole design suitable for use in narrow streets	YES	0
IKT	IKT-04-TEST-Johansen	2	To develop a proposal for Swedish national standard for prefabricated stormwater facilities	YES	0
INSA	INSA-01-OTHU-Fuchs	1	To measure the spatial distribution of soil moisture in a swale under artificial heavy rains	YES	3
INSA	INSA-02-OTHU-Prodanovic	2	To explore the relationship between plant parameters and the water management performance of urban nature-based solutions	YES	0
INSA	INSA-03-GROOF-Förster	2	To compare experimental and modelling data of the hydrological response of green roofs across scales, sites and experimental setup	YES	0
INSA	INSA-04-DRB-Lhomme	3	To test multi-parameters sensing device using water quality and electro-conductivity analysis to measure water and sediments heights in urban drainage systems	YES	0
AAU	AAU-01-FREJLEV-Laanearu	3	Air-water stratified flow in a poorly ventilated sewer main	YES	0

- **UDC-01-BENS-Peña. Evaluation of new flow and quality monitoring devices for sewers**

This TA project involved two SMEs (Ubertone and Photrack) and the Polytechnical University of Cartagena (UPCT) aiming to adapt and validate new monitoring flow and quality technologies for sewers through a series of tests where the wastewater flow through two pipes with circular and egg-shaped cross-sections was characterized. UDC was in charge of the experimental campaign and user group members visited the facility for installation and testing of complementary devices. A presential meeting was organized after the access with Ubertone, Photrack and UPCT to share the results of each device, find synergies and coordinate the dissemination of the results. The experimental campaign comprises a total of 76 tests for different discharges, slopes, and downstream boundary conditions implying the installation of complementary equipment to allow online data transmission and model setup readjustments. Depths, flows and water quality from laboratory analysis were measured. Ubertone installed a new average velocity profiler, which has been tested and compared to other methods available in the flume facility in terms of capability, quality, and limits for realistic conditions. Photrack tested an imaging system that had originally developed in river monitoring and is being brought into operational use in sewers. This proposal also aimed to evaluate the SSC variations by surface images and acoustic backscattering. A novel spectrophotometer developed by UPCT complemented quality measurements. Preliminary results showed the high potential of tested devices in realistic but controlled conditions, and the data generated is being used to improve their performance in sewer systems.

- **UDC-02-BLOCK-Zafra. Methodology to determine the potential heavy metal loads washed-off by stormwater runoff from road-deposited sediments**

This TA project focused on the analysis of the potential Heavy metals (HMs) load washed-off in rainfall events from urban road-deposited surface (RDS). HMs represent one the most significant factors in the environmental pollution of water, soil, and air. HMs research in urban environments has gone into the transport and dynamics runoff direction, especially for the road-deposited sediment (RDS) present in urban areas. The project comprised the characterization of the RDS load in a real street and the assessment of HM wash-off in BLOCK facility at UDC. The assessment of HM wash-off in the physical model was performed through eight tests with deionized water for RDS loads of 0, 100, 150, and 200 g/m^2 and two different rainfall intensities (30 and 50 mm/h). Modifications in the facility to work with deionized water and numerous laboratory determinations were required to analyse in detail the mobilization of heavy metals during the tests. A visiting researcher was in charge of the experiments during all the access period with the visit of the user group leader at the beginning and end of the experimental campaign and the support of UDC. Monthly meetings are being organised between the user group and the UDC to work on the analysis of the results obtained towards joint publications on particulate and heavy metal wash-off in urban environments. Project results will help public and private stakeholders for decision-making and visualize possible management scenarios of urban drainage systems in the framework of HM pollution.

- **UDC-03-STREET-Bellos. Urban Flooding: Houses as reservoirs**

A laboratory experiment was proposed to investigate the impact of the potential storage of flooded houses acting like reservoirs in a pluvial flood hitting an idealised city. The stored flood volume, the so-called storage effect, has not been previously investigated, either numerically or experimentally. A 26.1 m^2 concrete platform with 25 blocks (representing buildings with basements) with detachable doors was built in STREET facility. Different scenarios for several city configurations were implemented as the distorted physical model will allow various rainfall-runoff intensities and adjustment of the flood volume stored in buildings. Flood characteristics such as water depths, velocities and hydrographs have been measured during the experiments. The results suggest that the storage effect of the houses has a significant impact on the overall flood characteristics in densely urbanized areas, suggesting that further consideration should be given to include the storage effect in urban flood modelling. Contact with the user group has been maintained to assist in the modelling of the conducted tests.

- **UDC-04-BLOCK-Franca. Inception of Transport of Litter Under Pluvial Conditions (IT-LUP)**

This is a project of the 2nd TA Call. Plastic pollution originates from human activities, with urban environments acting as hotspots, but little is known about how litter, including plastic, enters the water cycle and this limits the prediction of pollution hydrographs. The project aims to study the incipient motion of the five most common types of litter on urban catchment surfaces. These may comprehend soft and hard plastic fragments, films and cigarette butts, among others. The primary goal of this project is to establish generalised relationships, based on rainfall intensity and street runoff (i.e., depth and velocity) that can predict at which point of a storm litter gets mobilised and transported in the direction of the urban drainage system. A secondary goal of this project is to describe the dynamics of the early movement of litter, which can range from intermittent tumbling movement over the street-floor (filling and emptying with water, potentially) to, rather differently, completely floating, or surfing over the runoff layer. The User Facility Agreement has already been signed and the access is planned to start by June 2024. All the necessary modifications of the facility, which include the building of a structure with different surface materials (concrete, tiles and grass) that will allow to test different surface slopes, are being arranged.

- **UDC-05-BLOCK-Coupe. Soil moisture supply and green roof plant requirements incorporating drainage and energy functions**

This is a project of the 2nd TA Call. The research will use the green roofs of BLOCK facility to grow habitat enhancing plants in a proprietary green roof substrate, on a variety of roof slopes with subbase replacement voids, wicking materials and recycled content. Soil moisture values through roof profiles will be correlated with plant health, growth and diversity, to identify key moisture values that promote a viable sward cover, flowering and seeding for long-term communities. Furthermore, the viability of installing ground source heat pump collection loops into roofs of different composition will be evaluated, including with slope, varying water depth and material for subbase. Therefore, the project aims to update the specification of green roof options with the planning and construction authorities, to open new opportunities for GBGR deployment, new markets and more urban green infrastructure. A first contact has been

produced between the User Group and UDC after the resolution of the 2nd TA call to analyse in detail the proposal and coordinate the access that is expected to start by November 2024.

- **UDC-06-STREET-Linnemann. Hydraulic Characterization of Permeable Pavement Bonded With A Novel Polyurethane Binder (HyPermaPave)**

This is a project of the 2nd TA Call. The project researches the potential of Polyurethane Bound Permeable Mixture (PBPM), a novel permeable pavement developed by RWTH Aachen University, to address urban flooding and runoff water pollution arising from impervious city surfaces. Conventional asphalt permeable pavements face issues like grain ravelling and low durability, preventing their widespread adoption. The novel PBPM combines a polyurethane binder with aggregates, showing better mechanical properties compared to traditional asphalt pavements. However, from PBPM little is known about its hydraulic properties and pollutant interactions. This research focuses on clogging and pollutants as a first-approach study, potentially positioning PBPM as a viable alternative to traditional asphalt pavements. Initial meetings have been organized between UDC and representatives of the user group to analyse the initial proposal and prepare the User Facility Agreement. It is expected that the access start by mid of September 2024.

- **UDC-07-STREET-Lutze. Active Building Materials: Integration of Visible Light-Driven TiO2-based Carbon Nanotubes for Enhanced Degradation of Micropollutants in Rainwater Runoff [UDC — STREET]**

This is a project of the 2nd TA Call. The research is focused on exploring a photocatalytic option to adsorb and degrade micropollutants found in building materials on-site, including pesticides from bituminous roof sheets, preventing their emission and transport by rainwater. The approach involves using carbon nanotubes (CNTs) coupled with visible light-driven TiO_2 in a spray application. The project uses the scaled city model built for UDC-03-STREET-Bellos, where a total of 20 new roofs have been built to install the bituminous layer with the pollutant. A modification to use deionized water at the rainfall simulator of the STREET facility was also required. The experimental matrix comprises the analysis of pollutant wash-off from roofs during rain events using different catalyst and initial conditions. Samples collected are being sent to TU Darmstadt for analysis with specialized equipment. The main visitant researcher (PhD student) was 1 week before the access performing preliminary tests to stablish and prepare the needed concentrations of catalyst and pollutant before the Access. A main visit of the most part of the User group at the beginning of the access was used to discuss preliminary results, coordinate the teams from TU Darmstadt and NTNU involved in the proposal, and define the last details of the experimental campaign. The experiments have been started and is expected to finish by end of May 2024.

- **USFD-01-ABFLUME-Mignot. Pollutant Transport in Urban Floodwaters [USFD - A/B FLUME]**

The aim of this project was to study pollution dispersion in shallow flow flood flows within a controlled laboratory setting where soluble tracers were ejected from the model manhole into the surface flow. The work utilized 3 different tracer methods: dye (for a Planar Concentration

based method), salt (for a conductivity method) and temperature (for a thermometry method). In first phase, testing compared 2D concentrations estimated by these 3 methods against benchmark probes, applied on a limited set of experimental configurations. Then, several further experimental configurations are studied to establish reference experimental benchmarks to be used by numerical modelers to calibrate operational models of pollutant transport in floodwater. Results of these experiments are currently being compiled by the project team for publication.

- **UFSD-02-ANNULAR-Regueiro. Temperature time series analysis for predicting sedimentation in sewer systems [USFD - ANNULAR]**

This TA aimed to test the innovative use of thermal probes to continuously monitor sediment build-up in sewer systems, through monitoring the temperature oscillations in the liquid and solid phases to measure the heat transfer processes between both media. The phase shift in the temperature oscillations can then be utilized to estimate the buildup of sediment bed deposits. For this purpose, a series of laboratory experiments in the ANNULAR facility have been carried out, using different sediment thicknesses and water temperature gradients. The main objective of this TA study is to develop a methodology to analyze temperature oscillations and predict sedimentation processes under flow conditions. The sediment depth estimations from the experiments showed a low uncertainty and a high precision compared to the reference depth measurements. These results confirmed that systems based on temperature measurements are a viable solution for sediment monitoring in combined sewer pipes without measuring hydraulic variables. The results have been presented at the recent 16th International Conference on Urban Drainage, and accepted for publication at Water Science and Technology.[68]

- **UFSD-03-ANNULAR-Morato. Annular Flume studies to test the effect on Antibiotic Resistant Genes and Use of CRISPR- Cas in E. coli from sediments affected by sewage pollution [USFD – ANNULAR]**

This TA aimed to investigate antimicrobial resistance (AMR) processes between sediment biofilms and water in rivers affected by anthropogenic pollution. The project involved field and laboratory work at the ANNULAR FLUME facility in UFSD and included characterisation of AMR in samples. The study focused on the spread of extended-spectrum beta-lactamases (ESBLs) genes. ESBLs are the predominant cephalosporin resistance determinants in Enterobacteriaceae and among the ESBL enzyme families the CTX-M are the most widespread. Simultaneously, laboratory experiments were conducted to test the molecular editing tool CRISP-Cas9 in the bacteria E. coli to study its feasibility to be applied to control AMR spread in the environment. To study river AMR resistant processes and the use of CRISPR-Cas in *E. coli* within sediments from rivers, 300 L of water from the river Don were pumped and transported to the laboratory to be used in the annular flume experiments under controlled conditions. To study how hydrological perturbations in the riverbed can affect AMR spread from biofilm sediments mobilisation into the water, experiments were set up in the annular flume using gradual increases in shear stress. This set up allowed us to test the effect of increasing shear stress on

[68] Available online at: https://doi.org/10.2166/wst.2024.193.

bacteria load concentration and AMR spread exchanges between sediment and water. Simultaneously in laboratory experiments run in parallel to the annular flume, the project demonstrated that the *in vitro* digestion of DNA showed high efficiency cleavage of CTX-M-1 using Cas9.

- **UFSD-04-BURIED-Li. A novel manhole design for separate sewer systems [USFD – BURIED]**

This TA was aimed to investigate the performance of a full-scale hybrid drainage system. The project involved laboratory work at the BURIED facility in UFSD and then calibration of SWMM hydrodynamic models. The calibrated models would then be used to discuss the advantage of such a hybrid drainage system with end user consultants in the project team. A design handbook is envisaged to disseminate the results more widely. The experimental set-up that was constructed for this TA comprised of two sections (i) Manhole 5 to 6 was built in a section of soil that was enclosed with an impermeable membrane to represent a clay soil and (ii) Manhole 2 to 3 in which the drainage system was built in a free-draining sand type soil in which permeability was much higher. The system between these manholes, comprised a traditional 300mm diameter drainage pipe and two 200mm slotted drainage pipes. In each manhole, and in the slotted pipes and in the surrounding soil, water level gauges were placed, and this allowed the flows of water into the system, and from the slotted drainage pipes into the surrounding soil to be measured. Steady flows tests were conducted first to assess the maximum flow carrying capacity before the infiltration process was exceeded. After this was measured, time varying flow tests were carried out to represent rainfall events from different catchment surface areas. The aim being to identify the infiltration capacity per meter of slotted pipe, as this could be used for design purposes when this type of hybrid system is used to replace a traditional single impermeable pipe drainage system or is used in a new build development as a sustainable drainage option. A rainfall time series was tested with sediment input to resemble car park run-off to investigate the sediment retention property of the system.

- **USFD-05-ABFLUME-Martins. Understanding the transport and fate of ejected sewer sediments during urban flood events [USFD – A/B FLUME]**

This TA is ongoing. The aim is to consider the transport and fate of particulates within pipes and manholes during urban flood events and quantify the potential of these sediments to be transported to surface flows. Particle Tracking Velocimetry is being used to track sediment particles within the manhole structure under a range of hydraulic conditions.

- **USFD-06-BURIED-Jokosimovic. Stormwater Conveyance System Performance Enhancement with Passive Control of Flow (SPEC-FLOW) [USFD – BURIED]**

This TA is in preparation. It aims to study the use of fixed hydraulic controls to enhance infiltration via a slotted drainage pipe into a well-drained soil. Preparatory meetings have been held and a sensor plan has been developed. It is planned that this TA will happen from the 3rd week in July to the 3rd week in August 2024.

- **USFD-07-RTCRIG-Vanderwerf. Measurement Uncertainty in Real Time Control and CSO quantification [USFD – RTC RIG]**

This TA is about to start. A full-scale combined sewer overflow chamber has been constructed and instrumented with over 20 water level monitors. A gate with real-time control capabilities has also been installed in the rig and in the final stages of testing It is expected that this TA will start on July 15, 2024.

- **USFD-08-RTCRIG-Gutierrez. Evaluation of uncertainties linked to different methods of CSO's estimation [USFD – RTC RIG]**

This is a project of the 2nd TA Call. This TA also uses the combined sewer overflow chamber as USFD-07-RTCRIG – Vanderverf, but is aimed at estimating flow rate and volume, from weir geometry and water level measurements. This TA is currently ongoing, there has been some delay due to a failed pump, so work had to be temporarily paused while the main laboratory sump is drained and the pump is replaced, it is planned to resume this TA between mid-August and mid-September. This has been agreed with the user group, who will examine the data that has already been collected.

- **DEL-01-BLOOP-Besharat: Project: Dynamic Behaviour of Air Pockets in Urban Drainage Systems (DAirUDS) [DEL B-LOOP]**

This project aims to address the issue of intermediate air pockets in urban drainage systems (UDS) under various transient flow conditions. Air pockets are typically entrapped at high points and uneven cross-sections of water pipe networks and have the potential to lead to significant damages, such as geysers erupting and system component failures. This can have a considerable impact on sustainability and public health if not managed appropriately. This project uses the B-Loop facility at Deltares to investigate the problem of air entrapment at the highest point of a pressurised undulating pipe profile within UDS. This will improve knowledge of the dynamics of air-water interaction which, in turn, will help to improve current numerical approaches towards more accurate simulations and air location/size detection. This knowledge will be instrumental in comprehending adverse effects during operation and suggesting strategies to mitigate negative impacts. To this purpose, the beta loop facility had to modify its geometry to accommodate an up-bend that would promote the formation of gas pockets. This new pipe configuration had additionally a transparent section to measure optically the evolution of dynamics of the gas pocket. Additionally, high-precision gas mass flow controller allowed modifying the intake/outtake of gas to test different configurations. Modifications of the facility have started during RP2 but no experiments have yet been conducted.

- **DEL-02-BLOOP-Farhadirushan: Advancing Urban Drainage: Testing Distributed Acoustic Sensing (DAS) for Efficient Wastewater Transportation [DEL B-LOOP]**

This project aims at assessing a novel method for extracting quantitative information on opaque non-Newtonian flows in pressurized pipe transport. The project proposes using state-of-the-art, non-intrusive Distributed Fibre Optic Sensing. Distributed Acoustic Sensing (DAS) offers a non-intrusive, low-maintenance solution for monitoring deformations, noise and vibrations in different environments. This research will investigate uses of DAS to precisely identify flow rates,

phases, and compositions in highly concentrated slurry flows. This type of flows is characteristic of innovative sanitation systems which aim at reducing water consumption in the transport of waste (e.g. vacuum toilets). Unfortunately, decreasing the water fraction implies increasing solid content. Such flows often exhibit non-Newtonian characteristics (such as shear-thinning viscosity), which are still not described in detail (knowledge that is relevant for optimising transport systems). This TA will make use of a high-resolution DAS system, which is wrapped around the pipe exterior. By analysing sound propagation characteristics, this aims at retrieving relevant information on the flow properties (such as turbulence levels, bulk velocity or stratification in the pipe). This investigation will provide data to enhance the description of flow dynamics throughout wastewater transportation pipelines and will be the first characterization of a high-resolution DAS system under high-concentrated domestic slurry flows.

- **EAWAG-01-HALL-Bares. To assess the feasibility of non-contact water quality monitoring methods with hyperspectral imaging [EAWAG HALL]**

The TA EAWAG-01-HALL-Bares started in June 2022 and ended in December 2023, aiming at assessing the performances of hyperspectral imaging systems for non-contact pollution measurement in wastewater samples. It was divided into i) a first proof-of-concept series of tests performed in the EAWAG laboratories in July 2022 and ii) an extensive series of pilot-scale tests in the EAWAG experimental hall between May and October 2023. The proof-of-concept study, based on 144 samples of synthetic wastewaters, demonstrated the potential of this approach, with measurement accuracy below 10% for pollution indicators such as turbidity, ammonium, total nitrogen and phosphates. The results were published in a peer-reviewed journal in early 2024,[69] and the data placed in an online repository. A unique dataset from the pilot scale tests, containing 4,800 hyperspectral acquisitions, measurements from online sensors and reference pollution measurements of 520 samples, are currently being analysed. The open dataset will be disseminated in a dedicated peer-reviewed publication, in the open data journal ESSD (Q3 of 2025).

A remarkable success of this TA is that the user Photrack (SME) acquired follow-up R&D funding from the Swiss innosuisse agency (0.5Mio CHF) to develop a prototype for water quality monitoring with spectral imaging.

- **EAWAG-02-HALL-Langeveld. To stablish the optimal configuration of thermal sensors distribution to determine sewer sediment thermal properties and thickness [EAWAG HALL]**

This TA established the base info to detect and, a novelty, quantify sediments in UDS from temperature sensors. Specifically, these experiments sought to demonstrate the application of this methodology for assessing sewer sediment accumulation. It was successfully finished in March 2023.

At the experimental HALL of EAWAG, the primary objectives of this project included the development of a system utilizing active temperature sensors and its application for measuring

[69] Online at: https://doi.org/10.1039/D3EW00541K.

the thermal properties of UDS sediments by repeated heating and cooling. In a laboratory setup, extra temperature sensors were installed at various heights to estimate sediment depth and extra hardware was developed, which forms the MONTSE system. The data are archived in Zenodo, with a detailed data collection report to enable the findings to be used and reproduced by others under a CC BY-NC 4.0 license. The results of this TA have been refined by measurements in USFD to investigate the influence of flow velocity on the estimated sediment levels (see USFD-02-ANNULAR-Regueiro)

It is worth highlighting that this TA led to follow-up work consist in a MSc thesis with ETH Zurich and a project collaboration with the Eastern Switzerland University of Applied Sciences (OST), where MONTSE is applied to sediment monitoring in gullies. This is supported by 20k EUR from the Zurich Cantonal Road Department. Further collaboration with Lulea University on MONTSE applications is planned.

- **EAWAG-03-UWO-Dittmer. Improve the reliability of Urban Drainage Modelling with probabilistic Machine Learning-methods [EAWAG UWO]**

A well-calibrated model is crucial for many applications in combined sewer network operations, accurately representing real-world conditions. Traditional and physics-based models, such as SWMM, involve simplifications and significant computational effort for calibration and simulation. ML models, while capable of learning from historical data, depend heavily on data quality and availability. To overcome these limitations, we introduced a hybrid approach for advanced modelling of combined sewer systems. Initially, we used a well-calibrated SWMM model by EAWAG researchers and incorporated its simulation output along with measurement data provided by EAWAG into a machine learning model (XGBoost). This combination of physics-based and data-driven modelling improves predictions by leveraging hydrological principles and empirical data patterns. Our case study in Fehraltorf, the EAWAG field laboratory, demonstrated that this approach enhances accuracy and reduces computational effort compared to traditional physics-based models, especially under extreme weather conditions. We successfully tested this approach in additional test cases in Germany and Austria.

Future research will focus on modelling entire combined sewer networks rather than single point evaluations. We aim to apply deep learning and graph neural networks to incorporate spatial relationships between model nodes. Additionally, we will improve the parameter selection of input data to further enhance model accuracy and performance.

- **EAWAG-04-UWO-Abdel. Maximising the Benefits of Sewer Heat Recovery [EAWAG UWO]**

This is a project of the 2nd TA Call. A measurement campaign was designed to monitor the Hydrosulphide (H2S) concentration and temperatures in the UWO sewer network. The aim is to investigate the impact of heat recovery on mitigating the formation of H2S in sewer buried structure, through computational modelling. There are currently no field or experimental studies reporting on such additional benefits. Following a thorough study of the UWO sewer network, considering the practicality of installing sensors and the wastewater characterises, two locations were selected. One represents a mixture of industrial and domestic wastewaters while the other is located downstream of a textile manufacturing complex that has high H2S effluent. A DS00004V01 SulfiLogger™ X1-1020-5mgL has been installed in each location, and H2S and

temperature data have been recorded since March 2024. Data is being processed and thorough data analysis and the development of computational modelling to simulate the impact of heat recovery on H2S are the next steps.

- **EAWAG-05-UWO-Dittmer. Spatio-temporally advanced resolution of rainfall data for ingenious urban hydrological applications (STARR-ING) [EAWAG UWO]**

This is a project of the 2nd TA Call. The TA investigates uses the UWO dataset to assess the required spatio-temporal resolution of precipitation for rainfall-runoff modelling in urban hydrology. The kick-off meeting was held online on March 22, 2024. As a first step, a simulation study was conducted to investigate the effect of increasing the spatio-temporal resolution of precipitation input data for rainfall-runoff modelling in urban hydrology. Due to the increased spatio-temporal resolution of publicly available precipitation data in recent decades, recommended rainfall resolutions from literature (dx=1km, dt=1min) can be tested using the UWO open dataset. Subsequently, the study will examine the limits of downscaling, considering the benefits, expenses and uncertainty associated with this process.

The study will be conducted in accordance with the Methodology and Access Plan (MAP), which has been developed to ensure the integrity and transparency of the research process. The study is divided into three main stages: The first stage involves the collection and preparation of the required data, which will then be aggregated in various temporal and spatial ways. The second stage will involve the execution of the simulations. Finally, the results of the simulations will be compared to the measured data to validate the findings using variograms. A peer-reviewed scientific publication is envisaged.

- **IKT-01-LTF-Verhulst. Investigation of the rehabilitated wastewater pressure pipes in response to pressure surges in operation [IKT — Large Test Facility (LTF)]**

Pressure surges and fluctuations in sewage pressure pipes can be caused by the operation of the pumps. However, the pronounced pressure surges that can frequently occur are an often-unrecognised cause of damage.[70] In order to avoid pressure surges, appropriate measures can be included in the planning of pressure sewers (including pressure surge calculations for longer pipelines, design measures such as the arrangement of aeration and deaeration fittings at high points) and their construction. However, in the past, the pressure surge phenomenon was often not adequately addressed. As a result, consequent damage can be observed in older pressure sewer pipes. In the case of trenchless rehabilitation of pressure sewer pipes using relining, the fundamental question is how the host pipe-liner combination behaves under pressure surge loadings and to what extent it can withstand this. This applies at least to the case where a rehabilitated pipeline is expected to still be subjected to a slight pressure surge load despite the retrofitting of aeration and deaeration valves. There are currently no reliable statements on this,

[70] See on this matter: Thomsen, J.; Morrison, R.; Sangster, T.; Hayward, P.*: Inspection Guidelines for Wastewater Force Mains. Water Environment Research Foundation (WERF)*, Alexandria (Virginia, USA), edited by Jason Consultants LLC, Colombus (Ohio, USA), 2010; Roscher, H.; Rammelsberg, J.; Braun, T.; Brussig, P.; Ahrens, J.; Stiller, B.; Riege, U.; Wildermuth, R.; Gerdes, K.; Zech, H.; Weigt, R.; Kleinau, A.; Rose, A.; Gaebelein, W.; Sommer, J.; Möller, W.; Schlosser, H.-.U.; Böhme, A.; Kröfges, W.: *Sanierung Städtischer Wasserversorgungsnetze - Strategien, Verfahren, Fallbeispiele der Rehabilitation*, Verlag Bauwesen, Berlin, 2000.

because common calculation approaches and currently available publications on scientific investigations are aimed at the host pipe and the situation of an undamaged sewage pressure pipe, but not at a rehabilitated pipe.

This project investigated for the first time the extent to which pressure surge loads can have an influence on a pipeline rehabilitated using a liner. Therefore, an experimental setup was used in IKT's Large Test Facility (LTF) consisting of a wastewater pressure circuit system. A defined section with a length of approx. 8 metres was rehabilitated with a so called close-fit-liner (polyethylene of high density), the system was subjected to a range pressure surge loads that can occur in wastewater pressure pipes. After the trials the results are compared to those of a common simulation programme.

The tests discussed in this report could in principle be modelled well with the simulation programme SIR 3S. Since IKT itself had no pre-existing expertise on the analysis and evaluation of hydraulic data consistent with "water hammer effect" research, it was necessary to hire a subcontractor for the performance of analysis and the interpretation of recorded measurement data. The project was successfully completed in the reporting period. The Data Storage report and the Transnational Access report were prepared.

- **IKT-02-LTF-Beenen. Assessment of Inspection Tools for Rising Mains (AIR) [IKT — Large Test Facility (LTF)]**

Sewage pressure pipes are undoubtedly particularly critical structures in the sewerage system. In the event of a failure, exfiltration, flooding and the associated risks for people and the environment are to be expected. In order to minimize the risk of damage or operational failure of these pipes, regular condition assessments are required. However, the inspection of wastewater pressure pipes poses a problem for many operators. A conventional CCTV condition assessment or leak test as with gravity pipelines is usually not possible due to certain boundary conditions (e.g., lack of access openings, bends, full or partial filling of the pipelines and gradient). New, innovative inspection techniques are required that provide meaningful results on the condition of the sewage pressure pipe. In recent years, some promising inspection techniques have been (further) developed. Within the framework of this TA project, selected innovative inspection techniques have been examined in a test set-up for their performance and application limits. A test setup was constructed in the large-scale test facility of IKT, consisting of a system of wastewater pumps and pressure pipes, with typical damage patterns to be detected by the inspection techniques. Different pipe materials were installed in sections of the test setup to determine their influence on the different inspection techniques. The project was successfully completed in the reporting period.

- **IKT-03-TEST-Carnacina. A novel manhole design improving the hydraulic performance of separate sewer systems [IKT — Hydraulic Test Stand (TEST)]**

This is a project of the 2nd TA Call. The project presents an innovative manhole design suitable for use in narrow streets, particularly in hilly regions providing a cost-effective and space-efficient solutions for separate urban sewer networks to improve the adverse environmental impacts of storm drainage systems. It addresses the challenges of disruptions to city streets and flooding events in downstream networks by mitigating the flow energy inside the storm chamber and

enabling separate sewer pipes to be accommodated in one trench. The new shape of the manhole generates a new flow pattern for stormwater. It is therefore important to understand the hydraulic properties of the newly designed stormwater manhole chamber. The structural and hydraulic properties of a physical scale model of the new design have been assessed at a lab in the United Kingdom, and the results showed that the new manhole design provided structural integrity, stability, and significant improvements in hydraulic performance compared with the conventional system. The project's target is to confirm the hydraulic and structural performance of the new system at a full-scale demonstration facility to facilitate its wide-scale adoption and approval.

As this is a relatively complex test setup, several user meetings were held between IKT and Liverpool John Moores University (LJMU). In this context, different solutions for a test setup were developed by IKT in close coordination with LJMU in order to realize the high flow rates and other test requirements. Considering the time for delivering the materials and for the design and the manufacturing of the manhole, the implementation of the experiment is planned for September/October 2024.

- **IKT-04-TEST-Johansen. Standard development for stormwater management in Sweden [IKT — Hydraulic Test Stand (TEST)]**

This is a project of the 2nd TA Call. Currently, there are no Swedish national standards available for evaluating the performance of prefabricated stormwater solutions (ability to clean and delay stormwater). Within this project, RISE will therefore develop a proposal for a national standard for prefabricated stormwater facilities and, together with IKT test the standard within their "IKT Hydraulic Test Stand (IKT TEST)". The results will be the basis for a standard development process together with the Swedish Institute for Standards (SIS) with the aim of a final adoption during 2024-2025. The overall purpose of the project is to enable a better competitive, innovative and transparent market for prefabricated stormwater solutions for both the suppliers and the procurers.

- **INSA-01-OTHU-Fuchs. In-situ SuDS modelling [INSA — OTHU SuDS]**

The aim of the project "In-situ SuDS Modeling" was to test and, if possible, improve existing models with respect to the use of SuDS for infiltration. The experiments on the OTHU-SuDS research infrastructure went very well after adjustments and adaptation of the experimental facility. An original device for the irrigation of the swale was developed to simulate runoff water linked to rainfall of different return periods. The inflow and soil moisture were measured over a week. The objective was to use these data to improve the capacity of the models to simulate the evolution of the volumetric water content in the soils of SuDS, when extreme events due to climate change occur. Horton model, water balance equation and various empirical functions (power and sigmoid functions) were tested to represent the variation of soil moisture. Results show that Horton model demonstrated the capability to simulate the storage change in the swale (using the averaged values of performed measurements). The sigmoid function seems better than the power law to capture the variation of the soil moisture according to the depth in the soil.

- **INSA-02-OTHU-Prodanovic. NBS pRECision cONdition Assessment (NBS-RECON) [INSA — OTHU SuDS and GROOF]**

This is a project of the 2nd TA Call. The NBS-RECON TA project aims to explore the relationship between plant parameters and the water management performance of urban NBS (Nature Based Solutions). This will be done by monitored two NBS research facilities at INSA: (1) OTHU-SuDS (biofiltration system) and (2) GROOF (green roof), incorporating novel low-cost multi-spectral plant monitoring camera (Plant-O-Meter). The research will identify plant traits that can be used for NBS condition assessment, triggering maintenance actions.

- **INSA-03-GROOF-Förster. Intercomparison of the hydrological Response of Green Roofs Across Scales sites and experimental setups (INDOOR — GRASP [INSA-GROOF]**

This is a project of the 2nd TA Call. The project will conduct a paired green roof experiment, considering open site experimental plots at INSA (GROOF) for which smaller indoor test plots are built in the laboratory at IKT. Measured rainfall from outside is scheduled as rainfall irrigated to the indoor experiment, suggesting that rainfall forcing is equal across experiments. One will test the hypothesis that differences in the design of both experimental types (outdoor vs. indoor) can be explained in a deterministic way through models. This way, this project aims at developing a model which can be utilized to scale between both type of experiments.

- **INSA-04-DRB-Lhomme. Project: OSRAI'Level [INSA — DRB]**

The OSRAI'Level TA project of the 3rd Call will evaluate the performance and reliability of a multi-parameters sensing device using water quality and electro-conductivity analysis to measure water and sediments heights in urban drainage systems. Using all measured parameters, one of its main purposes is to characterize water inflows leading to the identification of the rainfall-induced infiltration component or flow components due to the wrong connection to the drainage system.

- **AAU-01-FREJLEV-Laanearu: Air-water stratified flow in a poorly ventilated sewer main [AAU – FREJLEV]**

This is a project of the 3rd TA Call. The TA focuses on the air-water stratified flow exploration in the Frejlev research station, where the underground pilot-scale sewer reactors will be redesigned to mimic the varying ventilation conditions of sewer main. The experimental research is aiming to gain deeper into the dynamics of the two-phase fluid with significant density difference of immiscible fluids. The H_2S concentration due to air fluxes in the pilot-scale sewer reactors will be studied for different ventilation condition and water detention times. State-of-the-art numerical simulation tools will guide the design of the experimental tests and facilitate their interpretation. The TA is still under the planning phase and is expected to star in November 2024 and be finished February 2025.

Scientific output of the users at the facilities

In the following paragraphs the main scientific outputs expected from the different projects developed within Co-UDlabs are shown grouped by its 17 facilities:

- **UDC-BENS:** the Bens facility was used in the project **UDC-01-BENS-Peña**. Two SMEs and UPCT are working with the data generated during the TA. Photrack is collaborating with Ubertone in the improvement of the estimation of the flow discharge from measured velocities using a CFD model. Ubertone is using the data for developing improved algorithms on the detection of water depth and on the signal postprocessing. Both SMEs are also exploring the suitability of the equipment for water quality determinations in sewer systems and after their projects they can assure that their products are suitable for flow discharge estimation in urban drainage. A communication has been accepted for ICUD congress 2024. A dataset will be released before the end of the project and the team is also working on a data article with the results generated within the TA.
- **UDC-BLOCK:** Block facility was used in the project **UDC-02-BLOCK-Zafra** lead by a Colombian university team. With the help of UDC a ICUD 2024 communication and national Spanish conference Meta 2024 has been submitted and accepted. Two journal articles are in progress dealing with the analysis of the results obtained from the test on wash-off of particulate and heavy metal mobilization in urban catchments. A dataset is in progress and possible data article is to be submitted with the dataset. Besides the previous project, Block facility will host two more projects during the RP3.

  In **UDC-04-BLOCK-Franca** project, the work to develop is part of the MsC of the main visiting researcher and within the research line of the user group members. A joint publication and a comprehensive dataset are expected from the results of the TA related with the onset on motion of large plastics due to rainfall and stormwater runoff.

  In the project **UDC-05-BLOCK-Coupe** we expect that part of the PhD of the main visiting researcher can be developed in the framework of green roof hydrological performance and heat recovery capabilities. A dataset and joint communication activities are planned.
- **UDC STREET** held during the 1st call the project **UDC-03-STREET-Bellos**. Till now the team presented two communications at Novatech 2023 and at the Spanish Water Engineering Conference in 2023. A MSc thesis to be submitted with the modelling of the experiment. The team is working towards a joint publication and a dataset will be uploaded by the end of 2024. Besides the previous project, STREET facility is hosting two more projects.

  UDC-06-STREET-Linnemann project deals with the clogging of permeable pavement and pollutant leaching. The project to develop is part of the PhD of the main visiting researcher and it is expected to publish a joint publication by 2025 and also a dataset.

  UDC-07-STREET-Lutze project started already during RP2 period. The work that is being developed is part of the PhD of the main visiting researcher and a MSc student will be involved during the project. It is expected at least one joint article in a specialized journal and a dataset with the data generated.
- **UFSD–ABFlume** has been used for **USFD-01-ABFLUME-Mignot** and **UFSD-05-ABFLUME-Martins** as well as for several activities in WP8. This has involved several tests looking at hydraulic and flow partitioning energy losses in surcharging urban drainage flows, as well

as pollutant and water quality processes during flood conditions. Outputs can be used for numerical model validation.

- **UFSD–ANNULAR** has been used for **USFD-02-Annular–Regueiro** and **USFD-03-annular-Morato**. USFD-02-Annular–Regueiro involved tests looking at the use of temperature probes for monitoring sediment build up under different hydraulic conditions, the results of the tests indicated that temperature probes are a promising and reliable low-cost alternative to monitoring sediment build up in urban drainage systems. The results were presented at the 16th International Conference on Urban Drainage and published in Water Science and technology.
- At **UFSD – RTCRIG** the projects USFD-07-RTCRIG Vanderverf and USFD-08-RTCRIG Gutiérrez have only recently started, the quality of the data cannot yet be judged. However, the tests align well with growing requirement to monitor, understand and reduce combined sewer overflow spills (due to the revised UWWTD).
- Lastly, at **UFSD – BURIED** the data collected from this facility at **USFD-04-BURIED-Li** project are being processed and the user group have made a presentation - Li et al. (2024) at the 8th IAHR Congress 2024, in Portugal. The project **USFD-06-BURIED-Joksimovic** will start on 3Q of 2024.
- In **DELTARES B-LOOP** facility the **DEL-01-BLOOP-Besharat** started with the modification of the facility by the end of RP2, their experiments on gas pocket transport in pressurized transport pipe systems will start as planned in the spring of 2024. It is too early to envision the nature of the scientific output of their research. **DEL-02-BLOOP-Farhadiroushan** project intents to perform the first experiments on acoustic properties of non-Newtonian flows for concentrated domestic slurry transport processes using fibre optic distributed acoustic sensors (DAS). This dataset is very promising and highly valuable, but the quality of measurements cannot be yet judged, since no data is available yet (experiments planned for September 2024).
- At **EAWAG-HALL** facility the **EAWAG-01-HALL-Bares** TA on water quality monitoring advanced lab trial results from JRA Smart Sensing (WP6) to pilot-scale hyperspectral monitoring, creating a unique dataset with 4,800 hyperspectral acquisitions and 520 reference pollution measurements. Preliminary results are promising for turbidity, ammonium, total nitrogen, and phosphates. Significant findings for WWTP influent and sewer monitoring are expected, and the dataset will be published in Earth-System-Science Data (ESSD) in Q3 of 2025.

  The TA **EAWAG-02-HALL-Langeveld** on sediment quantification yielded first-time ever measurements of the thermal properties of UDS sediments, leading to a peer-reviewed publication.[71] Among other things, this also led to novel applications in gullies, which are currently being tested.

[71] See: https://pubs.rsc.org/en/content/articlehtml/2024/ew/d3ew00825h.

- At the **EAWAG-UWO** facility the **EAWAG-03-UWO-Dittmer** project uses the UWO open dataset, a physics-leveraged machine learning approach has been developed to improve rainfall-runoff predictions. Initial results indicate that this approach enhances model accuracy and reduces computational effort, particularly under extreme weather conditions. The successful transferability of this approach has been reportedly tested for case studies in Austria and Germany. A peer-reviewed publication by the user group is in preparation. The TA **EAWAG-04-UWO-Abdelaal** breaks new ground in assessing the hydrosulphide production, as a function of temperature. This is an important boundary condition for heat recovery from wastewater and therefore very relevant for realistic contributions towards Net Zero. If successful, the results of this project will be submitted for publication in two high-impact peer-reviewed journals. One publication will focus on the measurement campaign providing a comprehensive data analysis of temperature variation, heat transfer and hydrosulphide formation in the network. The other will focus on the simulations and the optimization of potential heat recovery in a sewer network and unwanted formation of hydrosulphite. Lastly, the TA **EAWAG-05-UWO-Dittmer** investigates the required spatio-temporal resolution for urban hydrology sewer design. It is planned to publish the results of this transnational access and collaborative research in at least one peer-reviewed publication. The raw and processed data collected during the TA will be published freely accessible on Zenodo.
- The main scientific outcomes from IKT-LTF can be summarised as follows. **The IKT-01-LTF-Verhulst** project investigated for the first time the extent to which pressure surge loads can have an influence on a pipeline rehabilitated using a liner. The results, which are of great importance for network operators, will be discussed in the relevant national specialised press and presented at appropriate conferences. Both organisations have working groups on company-specific topics that will take up the results. The **IKT-02-LTF-Beenen** project was focused on minimizing the risk of damage or operational failure sewer pipes through new and innovative inspection techniques. Within the framework of this TA project, selected innovative inspection techniques have been examined in a test set-up for their performance and application limits. A test setup was constructed in the large-scale test facility of IKT, consisting of a system of wastewater pumps and pressure pipes, with typical damage patterns to be detected by the inspection techniques. Different pipe materials were installed in sections of the test setup to determine their influence on the different inspection techniques. A comparison of the inspection reports provided by the commercial parties and the actual damages present, show that the inspection techniques can detect a large variety of defects and most of them are able to provide sizing within specified limits. The results, which are of great importance for network operators, will be discussed in the relevant national specialised press and presented at appropriate conferences. Both organisations have working groups on company-specific topics that will take up the results.

  The main expected scientific outcomes from **IKT-TEST** can be summarised as follows. **IKT-03-TEST-Carnacina** will be to check in a scale model the behaviour of the innovative manhole design. At the current status are nor further plans about publications.

Meanwhile, in **IKT-04-TEST-Johansen** the test rig will be to use it to verify a test standard, developed by RISE in Sweden without any test rig, which can be used for this new standard. The idea is to verify the standard, so that it could be use by the SIS – Swedish Institute of Sweden for the Swedish market. Therefore, a workgroup of SIS will be work further with these results. The objective is to write one peer reviewed paper with the Technical University of Lulea, wo is part of the project team.

- At **INSA–OTHU**, in the project **INSA-01-OTHU-Fuchs** an original device for the irrigation of the swale was developed to simulate runoff water linked to rainfall of different return periods. Data were used to improve the capacity of the models to simulate the evolution of the volumetric water content in the soils of SuDS, when extreme events due to climate change occur. Horton model, water balance equation and various empirical functions (power and sigmoid functions) were tested to represent the variation of soil moisture. Results show that Horton model demonstrated the capability to simulate the storage change in the swale (using the averaged values of performed measurements). The sigmoid function performs better than the power law to capture the variation of the soil moisture according to the depth in the soil. The projects **INSA-02-OTHU-Prodanovic** and **INSA-03-OTHU-Förster** didn't start during the RP2 so is to too early to present scientific outputs.

- At **INSA – DBR** the project **INSA-04-DRB-Lhomme** will evaluate the performance and reliability of a multi-parameters sensing device using water quality and electro-conductivity analysis to measure water and sediments heights in urban drainage systems. Using all measured parameters, one of its main purposes is to characterize water inflows leading to the identification of the rainfall-induced infiltration component or flow components due to the wrong connection to the drainage system.

- Lastly, at Aalborg University facility the project **AAU-01-FREJLEV-Laanearu** has as main expected scientific output its novel insight, which will aid in understanding the complexity of stratified flow dynamics in urban drainage system networks and guide the creation of a new generation of models and designs to improve all stages of urban drainage systems management—from design to operational performance and extended system life.

User meetings

This sub-section provides an overview of meetings that facility providers have held with the user-groups from the TA proposals selected for their installations. Table A2.1 in Annex 2 reports a non-exhaustive list of user meetings, including the most relevant ones in the process of arranging and setting up the experimental campaigns at Co-UDlabs facilities. Most monitoring meetings held throughout the performance of the accesses have not been included in the list — as they generally involved specific people on specific technical issues that emerged during the experiments.

1.5 Resources used to provide access to Research Infrastructures

Table 1.10 shows personnel resources (in PMs) reported in the partners financial statements for Transnational Access activities performed during RP2, disaggregated by TA and with a short

description of the tasks performed with those resources in this timeframe. As mentioned above, only four TAs from the 2nd Call (UDC-07-STREET-Lutze, USFD-05-ABFLUME-Martins, DEL-01-BLOOP-Besharat and EAWAG-04-UWO-Abdelaal) have begun in RP2. Since a total of 18 TAs were accepted in the 2nd and 3rd Calls, it is expected that a significant number of pending PMs for WP9 activities and the performance of TAs be spent in RP3.

Table 1.10. Summary of resources to provide TA during RP2

Provider	Installation	Project	PM	Explanation of tasks
UDC	BENS	UDC-01-BENS-Peña	**8.51**	Logistical arrangements for experimental visits and final definition of UFA and UPP. Preparation and adaptation of the facility for the experiments. Development of the experiments. Follow up meetings and collaboration with data processing.
	BLOCK	UDC-02-BLOCK-Zafra	**6.11**	Logistical arrangements for experimental visits and final definition of UFA and UPP. Preparation and adaptation of the facility for the experiments. Development of the experiments. Follow up meetings and collaboration with data processing.
	STREET	UDC-03-STREET-Bellos	**4.22**	Development of the experiments. Follow up meetings and collaboration with data processing.
	BLOCK	UDC-04-BLOCK-Franca	**0.08**	Logistical arrangements for experimental visits and final definition of UFA and UPP
	BLOCK	UDC-05-BLOCK-Coupe	**0.03**	Arrangements for visits to be performed in RP3
	STREET	UDC-06-STREET-Linnemann	**0.03**	Final definition of UFA and UPP; l arrangements for visits to be performed in RP3.
	STREET	UDC-07-STREET-Lutze	**1.78**	Logistical arrangements for experimental visits and final definition of UFA and UPP. Preparation and adaptation of the facility for the experiments. Development of the preliminary experiments and starting of experiments.
USFD	A.B FLUME	USFD-01-ABFLUME-Mignot	**5.20**	Modification to install hot water injection for testing of thermal camera. Testing and commissioning of updated flow control software. Installation of surface obstructions.
	ANNULAR	USFD-02-ANNULAR-Regueiro	**1.96**	High resolution temperature monitoring system was constructed. Sediment sources, cleaned and placed in flume. Commissioning of sensing system and training to operate flume
	ANNULAR	USFD-03-ANNULAR-Morato	**3.46**	Flume commissioned. River sediment sourced and autoclaved. River water sourced, Significant microbiological laboratory support and training.
	BURIED	USFD-04-BURIED-Li	**12.68**	Design support. Construction of full- scale hybrid drainage

Provider	Installation	Project	PM	Explanation of tasks
				system. Involving removal and replacement of 1000m3 of materials and installation of approximately 100m of pipes. Water level sensor system (21 sensors installed) Video, ADV and sediment sampling equipment installed. Training and experimental support provided
	A/B FLUME	USFD-05-ABFLUME-Martins	**5.0**	Modification of system to handle particulates. Installation of injection system and sediment trap. Setting up and testing of PTV system.
USFD	BURIED	USFD-06-BURIED-Joksimovic	**1.55**	Modification of existing hybrid stormwater drainage system. Installation of flow retention devices, add water level sensors and ADV system
USFD	RTCRIG	USFD-07-RTCRIG-Vanderverf	**1.50**	Construction of full scale CSO, and instalation of upstream real time control gat system. Install> 20 water level sensors.
USFD	RTCRIG	USFD-08-RTC-Guitierrez	**1.50**	Construction of full-scale CSO, with interchangeable side weirs. Install>20 water level sensors.
	BETA-LOOP	DEL-01-BLOOP-Besharat	**3.35**	Meetings preparation and organization of the TA, design of the setup.Preparation of the facility, purchasing materials, installation of instrumentation and pre-tests
	BETA-LOOP	DEL-02-BLOOP-Farhadiroushan	**0.29**	Meetings preparation, first visit to the facilities. Designing tests.
EAWAG	HALL	EAWAG-01-HALL-Bares	**3.8**	Design of sampling campaign, upgrade of flume with flow meter, automation of MV.X camera, sample collection, sensor installation and maintenance laboratory analysis, data cleaning and post-processing, data management
	HALL	EAWAG-02-HALL-Langeveld	**2.10**	Upgrade of MONTSE equipment with heater, integrating electronics, low-power data transmission, sediment collection with ERZ utility, laboratory experiments, data management
	UWO	EAWAG-03-UWO-Dittmer	**1.13**	Planning of stay at EAWAG, incl. administrative assistance in VISA process, Field visit, in-depth training on UWO dataset and hydrodyn. Rainfall runoff model, discussion on hybrid modelling approach
	UWO	EAWAG-04-UWO-Abdel	**0.77**	Assistance with design of sampling campaign, sensor installation and maintenance, assistance with sensor repair and manufacturer
	UWO	EAWAG-05-UWO-Dittmer	**0.20**	Assistance with MeteoSwiss radar data handling, raw data availability, design of monitoring campaign (OTT Parsivel DSD monitoring possible)

Provider	Installation	Project	PM	Explanation of tasks
IKT	IKT-LTF	IKT-01-LTF-Verhulst	**5.15**	Adaptation of the test stand for the TA-related research question. Carrying out the experiments and operating the equipment.
	IKT-LTF	IKT-02-LTF-Beenen	**3,63**	Adaptation of the test stand for the TA-related research question. Carrying out the experiments and operating the equipment.
	IKT-HTS	IKT-03-HTS-LJMU	**1.80**	Discussions and meetings to plan the realisation of the test.
	IKT-HTS	IKT-04-HTS-RISE	**0.03**	Meetings to organize the work at the test rig.
INSA	OTHU-Suds	INSA-01-OTHU-Fuchs	**2.5**	Design, installation, monitoring, data processing, publication
	OTHU-Suds	INSA-02-OTHU-Prodanovic	**0.20**	Design and preparation of the experiments
	OTHU-DRB	INSA-04-DRB-Lhomme	**1**	Design, installation, data control
	GROOF	INSA-03-GROOF-Förster	**0.15**	Meetings and site visit to design the experiments

Information of other direct costs related with TA provision to users' projects in RP2 as well as internal invoicing costs from UDC-02-BLOCK- Zafra project and subcontracting costs incurred at IKT-01-LTF-Verhulst project are provided periodic financial report part of RP2.

2 Update of the Plan for Exploitation and Dissemination of Results (PEDR)

An updated version (v2) of the PEDR (Deliverable D4.2) has been uploaded to the Co-UDlabs Zenodo community in November 2022 (M19). Additional minor updates (v2.1) were introduced as the DMP was revised at M20. The latest updated version of the PEDR (v3.1) has been compiled at the end of RP2 (M36) and is currently available in the Zenodo repository.[72]

3 Update of the Data Management Plan (DMP)

Three updated versions of the project's DMP (Deliverable D4.1) have been uploaded to the Co-UDlabs Zenodo community after M36. The latest version was uploaded in April 2024 (M36).[73] This version of the document includes a revised DMP, following internal discussions in ad hoc sessions held at the first (A Coruña, June 27-July 1, 2022) and third (Zürich, January 22-24, 2024) General Assemblies. The main agreements implemented after the revised version of the project DMP were as follows:

- All the datasets derived from coordinated NA, JRA and TA are reported in the Annex 1 of the project DMP. The annex includes an overview of the datasets content, type of data,

[72] See online: https://zenodo.org/record/7261592.
[73] Available online: https://doi.org/10.5281/zenodo.7261555.

license and metadata. This section was coordinated with WP2 activities in order to improve project data harmonization.

- Project Deliverables, Grey literature (congress papers) and journal papers will be uploaded to Zenodo by the partners. UDC will review and approve the uploads into Zenodo community. These documents will be reported in Deliverable 4.2 (Plan for Communication, Dissemination and Exploitation of results) and also in the project website.
- Regarding internal procedures for JRA and TA Data Management Plan, the assembly agreed to maintain the structure of tasks and procedures defined in the previous project DMP with the following remarks:
    - JRA and TA specific Data management Plan can be allocated at DMPonline tool or at local-shared TA project internal SharePoint. A template for the 2nd and 3rd call TA projects DMP is available as Annex 1 in the project DMP (Deliverable 4.1).
    - Datasets from JRA and TA will include a Data Storage Report. The template was shared by UDC to partners in M17 and is included as Annex 3 in the project DMP (Deliverable 4.1).
    - A guide for uploading the datasets to Zenodo for internal and external users was drafted by UDC at M17 and is included as Annex 2 in the project DMP (Deliverable 4.1).

4 Follow-up of recommendations and comments from previous review(s)

Following the first Review in RP1, the consortium was encouraged to involve Central Eastern Europe (CEE) countries more in project activities, underscoring how relevant it was to the goals of Co-UDlabs that the consortium encouraged even more infrastructure operators (municipalities, water and sanitation utilities, private companies, academic institutions, etc.) and community stakeholders from CEE countries to take part in Europe-wide initiatives and collaboration. Co-UDlabs began, accordingly, developing a list of relevant contacts in the area, which included all Eastern European National Contact Points (NCPs) for Research Infrastructures within the Horizon framework; partners in European projects that in the Co-UDlabs Grant Agreement had already been identified as potential partners for project and research synergies; other EU projects coming up on the CORDIS portal through relevant keyword searches — urban drainage, sewers, water management, wastewater, among many others; and European networks in the sector of water and wastewater management. These contacts were sent a direct e-mail, circulating news about the Co-UDlabs project and inviting them to attend the webinar that would launch the 2nd Co-UDlabs TA call in June 2023 while also disseminating the news within their own networks. Co-UDlabs partners also reached out to their own CEE partners and associates, including Eastern European researchers participating in relevant sector conferences and events like, for instance, the 2023 World Green Infrastructure Congress (WGIC). Feedback to these communication efforts was smaller than expected. New

stakeholders from the region, however, registered for the Co-UDlabs newsletter and there certainly was an appreciable increase in CEE countries' participation in Co-UDlabs' webinars and the 2nd and 3rd TA calls.

Another comment from the reviewers mentioned that more attention needs to be paid to WP9 and dissemination activities among infrastructure operators and use all the selected infrastructures. In this regard, all the project facility providers are offering their facilities and even the number of TA projects being developed is higher than the stated in the project proposal. Water utilities were targeted for project activities such as training and TA programme outreach within the second review period. For instance, Co-UDlabs webinar for 2nd TA call was announced through the International Association of Water Service Companies in the Danube River Catchment Area website[74] and weekly digest which was received by more of 800 users in the region. We also plan to involve water utilities and operators through the dissemination of WP2 survey on monitoring CSOs that is released in June 2024.

5 Deviations from Annex 1 and Annex 2

5.1 Tasks

Work plan implementation in RP2 was generally successful and consistent with the project's expected timeline and outcomes. 10 Deliverables out of 16 total scheduled for RP2 were submitted on time. Three re-scheduled Deliverables were eventually submitted within RP2. The remaining three postponed Deliverables have been re-scheduled for RP3. All re-scheduling requests were submitted to the office of the Project Advisor and accepted following due diligence and the provision of reasoned explanations. Two Milestones originally planned for RP2 (MS12 and MS16) were re-scheduled and eventually achieved within RP2. The following is a per-WP list of the main recorded deviations from the schedules, work plans, and expected outcomes of Co-UDlabs' Work Packages. Wherever available, a brief description of the measures and initiatives carried out to address and resolve these issues is included.

Work Package 1

There have been no major deviations from the work plan.

Work Package 2

- **There have been no major deviations from the work plan**. Minor deviations on Harmonisation and Smart Governance will not affect planned activities: activities related to UDS data harmonisation and interoperability through the definition of common standards, protocols, and methods have been realigned by hiring key personnel with expertise in interoperability and adjusting Deliverable timelines.
- Regarding the **survey on Smart Governance**, survey's upscaling from the Swiss context to the partner countries has been more challenging than anticipated. This difficulty has

[74] See: https://www.iawd.at/eng/event/785/details/w/0/co-udlabs-webinar-2nd-global-call-for-transnational-access-proposals/.

stemmed from: i) differing specificities of each country's systems, such as private companies handling tasks instead of municipalities, parishes rather than municipalities in the United Kingdom, the absence of municipal organizations in the Netherlands, among others; ii) subtle terminological differences between Germany and Switzerland; and iii) different formal requirements among partners, e.g., required approval by ethics committees from social science and IT for some partners. The online survey has been rolled out in June 2024, taking advantage of Co-UDlabs' participation at ICUD to promote the survey more extensively.

- Overall, and considering the above, WP2 requires additional time to complete the tasks for Harmonization and Smart Governance. It will then officially request an extension of deadline for Deliverable D2.5, from M41 (September 2024) to M44 (December 2024).

Work Package 3

- **AAU's scheduled PhD course on Sewer processes** had to be delayed for Q3 in 2024. Applications to attend the course when originally planned was too low to effectively carry out the activity. The course has been replanned accordingly at a more convenient time of the year and will be supported by a more effective communication effort.
- Based on the success of the 25th European Junior Scientist Workshop (EJSW) in 2022, Co-UDlabs agreed to support the organisation of the **26th EJSW in 2024**, even though this activity was not initially part of the DoA in the GA. The Workshop will take place right after the end of RP2, but some resources have already been used by Deltares and INSA to organize and coordinate this edition. By the end of RP2, the event already had 20 registered participants. The call to register was still open for early-stage researcher participants from all over Europe and elsewhere.

Work Package 4

- A **factsheet with testimonials and success stories from the various TA projects** carried out within Co-UDlabs was created at M26, to be distributed during the Novatech 2023 conference, the international event in which Co-UDlabs' 2nd TA Call was officially launched. The factsheet has been constantly updated since as new testimonials and stories from newly completed or awarded TAs are received. This specific communication tool — which has proved to be effective to advertise the benefits and positive outcomes of large-infrastructure accesses and extremely efficient in terms of needed resources — was not foreseen in the Grant Agreement but was added to the WP4 toolkit for communication and dissemination by consensus among all partners and facility providers.
- According to the Grant Agreement, a Co-UDlabs **media press kit** was expected to be available at M24 (April 2023). However, it was consensually agreed in the Consortium that — to maximise its impact — it would be more effective to finalise the media press kit during Reporting Period 3, since by then most results, outcomes, and analyses from the TA proposals carried out at Co-UDlabs facilities would be publicly available.

- Co-UDlabs also expected to prepare a **knowledge portfolio** in the project's first year as a bridge between information and academic knowledge already available before Co-UDlabs and the contributions brought forward by the project. It was also planned to update the portfolio yearly via a questionnaire. Eventually since on one side each partner identified and agreed on the background needed to implement the action or exploit the results of the project in the Consortium Agreement already, it was decided by project partners to start the work on exploitation during the last 2 years of the project. Accordingly, the preliminary list of project exploitable results identified in the Grant Agreement was updated under the lead of Euronovia during 2023 and it was included in the third version of the PEDR submitted at M36. Among the list of results identified, the consortium selected three key exploitable results which were further analysed within the Horizon Results Booster seminar in February 2024.

Work Package 5-9

- After the review meeting of RP1 we agreed with the Project Advisor on an updated calendar for the 2nd TA Call for proposals and related Deliverables and Milestones. The changes were accepted in March 2023. Nevertheless, and as explained in Section 1.4.1, due to the necessity to open an extraordinary 3rd TA Call, Deliverable 5.3 was postponed from M33 to M34 with the agreement of the Project Advisor's office following a decision by the Co-UDlabs' General Assembly in Zürich (January 2024).

Work Package 6

- In **sensor testing**, WP6 is experiencing both significant and minor delays for some sensors, even though these will not affect planned work. Issues with key personnel availability at INSA delayed testing of sensors #33 and #43, but neither the successful evaluation of new sensors (as in Task 6.1) nor related scientific publications planned for this WP will be affected by such delays. Minor delays were also incurred due to the need to transfer sensors from EAWAG (a non-EU partner) to UDC in Spain. At UDC, tests of hyperspectral MV/X sensors have been replaced by using the Pollutionkeeper multispectral camera. This device appears to offer better performance due to UV sensing capabilities, spatial imaging for robust elimination of specular reflection, and outlier detection, as well as a higher TRL than the MV/X. This adjustment, made in agreement with the WP6 core group, will not affect progress with the workplan. **Personnel availability issues** at INSA also delayed tests on sensor #31 (see also Section 5.2 below).
- Given these delays in sensor testing, an **extension of the Deliverable D6.2**, from M36 (April 2024) to M44 (December 2024) was agreed with the Project Advisor, following discussions held at Co-UDlabs' 3rd General Assembly in Zürich. The need for comprehensive sensor testing and refinement has necessitated additional resources for the DischargeKeeper (#12) and the ISA probe (#24). For DischargeKeeper, an extended timeline allows for a more thorough examination of the camera's performance. This includes the use of physically based calibration functions and CFD simulations, which facilitate better identification and resolution of potential issues or limitations. For ISA probe and others, this extended testing period ensures meticulous scrutiny and

optimisation of the calibration process, leading to improved accuracy and consistency in data collection. Moreover, the additional time allows the project team to integrate the results of Task 2.1 with Task 6.2 more effectively. This includes discussing potential use cases and business opportunities with relevant stakeholders (see Section 1.2.12).

- In Task 6.3, which focuses on spatial monitoring, it would be beneficial to leverage the synergies with Task 2.3. The results from the postponed survey of Task 2.3, which now includes specific questions informing Task 6.3, can be integrated. This will ensure better consistency of Task 6.3 work with the information collected from the UD community. However, this leaves only a short window for data analysis and integration, which could affect overall progress. Changes in the team structure and temporary staff unavailability at INSA have further impacted INSA's capacity in late-RP2 and early-RP3. As a result, **WP6 will request a 3-month extension of the deadline for Deliverable D6.4** from M41 (September 2024) to M44 (December 2024).
- A non-planned task was conducted between Deltares and the USFD to produce a spatial statistical analysis of the United Kingdom's public data on CSO discharges. This research resulted in a conference article for ICUD 2024, and a journal publication is currently being prepared by a Postdoctoral researcher at the USFD.

Work Package 7

- An **extension of Deliverable D7.4** to M42 was agreed with the Project Advisor, following discussions held at Co-UDlabs' 3rd General Assembly in Zürich. This would allow the laboratory tests in Task 7.2 to be completed at UFSD and IKT. Both the need to hire new experimental staff at USFD and unavailability of the BURIED facility due to the development of the USFD-04-BURIED-Li experimental campaigns made progress on the Deliverable harder, making a postponement inevitable.

Work Package 8

- Regarding WP8, an **extension of Deliverable 8.3 to M42** was agreed upon with the Project Advisor following discussions held after the Co-UDlabs General Assembly in Zürich.
- Additional experiments, not initially foreseen in the Grant Agreement, have been developed at the BLOCK facility of UDC in collaboration with EAWAG. These experiments focus on the long-term performance of green roofs. These additions to the original plan are expected to positively impact project implementation and will also enable Co-UDlabs to enhance the analysis of resilience and sustainability of UD nature-based solutions. This enhancement is in line with recommendations from the Project Advisor's office and independent reviews of project implementation during the first reporting period. Importantly, these additions do not imply any additional costs or resource requirements for WP8 or the project as a whole.
- Furthermore, as introduced in RP1, two tasks were conducted at Deltares related to the evaluation of the performance of UD hydraulic structures, which were not originally planned. Two experimental campaigns and one field campaign were organised to gather new data on gully pot sediment accumulation processes (in collaboration with EAWAG and

UDC), and on the transport of macro-plastic elements through gully pot structures. This research has generated two additional dataset publications (available on Zenodo), two conference papers (for SPN11 in August 2022 and Novatech in July 2023), and two journal article publications (one currently under review and another in preparation).

Work Package 10

- **There have been no major deviations from the expected workplan for WP10**. Reporting tasks for RP1 were all completed in time, and WP10 also supported communication with the office of the Project Advisor and the Financial Officer to amend any inconsistencies in official reporting documents and data.
- As regards internal reporting, and as it was agreed by the consortium, WP10 has refrained from convening internal 'regular meetings' as the key tool for project-wide exchange and communication, opting instead for more targeted, shorter, and more time-efficient WP-based technical meetings for specific JRAs, NAs, or TA providers.
- In RP2, Co-**UDlabs organised two General Assemblies**, even though the institution is expected to normally meet once per year. The Assemblies were essential for practical reasons linked to the project implementation plan. The 2nd General Assembly in Lyon (July 2023) was organised at the same time as the launch event for the 2nd TA Call and was key for all partners and facility providers to distribute tasks and plan installation availability. The 3rd General Assembly in Zürich (January 2024) was organised at the same time as the conclusion of the 2nd and 3rd TA Calls, and it was an opportunity for the consortium to officially close the TA application and evaluation mechanisms and start arranging the last round of TA experiments at Co-UDlabs facilities. The 3rd General Assembly was also a valuable opportunity for the consortium to meet before setting up work for the 2nd Periodic Report. Co-UDlabs plans to have its 4th General Assembly in December 2024, hosted by IKT in Gelsenkirchen (Germany).

5.2 Use of resources

5.2.1 Deviations in partners' structure and composition

In the following section, the report presents deviations in the structure and composition of our partners. Thus far, Co-UDlabs has not experienced any changes in the composition of partners at the consortium level. However, some partners have undergone changes in their personnel composition:

- **UDC.** During RP2, one hired post-doc researcher left their post at UDC with Co-UDlabs in August 2023. The position was then advertised and a new researcher — Dr María Alejandra Pimiento Abella — was hired in February 2024, the recruitment process having been longer than expected because of policies with non-EU personnel hirings. During RP2, Professors Luís Cea and Jerónimo Puertas have had to reduce their participation in the project for sick leave and a new position as UDC vice-Rector respectively. Their duties as WP8 and WP9 coordinators will be assumed by other UDC personnel.

- **UFSD** An experienced post-doc researcher, Dr Ehsan Kazemi, left in June 2023 for a senior position in a specialist modelling consultancy. He was contributing to WP7. He was replaced by two less experienced post-doc researchers, Dr Alemtsehay Seyoum (since March 2024) and Dr Yiqi Wu (since April 2024). Dr Seyoum has strong experience in network modelling and optimisation and will support Task 7.3 in WP7. Dr Wu has strong experience in deterioration modelling and spatial data analysis and will support Task 6.3 in WP6 and Task 7.3 in WP7 until the end of the project. An experienced experimental researcher, Dr Gavin Sailor, joined in November 2023 to support Task 7.2 in WP7. Part-time support from one PhD and one Master's student was also provided for more basic data management tasks. Two Master's students provided support in WP9 for USFD-02-ANNULAR-Regueiro and USFD-03-ANNULAR-Morato. One experienced research technician and one post-doc researcher provided highly specialised part-time support in molecular microbiological characterisation for USFD-03-ANNULAR-Morato.
- **Deltares.** The previous Principal Investigator (PI) at Deltares, Prof. François Clemens-Meyer, left the organisation in November 2022. Dr Antonio Moreno Ródenas took over the coordination tasks of Prof. Clemens as project leader for Deltares in Co-UDlabs. Due to the unique knowledge of Prof. Clemens, his input to specific tasks for Deltares' contribution to the project was still required. Deltares, through Co-UDlabs coordinators at UDC, sought the permission of the Project Advisor to involve Prof. Clemens in specific tasks as a per-service agreement. This permission was granted. Deltares, at the request of Dr Moreno Ródenas, has required the contribution of Prof. Clemens in several tasks. These costs, not initially foreseen in Annex 1, are justified in the financial statement.
- **INSA**. Mathieu Lepot, a post-doc hired for the project, found a permanent position and ended his work in Co-UDlabs at the end of December 2023. The position was advertised from January 2024, and a new post-doc, Dr Yara Arbid, was hired, starting on April 1, 2024. The recruitment process was ultimately longer than expected because of requirements of non-EU personnel hirings. The position, however, was filled only for one month, as the researcher left the INSA team for a stable position. Finally, INSA team leader and WP6 coordinator, Prof. Bertrand-Krajewski, had to resort to sick leave from April to June 2024. Because of this set of conditions, many activities involving INSA have been delayed since December 2023 — especially in WP6 and in INSA TAs.
- **GRAIE.** Dr Katharina Tondera, who had worked for GRAIE during RP1, has since joined another research institution working on topics close to Co-UDlabs'. Because of Dr Tondera's knowledge of WP1 activities, her involvement in the definition of Co-UDlabs' network of UD institutions, partners, and stakeholders, and her academic skills in the field of UD regulations and practices, she has continued to support GRAIE as a private consultant and communicate on project activities at international events. As agreed with the office of the Project Advisor, Dr Tondera's contributions will be regarded as direct costs for GRAIE. Finally, Dr Abigail Legge joined GRAIE in January 2024 to work on Deliverable D1.2 and provide support to Elodie Brelot — GRAIE's PI — on several Co-UDlabs tasks.

5.2.2 Deviations in Work Package expected use of resources

All partners were required to share information on any deviations in their workplan as for the use of person/months (PMs) and resource allocation for specific tasks. Ultimately, current figures in project-wide PMs and budget expenses remain within the limits of a reasonable use of resources and in line with the requirements of the Grant Agreement (FIGURE XX).

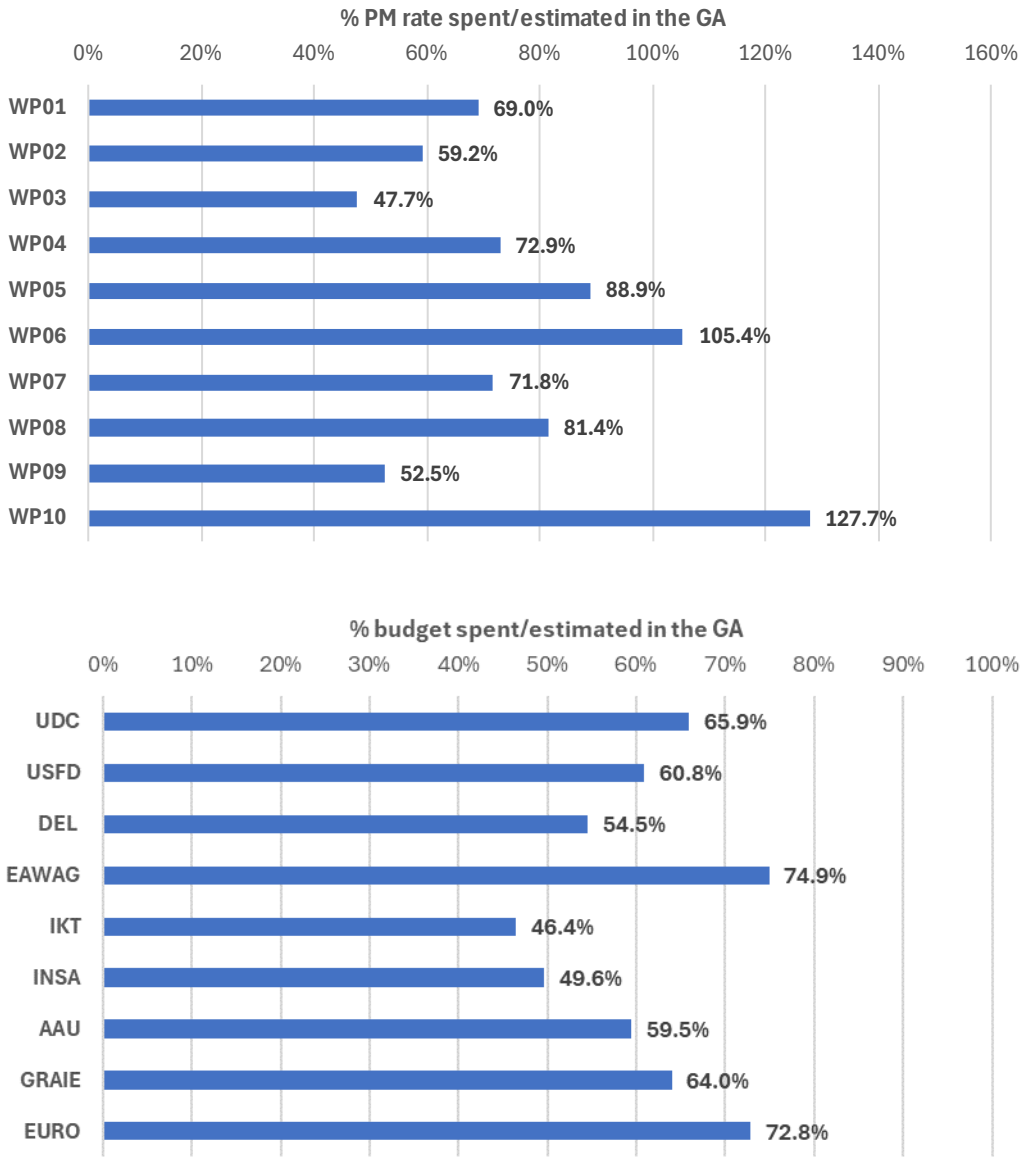

Figure 5.1. Percentage of PM rate spent after RP2 over the estimated PM in the GA per project WP (above) and percentage of budget spent after RP2 over the estimated budget per partner (below)

At the end of RP2, Co-UDlabs reached 75% of its lifetime. Expenditures project-wide, on the other hand, sat at 60% of total budgeted costs. In terms of personnel costs, at the end of RP2 partners had already spent 73.2% of their personnel budget as foreseen in the Grant Agreement — remarkably consistent with the project implementation rate.

To understand the distance actual expenditures (both for direct costs and personnel costs) it is key to understand that such an analysis inevitably treats project implementation as a linear task

development, in which the distribution of work and resources is proportional throughout the duration of the project's 48-month lifetime. This is hardly the case with the actual implementation of the project, in which partners often carry out a workplan that may concentrate peaks of activity at specific times of the project, interspersed with periods in which tasks and expenditures are far more limited. This varying approach to work distribution and resource allocation is essential to make sense of swings and large deltas in the use of resources.

In an INFRAIA project such as Co-UDlabs, moreover, a large part of available budget is allocated to the organisation and provision of transnational access to the research infrastructure — part of the work of **Work Package 9** in Co-UDlabs' DoA. By the end of RP2 in M36, Co-UDlabs' facility providers had only finalised 13 of the total 31 projects that have been accepted via the project's three official TA Calls: it is to be expected that, since a majority of WP9-related activities will be taking place in RP3, connected expenditure in both direct and personnel costs will rise accordingly, closing out the current gap between actual expenditure and foreseen budget.

The prominence of WP9 in budget allocation explains, moreover, gaps for specific partners too: some facility providers have had little to no WP9 expenses in RP2 because access provision in their case has concentrated almost entirely on projects accepted in the 2nd and 3rd TA Calls — which had barely concluded (January 2024) by the time RP2 ended (April 2024). Very nearly all WP9 efforts for INSA (3 projects out of 4), Deltares (2 out of 2), and AAU (1 out of 1) will be undertaken in RP3. A partner like IKT — which has piecemeal contributions to JRAs and NAs and a much more significant budget allocation for TA provision — will likely compensate a low budget expenditure figure at RP2 (46.4%) during the next period, in which the institution will host two more TAs at their facilities, after finalising the first two projects in RP2.

The linearity bias in the analysis of project implementation can also explain some of the peaks and lows in current PM allocation and personnel expenses for some partners. The non-linear distribution of work in Work Package's overall schedule — e.g., no JRA workplan spans the project's whole 48-month duration, and JRA tasks are planned on average to last just a little over 24 months — can explain, for instance, peaks in **Work Package 6** (105.4% of budgeted PMs but, at the end of RP2, WP6 was already at 82.8% of its schedule, with just one task still open). Unexpected difficulties and incidents that may have hindered the research process have also been variables that were hard to take into foreseeable consideration at the proposal-writing stage. Changes in personnel, for instance, have affected the consistency of several partners' work during RP2.

Other WPs, finally, have recorded a trend of lower (direct and personnel) expenditure than originally planned. **Work Package 3**, in particular, records a resource allocation about 30% lower than (linearly) expected budgets at this point of project implementation. Since workplan implementation has been quite consistent, it is to be expected that these figures will not change significantly by the end of the project. Various reasons have contributed to these data: WP3 relied extensively on training, education, and awareness-raising initiatives that — at the time of proposal writing — were more 'conventionally' designed to be in-person events with very high related costs for transportation, mobility, and event planning. Especially because of the restrictions applied during the COVID pandemics, many WP3 activities were then re-thought and

re-designed with hybrid events as the standard, with long-lasting consequence on expenditure that endured well into RP2.

Work Packages like **WP4, WP5, WP7, and WP8** all show a distribution of resources which is more consistent with a linear approach, mostly because their activities distribute more proportionally across the duration of the project. WP5 tasks, in particular, refer to the organisation and arrangements of the TA Calls, and its workplan has been implemented almost entirely (with a consistent budget expenditure of almost 90%). Communication and dissemination tasks for WP4 (72.5% expenditure at 75% of project lifetime) are evenly distributed across project's lifetime and resource allocation has been very consistent to date.

Work Package 10, finally, shows a higher resource allocation than originally anticipated. Issues with underfunded project management had already been clear in RP1, during which WP coordinators at UDC had already requested more PMs for WP10 to fully contribute to work-intensive tasks such as inter-WP coordination and streamlined organisation of the Transnational Access programme. The request was accepted, and more PMs have been allocated for the final 22 months of the project's lifetime. All these elements considered, the current ratio of actual/expected personnel costs for WP10 (127.7%) would be down to 93% had this extension been computed in the WP's overall budget since the beginning of Co-UDlabs. More details are provided below.

The remainder of this section provides an analysis of budget execution deviations in RP2 with specific explanations per partner.

Universidade da Coruña

In WP10, UDC had already anticipated at the end of RP1 an increase of PMs available for project management. Especially after the inception of the Transnational Access programme, it became clear for UDC staff that the resources originally budgeted for WP10 would not have been sufficient to support project management, partner coordination, and the consistency of TA-related tasks across the whole research infrastructure. Accordingly, UDC had foreseen the allocation of additional PMs to cover the project manager's position expanding from part-time to full-time. This change has been quantified in about 11.5 PMs more to be added to WP10 throughout the remaining lifetime of the project, with 5.5 PMs being reallocated specifically in RP2. These resources are funded via both a restructuring of UDC's PMs across all project WPs and a reallocation of Other Direct Costs funds for travelling and internal mobility that could not be spent as originally planned.[75] This budget and workplan modifications were agreed with the office of the Project Advisor in March 2023.

Due to the communication efforts and related activities required to successfully set up the Transnational Access programme, UDC has experienced higher costs than anticipated in WP4. Even though most of TA-related engagement and communication activities have now ended, UDC anticipates an increase in PM dedication to this WP overall at the end of the project (128.7%

[75] These expenses refer mainly to budgeted travel costs for IAB and EEP meetings and activities that were eventually conducted entirely online.

at the end of RP2), especially considering that additional dissemination efforts will be required to provide visibility to the initial scientific and academic results of the TA projects.

More generally, resource allocation for the rest of the WPs has been in line with expectations. WP7 is an exception: the UDC team has eventually contributed less than initially expected, but tasks developed by other project partners have made sure that the final output of WP7 would not be jeopardize in the least by UDC's reduced contribution.

Additionally, in Q4 of 2023 all of UDC as an entity went through a sudden change of administrative and management software and infrastructure, which has heavily affected working capacity of UDC teams — including Co-UDlabs coordination — for a few months, including all of Q1 of 2024 and a meaningful part of RP2. This has especially affected UDC's ability to file costs and pay suppliers, with a related slowing down of activity and initiative by UDC researchers and staff. Proximity to the end of RP2 has also made it necessary for UDC to re-distribute a marginal part of RP2 direct costs to RP3. These exceptions will be duly explained in RP3's technical and financial reports.

Finally, UDC has recorded and submitted expenditure as internal invoicing costs which was not originally foreseen in the Grant Agreement. At the proposal-writing stage, UDC's centralised analysis laboratories (SAI) did not yet meet the requirements for these costs to be eligible as internal invoicing. Accordingly, expected costs for these services were allocated to Subcontracting. Since late 2021, however, SAI services have begun complying with H2020 requirements for Internally Invoiced costs. After RP1, UDC requested to the Project Advisor office to transfer part of the Subcontracting budget to Internal Invoicing to perform specific analyses that could not be autonomously developed at CITEEC laboratories. This request was accepted and in RP2 a total amount of EUR 5,651.05 was allocated to Internal Invoicing for laboratory analyses as part of UDC-02-BLOCK-Zafra's TA activities. It is expected that approximately an additional EUR 12,000 will be required for Internal Invoicing in RP3 for final analyses of heavy metals required in TA activities of UDC-02-BLOCK-Zafra, UDC-06-STREET-Linnemann, and UDC-07-STREET-Lutze. These costs will be covered with funds originally budgeted for Subcontracting.

University of Sheffield

Overall, USFD has experienced limited deviations from planned expenditure and utilised 76% of the anticipated PM when through 75% of the project's lifetime. USFD has 7.3 PMs left of total 10 PMs budgeted for WP6. This lower budget execution is partially explained by delays in the provision of CSO data for Task 6.3 and staff composition changes: newly-hired Dr Wu has only recently begun working on Task 6.3, and no more issues in WP6 implementation are foreseen for the remainder of the project. USFD has 3.41 PMs left from of the 24 total PMs budgeted for the WP7. The modelling effort in this WP was impacted by Dr Kazemi's departure, with Dr Seyoum's arrival the defect modelling has started but at a lower monthly PM cost rate. Accordingly, it is expected that the PM budget for WP7 will in fact be exceeded by the end of the project, but by a modest amount. On WP8, USFD budgeted 18 PMs at proposal-writing stage, and at the end of RP2 a total 20.14 PMs had already been allocated to WP8 (112%). USFD, however, have also provided additional funds from the United Kingdom's domestic research council to support the activities in WP8. USFD will be expected to have allocated additional 18 to 20 PMs on WP8 tasks

by the end of the project. On WP9, USFD budgeted 57 PMs and still has 17.8 PMs available. USFD is about to move into an intense period of experimental activity at the start of RP3 for the provision of two accesses: USFD-07-RTCRIG-Vanderverf and USFD-08-RTCRIG-Gutierrez. WP9 activities are in progress for the preparation of USFD-06-BURIED-Joksimovic: it is likely the remaining WP9 PM resources will have been fully allocated by the end of RP3.

Deltares

WP3 required a higher allocation of PMs than originally expected. Deltares was eventually involved in the arrangement of more events than anticipated — e.g., planning and coordination of the 26th EJSW implied an unforeseen commitment of PMs by Deltares too. Unforeseen efforts in JRAs by Deltares staff were also required in WP8: these tasks addressed the creation of datasets on the performance of gully pots (urban hydraulic structures); on a field campaign in the Netherlands to monitor thermal processes in gully pot sediments in different municipalities (Delft, The Hague, and Rotterdam); and on transportability of buoyant macro-plastic elements through gully pots. Even if initially unforeseen, these activities have in fact allowed Co-UDlabs to take maximum advantage of synergies between the partners' diverse expertise and resources, joining EAWAG and UDC's work on the development of thermal sensor boxes with Deltares' physical experimental capacity and process knowledge on sediment accumulation in gullies.

Additionally, Deltares also allocated additional efforts to WP6 in support of USFD's activities — providing expertise in spatial statistical analysis techniques and obtain insights from the United Kingdom's CSO datasets.

Since Deltares did not host any TAs from the 1st TA Call, WP9 had low resource usage throughout RP2. Deltares' BLOOP facility, however, will host two experimental campaigns from the 2nd TA Call. Most of the budgeted personnel resources for WP9 will therefore be used in RP3.

EAWAG

In WP6, resources for Task 6.1 were reallocated for adequate testing of sensors #12 and #24. Additionally, EAWAG requested and obtained an authorisation from the Project Advisor office to use specific resources for sensor calibration by the manufacturers themselves — thus ensuring a more impartial evaluation of the product as partners can avoid biased recommendations due to partially-limited expertise in the adjustment of tested sensors. The service is cost-neutral for Co-UDlabs, following internal reallocation of resources between budget categories.

IKT

In Task 8.1.2 of WP 8, IKT carried out tests on permeable pavement as a basis to define standard methods for permeable pavement performance assessment, while also increasing the understanding of clogging processes. An effort of 2.32 PMs was spent on this WP compared to the 2.10 PMs originally budgeted for it, as the implementation of the tests was more work-intensive than estimated. During the planning phase of the tests, it was agreed that simulating an operating period of 40 years — instead of 10 years as originally planned — made more technical sense for the sake of the tests. This increased complexity in the test plans required additional time and personnel resources.

However, actual costs were significantly lower than estimated (a total of EUR 1,361.97 compared to a budget of EUR 12,000) as some of the test materials were internally provided by UDC, while others (pavement, stones, and other test materials) were rescued from IKT residual material that could then be used at no cost.

INSA

Additional resources have been allocated to WP6 to carry out extra unplanned work, especially for the development of the UDMT in Task 6.2, which required more work than originally expected.

On the contrary, WP8 has so long required fewer INSA resources than planned, since INSA's involvement in the WP will increase only by the end of 2024, i.e., in RP3. Resources allocated to WP9 were also limited in RP2, given that INSA's only 1st TA Call access was completed early in the period and required no excess costs. Most TA-related activities for INSA (three proposals from the 2nd and 3rd TA Calls) will be undertaken in RP3.

Because of different changes in team structure (see also Section 5.2.1 above), work on WP6 and WP9 tasks had been delayed more often than expected. However, considering that only 12 months are left in the project's lifetime and that a whole new recruitment process would take up most of such time, INSA has decided not to fill vacancies in their team, and will re-distribute the remaining PMs across current personnel.

Euronovia

Due to the impact of COVID restrictions and the subsequent interdiction to travel, but also due to an effort to re-arrange meetings and events, costs related to participation in project meetings and external events were limited: of the EUR 17,100 travel costs planned in the GA, only EUR 3,814 were spent by Euronovia in both RP1 and RP2. Budget originally allocated to the organisation of the exploitation workshop (EUR 3,000) was not used because the seminar on exploitation was organised for free within the Horizon Results Booster programme in February 2024. Only a minor part of Euronovia's budget allocated to exhibition booths (EUR 12,000) was eventually spent — mainly for printing promotional material. In fact, costs for the planned booth set-up at the Novatech conference in July 2023 were eventually covered by the event organisers. A booth set-up at ICUD 2024 is also being covered by event organisers at the Technological University of Delft as part of the arrangement for Co-UDlabs' participation in the conference's programme. As for personnel resources, communication and dissemination activities carried out within WP4 ultimately required more PMs than originally expected: in particular, the creation of the project's motion-design video; online project activities (e.g., active communication on social media and the website);[76] and communication initiatives for the advertisement and management of the 2nd and 3rd TA Calls have all been more demanding than it was foreseen. Since Euronovia considers that remaining available personnel resources will not be sufficient for activities yet to be performed in Reporting Period 3, it is expected that in RP3 Euronovia will allocate part of unspent budgeted Other Direct Costs to cover personnel costs.

[76] See also the KPIs summary in Annex 1 for more details.

5.3 Unforeseen subcontracting

Not applicable for Co-UDlabs during the second reporting period.

5.4 Unforeseen use of in-kind contribution from third party against payment or free of charges

Not applicable for Co-UDlabs during the second reporting period.

Annex 1. Key Performance Indicators (KPIs)

			Target audiences											
Dissemination/ communication channel	Tool	When (and where, if relevant)	Academics and researchers	Industry/ Practitioners	Government/ Policymakers	EU and intl. networks	National tech networks	EU projects	General public/ advocacy groups	KPI	Target (by the end of the project)	M36 April 2024	Partner(s) in charge
Events to be organised by the project partners	2 Early-stage researchers' seminars	June 27-28, 2022 and September 2024	●							Number of participants	**20**	**33**	**UDC, USFD**
	- 25th European Junior Scientists Workshop (EJSW) on UD monitoring	May 15-21, 2022	●							Number of participants	**22**	**20**	**INSA**
	PhD course on Sewer Processes	2023 --> October 7-11, 2024	●							Number of participants	**40**	**-**	**AAU**
	Industrial workshop on flow rate determination of pumping stations and hydraulic structures (1 day)	November 17, 2022		●			●			Number of participants	**20**	**45**	**DEL**
	Uncertainty assessment in UD monitoring data (2 days)	2023--> 6-7 March 2024		●			●			Number of participants	**Max. 12**	**8**	**INSA**
	Applied course on UD metrology (4 days)	July 16-19, 2024		●			●			Number of participants	**Max.12**	**-**	**UDC**
	2 IKT-association practice workshops (2 days)	November 3-4, 2021 and 2025	●	●			●			Number of participants	**20**	**59**	**IKT**
	Webinars and online lectures	2022 to 2025 1) September 21, 2022 2) May 16, 2023 3) June 12, 2023 4) March 15, 2024	●	●		●	●	●		Number of webinars	**6**	**4**	**IKT / all research institutions**
										Number of attendees	**30**	**1st webinar: 18 2nd webinar: 50 3rd webinar: 35 4th webinar: 25**	
	Side event at the Sewer Processes and Networks (SPN) conference	August 23, 2022 (Gratz, Austria)		●		●	●			Number of participants	**30**	**18**	**INSA/GRAIE**
	Side event at the NOVATECH conference	July 2023 (Lyon, France)		●		●	●			Number of participants	**30**	**49**	**GRAIE**

Dissemination/ communication channel	Tool	When (and where, if relevant)	Target audiences: Academics and researchers	Industry/ Practitioners	Government/ Policymakers	EU and intl. networks	National tech networks	EU projects	General public/ advocacy groups	KPI	Target (by the end of the project)	M36 April 2024	Partner(s) in charge
	2 webinars and 2 hackathons	Before the TA calls the access to the research infrastructures	●	●		●	●			Number of attendees	**60**	**1st webinar/hackathon: 100/61 2nd webinar/hackathon: 28/28**	**UDC**
	2 dissemination workshops on smart governance	Side events of IWA specialized working groups conferences or meetings 1) September 13, 2022 2) WP6 webinar in 2024		●	●	●	●	●		Number of participants	**30**	**1st workshop: 40**	**EAWAG**
	3 Workshops related with results of JRAs	Side events of IWA specialized working groups conferences or meetings: 1) UDMT workshop - August 23, 2022; 2) UDMT workshop - October 18, 2023; 3) WP7 online workshop in 2025 (IWA WG data and models)	●	●		●	●	●		Number of participants	**40**	**1) 18 2) 11**	**INSA, USFD, UDC**
	Final Info Day	At the end of the project	●	●	●	●	●	●	●	Number of attendees	**50**	**-**	**Euronovia, UDC**
Participation in external events and conferences	Scientific conferences	2022, 2023, 2024, 2025	●	●	●	●	●			Number of conferences	**15**	**14**	**All research partners**
	National technical events	2022, 2023, 2024, 2025		●			●			Number of events	**10**	**14**	**All partners**
	Fairs in innovation and technology related events	2022, 2023, 2024, 2025		●		●	●	●		Number of exhibitions	**3**	**2**	**All partners**
	Open-science events	2022, 2023, 2024, 2025						●	●	Number of events	**10**	**3**	**All partners**
Communication /dissem	Project branding (logo, visual identity, communication templates, project leaflet, etc.)	At the beginning of the project	●	●	●	●	●	●	●	1	**1**	**1**	**Euronovia**

Dissemination/ communication channel	Tool	When (and where, if relevant)	Target audiences: Academics and researchers	Industry/ Practitioners	Government/ Policymakers	EU and intl. networks	National tech networks	EU projects	General public/ advocacy groups	KPI	Target (by the end of the project)	M36 April 2024	Partner(s) in charge
	Communication package	M6	●	●	●	●	●	●	●	1	**1**	**1**	**Euronovia**
	Flyer	M6	●	●	●	●	●	●	●	Number of flyers distributed	**2000**	**1000**	**Euronovia**
	Brochure	M24	●	●	●	●	●	●	●	Number of brochures distributed	**2000**	**1000**	**Euronovia**
	Newsletter	Every 6 months, starting M6	●	●	●	●	●	●	●	Number of issues	**8**	**4**	**Euronovia**
										Number of subscribers	**100**	**481**	**Euronovia**
	Press release	At the start and at the end of the project	●	●	●	●	●	●	●	Number of press releases	**2**	**1**	**Euronovia**
	Articles in specialized magazines	Whole project duration	●	●		●	●			Number of articles	**2**	**0**	**All partners**
	Timeline infography	At the end of the project	●	●	●	●	●	●	●	Number of infographics	**1**	**2 infographics on results of TA**	**Euronovia**
	1 Motion design video	September 2022	●	●	●	●	●	●	●	Number of views on YouTube	**500**	**312**	**Euronovia**
	Website	Whole project duration	●	●	●	●	●	●	●	Number of visits	**100/month**	**90/month**	**Euronovia**
										Number of news	**1 news/ month = 48**	**68**	
	LinkedIn page	Whole project duration	●	●	●	●	●	●	●	Number of members	**200**	**482**	**All (leader: Euronovia)**
										Number of posts	**1/month = 48**	**114**	
	Twitter account	Whole project duration	●	●	●	●	●	●	●	Number of followers	**200**	**205**	**All (leader: Euronovia)**
										Number of tweets	**1/week= 208**	**259**	
	Youtube channel with videos and interviews	from M12	●	●	●	●	●	●	●	Number of videos	**15**	**21**	**All (leaders: Deltares/IKT)**
										Number of views /videos	**500/video**	**1235 in total**	

Dissemination/ communication channel	Tool	When (and where, if relevant)	Target audiences: Academics and researchers	Industry/ Practitioners	Government/ Policymakers	EU and intL networks	National tech networks	EU projects	General public/ advocacy groups	KPI	Target (by the end of the project)	M36 April 2024	Partner(s) in charge
	Media press kit	M24 and M48	●	●	●	●	●	●	●	Number of press kit	**2**	**-**	**Euronovia**
	Public relations and media coverage	Whole project duration			●	●	●	●	●	Number of external articles in the media	**15**	**18**	**All partners**
Publications	Scientific publications (peer-reviewed research papers) and related datasets	From 2022	●	●						# of scientific papers	**10**	**5**	**All research partners**
										# of datasets	**20**	**10**	
										Number of visits/downloads of data-sets on Zenodo	**3000**	**2716**	
	Technical articles (international and national journals)	From 2022		●		●	●			# of technical papers	**8**	**0**	**All research partners**
	Conference proceedings	From 2022	●	●		●	●			# of conference papers	**15**	**15**	**All research partners**

Annex 2. User-group meetings

Table A2.1 lists relevant user-group meetings held by facility providers and representatives of the visiting groups in charge of Transnational Access projects. The list is not exhaustive and includes meetings held in preparation and arrangement of the experimental campaigns. For more details on user meetings and the arrangement of TAs, please see Section 1.4 above.

Table A2.1. Summary of the users' meetings with TA users during RP2

Project Acronym	Date	Venue	Approx. number of attendees	Description
UDC-01-BENS-Pena	20/01/2023	online	4	UFA preparation
UDC-01-BENS-Pena	03/02/2023	online	4	UFA preparation
UDC-01-BENS-Pena	24/02/2023	online	4	UFA preparation
UDC-01-BENS-Pena	18/04/2024	in-person	7	TA starting meeting and planning sensors installation
UDC-01-BENS-Pena	02/05/2024	online	4	TA follow-up meeting
UDC-01-BENS-Pena	05/06/2023	in-person	5	Ubertone's visit
UDC-01-BENS-Pena	16/06/2023	online	4	TA follow-up meeting
UDC-01-BENS-Pena	29/06/2023	online	4	TA follow-up meeting
UDC-01-BENS-Pena	12/07/2023	online	4	TA follow-up meeting
UDC-01-BENS-Pena	19/07/2023	online	4	TA follow-up meeting
UDC-01-BENS-Pena	19/09/2023	in-person	9	Sharing results, coordination and planning publications
UDC-01-BENS-Pena	01/12/2023	online	4	Conference communication and follow-up
UDC-01-BENS-Pena	11/12/2023	online	4	Conference communication and follow-up

Project Acronym	Date	Venue	Approx. number of attendees	Description
UDC-01-BENS-Pena	09/02/2024	online	5	Photrack CFD modelling meeting
UDC-01-BENS-Pena	01/03/2024	online	4	Follow up meeting
UDC-02-BLOCK-Zafra	09/01/2023	online	3	UFA preparation
UDC-02-BLOCK-Zafra	19/01/2023	in-person	5	TA Kick off meeting
UDC-02-BLOCK-Zafra	17/02/2023	online	4	TA follow-up meeting
UDC-02-BLOCK-Zafra	24/02/2023	online	4	TA follow-up meeting
UDC-02-BLOCK-Zafra	17/03/2023	online	4	TA follow-up meeting
UDC-02-BLOCK-Zafra	31/03/2023	online	4	TA follow-up meeting
UDC-02-BLOCK-Zafra	14/04/2023	in-person	5	Meeting after finalising experimental campaign to define next steps
UDC-02-BLOCK-Zafra	11/05/2023	online	4	Analysis of results
UDC-02-BLOCK-Zafra	26/05/2023	online	4	Analysis of results
UDC-02-BLOCK-Zafra	29/06/2023	online	4	Analysis of results after TA
UDC-02-BLOCK-Zafra	14/07/2023	online	4	Analysis of results after TA
UDC-02-BLOCK-Zafra	27/07/2023	online	4	Analysis of results after TA
UDC-02-BLOCK-Zafra	07/09/2023	online	4	Analysis of results after TA
UDC-02-BLOCK-Zafra	11/10/2023	online	4	Analysis of results after TA
UDC-02-BLOCK-Zafra	16/11/2023	online	4	Analysis of results after TA
UDC-02-BLOCK-Zafra	15/12/2023	online	4	Conference communication and follow-up
UDC-02-BLOCK-Zafra	25/01/2024	online	4	Follow up meeting
UDC-02-BLOCK-Zafra	08/03/2024	online	4	Joint paper meeting

Project Acronym	Date	Venue	Approx. number of attendees	Description
UDC-02-BLOCK-Zafra	19/04/2024	online	4	Joint paper meeting
UDC-03-STREET-Bellos	25/11/2022	online	6	meeting during TA with all user group online
UDC-04-BLOCK-Franca	15/12/2023	online	5	First contact meeting. Coordination of TA
UDC-04-BLOCK-Franca	28/02/2024	online	5	Preparation of UFA
UDC-05-BLOCK-Coupe	19/12/2023	online	7	First contact meeting. Coordination of TA
UDC-06-STREET-Linnemann	12/12/2023	online	5	First contact meeting. Coordination of TA
UDC-06-STREET-Linnemann	20/12/2023	online	4	Coordination meeting
UDC-06-STREET-Linnemann	14/02/2024	online	3	Preparation of UFA
UDC-07-STREET-Lutze	14/12/2023	online	7	First contact meeting. Coordination of TA
UDC-07-STREET-Lutze	29/01/2024	online	4	Preparation of UFA
UDC-07-STREET-Lutze	11/03/2024	in-person	6	Preliminary test discussion
UDC-07-STREET-Lutze	03/04/2024	in-person	7	TA starting meeting
USFD-02-ANNULAR-Regueiro	28/11/2022	online	3	First contact with the user-group and involved technicians
USFD-02-ANNULAR-Regueiro	21/04/2023	online	3	Preparation and design of the experimental campaign
USFD-04-BURIED-Li	03/11/2022	online	3	Planning meeting
USFD-04-BURIED-Li	21/11/2022	online	2	Planning meeting
USFD-04-BURIED-Li	24/11/2022	online	3	Planning meeting
USFD-04-BURIED-Li	28/11/2022	online	4	Planning meeting
USFD-04-BURIED-Li	05/12/2022	online	2	Planning meeting
USFD-04-BURIED-Li	07/12/2022	online	3	Planning meeting

Project Acronym	Date	Venue	Approx. number of attendees	Description
USFD-04-BURIED-Li	14/12/2022	online	3	Planning meeting
USFD-04-BURIED-Li	06/01/2023	online	4	Planning meeting
USFD-04-BURIED-Li	10/01/2023	online	4	Planning meeting
USFD-05-ABFLUME-Martins	15/11/2023	online	2	Planning meeting
USFD-05-ABFLUME-Martins	15/12/2023	online	2	Planning meeting
USFD-05-ABFLUME-Martins	02/02/2024	online	2	Planning meeting
USFD-05-ABFLUME-Martins	15/03/2024	online	2	Planning meeting
USFD-06-BURIED-Joksimovic	15/04/2024	online	3	Planning meeting
USFD-07-RTCRIG-Van der Werf	21/11/2023	online	5	Planning meeting
USFD-07-RTCRIG-Van der Werf	01/12/2023	online	5	Planning meeting
USFD-07-RTCRIG-Van der Werf	19/01/2024	online	5	Planning meeting
USFD-07-RTCRIG-Van der Werf	21/02/2024	online	5	Planning meeting
USFD-07-RTCRIG-Van der Werf	06/03/2024	online	5	Planning meeting
USFD-07-RTCRIG-Van der Werf	25/03/2024	online	5	Planning meeting
USFD-07-RTCRIG-Van der Werf	19/04/2024	online	5	Planning meeting
USFD-07-RTCRIG-Van der Werf	29/04/2024	online	5	Planning meeting
USFD-08-RTCRIG-Gutierrez	05/10/2023	online	2	Planning meeting
USFD-08-RTCRIG-Gutierrez	21/11/2023	online	5	Planning meeting
USFD-08-RTCRIG-Gutierrez	19/01/2024	online	5	Planning meeting
USFD-08-RTCRIG-Gutierrez	06/03/2024	online	5	Planning meeting

Project Acronym	Date	Venue	Approx. number of attendees	Description
USFD-08-RTCRIG-Gutierrez	25/03/2024	online	5	Planning meeting
USFD-08-RTCRIG-Gutierrez	26/03/2024	online	2	Planning meeting
USFD-08-RTCRIG-Gutierrez	19/04/2024	online	5	Planning meeting
USFD-08-RTCRIG-Gutierrez	29/04/2024	online	5	Planning meeting
DEL-01-BLOOP-Besharat	09/02/2024	online	6	Preparation and design meeting
DEL-01-BLOOP-Besharat	29/04/2024	in-person	6	Reception of Elias and Rui-Ling at Deltares/ Preparation of experimental setup/
DEL-02-BLOOP-Farhadiroushan	15/09/2023	online	8	Discussion on potential use of iDAS systems in pipe transport experiments/
DEL-02-BLOOP-Farhadiroushan	12/10/2023	online	8	Discussion on non-newtonian wastewater flows and measurements/
DEL-02-BLOOP-Farhadiroushan	11/04/2024	in-person	1	Visit to the beta-loop facility, discussion on measurement configuration/
EAWAG-01-HALL-Bares	16/11/2022	in-person	1	Visit of the facility, demonstration of hyperspectral imaging and flume
EAWAG-01-HALL-Bares	16/11/2022	online	5	Progress meeting
EAWAG-01-HALL-Bares	23/03/2023	online	7	Kick Off of the flume experiment, experimental design and sampling layout
EAWAG-01-HALL-Bares	07/12/2023	online	6	Kick Out meeting of the flume experiment, publication plan, DMP, next steps and responsibilities
EAWAG-02-HALL-Langeveld	01/03/2023	online	5	Kick out meeting of the MONTSE sediment experiment, next steps
EAWAG-03-UWO-Dittmer	25/09/2023	in-person	4	Kick Off of visit to EAWAG, plan of visit, introduction to UWO municipality
EAWAG-03-UWO-Dittmer	26/09/2023	in-person	4	Field visit UWO Fehraltorf
EAWAG-03-UWO-Dittmer	29/09/2023	in-person	6	Details on dataset, sensors and maintenance protocols
EAWAG-03-UWO-Dittmer	30/09/2023	in-person	6	Details on SWMM model building and calibration
EAWAG-03-UWO-Dittmer	31/09/2023	in-person	5	Introduction of physic-leveraged ML methods to urban rainfall-runoff studies
EAWAG-03-UWO-Dittmer	03/10/2023	in-person	3	Closing meeting of PROBURB visit-week

Project Acronym	Date	Venue	Approx. number of attendees	Description
EAWAG-04-UWO-Abdelaal	20/03/2024	in-person	3	Field visit to UWO, installation of H2S sensors
EAWAG-04-UWO-Abdelaal	26/04/2024	online	6	Kickoff and progress meeting
EAWAG-05-UWO-Dittmer	22/03/2024	online	6	Kick-off meeting and workplan STARR-ING
IKT-01-LTF-Verhulst	06/08/2022	in-person	6	Determination of experimental setup and test procedure in detail
IKT-01-LTF-Verhulst	01/06/2023	in-person	9	Monitoring of experiments, exchange of operational experience in-situ
IKT-01-LTF-Verhulst	29/06/2023	in-person	4	Discussing results and observations
IKT-01-LTF-Verhulst	10/08/2023	in-person	8	Discussing results and observations
IKT-02-LTF-Beenen	08/12/2022	online	17	User-group meeting
IKT-02-LTF-Beenen	24/04/2023	in-person	4	Pipeline Inspection
IKT-02-LTF-Beenen	03/05/2023	in-person	4	Pipeline Inspection
IKT-02-LTF-Beenen	22/05/2023	in-person	4	Pipeline Inspection
IKT-02-LTF-Beenen	30/05/2023	in-person	4	Pipeline Inspection
IKT-02-LTF-Beenen	07/06/2023	in-person	8	Update on project development
IKT-03-TEST-Carnacina	05/01/2024	online	6	Kick-off-meeting to discuss first steps
IKT-03-TEST-Carnacina	02/02/2024	online	6	Discussing details of User Facility Agreement, discussing requirements of the test setup
IKT-03-TEST-Carnacina	29/02/2024	in-person	5	Discussing test setup and procedure in detail, discussing procurement of materials
IKT-03-TEST-Carnacina	06/03/2024	online	4	Discussing test setup and procurement of materials, discussing design of the manhole
IKT-03-TEST-Carnacina	12/04/2024	online	5	Discussing test setup and procurement of materials, discussing design of the manhole
IKT-04-TEST-Johansen	15/03/2024	online	4	Discussing test stand and procedure and dates for implementation
INSA-01-OTHU-Fuchs	12/04/2024	online	3	Preparation of a poster for ICUD in Delft

Project Acronym	Date	Venue	Approx. number of attendees	Description
INSA-02-OTHU-Prodanovic	14/02/2024	online	4	Preliminary discussion about objectives and feasibility
INSA-02-OTHU-Prodanovic	14/02/2024	in-person	4	Internal discussion about objectives and feasibility
INSA-02-OTHU-Prodanovic	22/03/2024	online	9	Workshop with all partners to discuss available data and models
INSA-03-GROOF-Förster	11/07/2023	online	4	Preliminary discussion about objectives and feasibility
INSA-03-GROOF-Förster	27/11/2023	in-person	4	Pre-design of the experimental work (design, size, instrumentation, protocols, etc/)
INSA-04-DRB-Lhomme	08/04/2024	online	4	Preliminary discussion about the implementation of the IJINUS prototype
AAU-01-FREJLEV-Laanearu	09/02/2024	online	4	Initial meeting/first contact
AAU-01-FREJLEV-Laanearu	16/04/2024	online	4	Project discussion, planning experimental setup and inspection visit
AAU-01-FREJLEV-Laanearu	12/06/2024	online	9	Preparation and design meeting