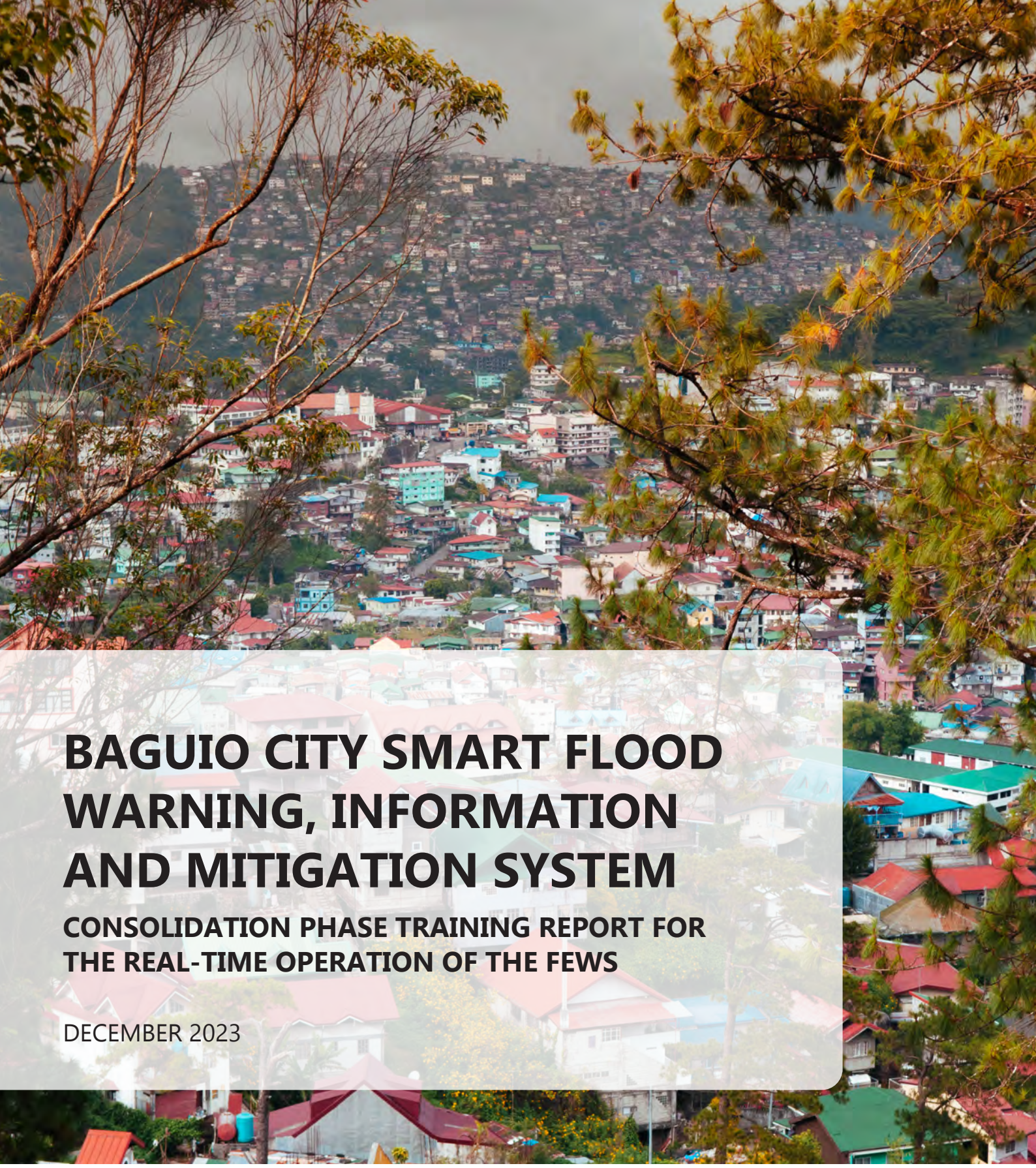

BAGUIO CITY SMART FLOOD WARNING, INFORMATION AND MITIGATION SYSTEM

CONSOLIDATION PHASE TRAINING REPORT FOR THE REAL-TIME OPERATION OF THE FEWS

DECEMBER 2023

ASEAN AUSTRALIA SMART CITIES TRUST FUND
Asian Development Bank

Australian Government
Department of Foreign Affairs and Trade

ADB

Project name	Baguio FEWS Consolidation Phase
Document type	FINAL
Version	1
Date	2023/12/07
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ABBREVIATIONS

AASCTF	ASEAN Australia Smart Cities Trust Fund
ADB	Asian Development Bank
API	Application programming
ASEAN	Association of Southeast Asian Nations
BCDEO	Baguio City District Engineering Office
CDRRMO	City Disaster Risk Reduction and Management Office
DA	Data Assimilation
DFAT	Department of Foreign Affairs and Trade (Australia)
DHI	Danish Hydraulic Institute
DOST	Department of Science and Technology (Philippines)

DOST-ASTI	DOST Advanced Science and Technology Institute
DOST-CAR	DOST Cordillera Administrative Region
FEWS	Flood Early Warning System
GEDSI	Gender Equity, Disability and Social Inclusion
LGU	Local Government Unit
NetCDF	Network Common Data Form
OTJ	On-the-job (Training)
PAGASA	Philippine Atmospheric Geophysical and Astronomical Services Administration
SOP	Standard Operating Procedures
WRF	Weather Research Forecasting

EXECUTIVE SUMMARY

In April 2019, the Asian Development Bank (ADB) approved the establishment of the ASEAN Australia Smart Cities Trust Fund (AASCTF or the Fund) under the Urban Financing Partnership Facility, with financing provided by the Government of Australia, through its Department of Foreign Affairs and Trade (DFAT).

The ADB, though the AASCTF, supported Baguio City in implementing the Smart Flood Early Warning, Information and Mitigation System project. The project assisted the city with both the planning for flood mitigation and the delivery of the services of flood early warning and responses, using smart technologies.

Following the completion of the pilot project in April 2023, the Baguio FEWS Consolidation Phase kicked off in May 2023. The activities of the consolidation phase build on what has been achieved and delivered under the pilot project. It covers activities supporting the Baguio LGU with continued technical assistance throughout the 2023 monsoon, which includes testing and troubleshooting throughout the monsoon, as well as finetuning the system during the post-monsoon phase. The 2023 monsoon test has been the first full-scale test of the Baguio FEWS during real-time operation.

This report provides an overview of the 2023 Baguio FEWS Training Program and the program effectiveness. Furthermore, the report assesses the ability of the Baguio LGU to operate and maintain the system beyond 2023.

The 2023 Baguio FEWS Training Program included instructor-led online training sessions, on-site On-the-Job (OTJ) training, and real-time operation of the FEWS. The members of the established FEWS O&M team participated in the training activities.

The results from satisfaction and knowledge surveys demonstrate that the training program successfully achieved its objective of increasing the local capacity to operate and maintain the FEWS. The knowledge level for the average participant improved from 3.1/5 prior to the training kick-off in April 2023 to 4.4/5 after completion of all training activities in October 2023. The participant satisfaction has remained high throughout the training program.

A key lesson from this training is the significance of maintaining ongoing and transparent communication between trainers and participants. Employing surveys before and after each training session enabled participants to self-assess their knowledge, express their needs, and enabled trainers to adjust the sessions based on the feedback received.

Furthermore, the training highlighted the importance of bringing participants together in a single location for OTJ training. This approach significantly enhances interaction and fosters collaboration among the O&M team members. The in-person setting encourages the exchange of ideas and the sharing of experiences, ultimately leading to more effective teamwork and knowledge transfer

Throughout the Consolidation Phase, the capacities within the FEWS O&M team steadily increased during the 2023 Baguio FEWS training program, however, the team is not yet at the professional level required to enable the team to be fully responsible for the operation and maintenance of the FEWS without technical support. Thus, further training and technical support for finetuning, testing, and operating the system will be needed beyond 2023.

The following annual training activities are recommended for 2024-2025:

- Pre-monsoon: online expert advice sessions and guidance in completion of pre-monsoon SOPs and pre-monsoon in-person OTJ training to ensure proper initiation of real-time monsoon operation
- Monsoon: expert advice and as-needed support in real-time operation, maintenance and troubleshooting of the FEWS
- Post-monsoon: online expert advice as-needed and guidance in completion of post-monsoon SOPs and post-monsoon in-person OTJ training to ensure proper assessment of system performance and implementation of post-monsoon SOPs.

1. INTRODUCTION

Source: Adobe Stock

1.1 ASEAN AUSTRALIA SMART CITIES TRUST FUND PROGRAM

In April 2019, the Asian Development Bank (ADB) approved the establishment of the ASEAN Australia Smart Cities Trust Fund (AASCTF or the Fund) under the Urban Financing Partnership Facility, with financing provided by the Government of Australia, through its Department of Foreign Affairs and Trade (DFAT). The Fund's envisioned impact aligns with ADB's Strategy 2030, as well as ASEAN's Sustainable Urbanization Strategy which aims to promote high quality of life, competitive economies, and sustainable environments. The expected outcome of the Fund will be that systems and governance in participating ASEAN cities are improved through the adaptation and adoption of digital solutions, across three core functional areas (planning systems, service delivery and financial management), in particular by way of:

- Strengthening city planning processes by enhancing the collection, storage, analysis and utilization of data on geospatial platforms;
- Promoting the use of integrated and smart network management systems to strengthen operational systems and to improve quality and efficiency of service delivery;
- Introducing integrated financial management information systems to improve institutional credit worthiness and fiscal standing.

AASCTF acts as a mechanism for facilitating and channeling resources and financing for eligible projects, as well as activities agreed between DFAT and ADB for project preparation, implementation, and capacity development.

1.2 BAGUIO CITY SMART FLOOD EARLY WARNING, INFORMATION AND MITIGATION SYSTEM PROJECT

The ADB, through the AASCTF, supported Baguio City in implementing the Smart Flood Early Warning, Information and Mitigation System project. The project assisted the city with both the planning for flood mitigation and the delivery of the services of flood early warning and responses, using smart technologies. The project outcome has been improved flood early warning system, responses, and mitigation measures of Baguio City. The project has three key outputs:

- Smart Flood Early Warning System (FEWS) established and operational;
- Real-time data capture system established in four river basins in Baguio City;
- Flood Mitigation Action Plan prepared.

Furthermore, the project enhanced local technical capacities through the implementation of a Targeted Capacity Building Program to enhance the sustainable delivery of FEWS. The FEWS has been developed with Baguio Local Government Unit (LGU) and other key stakeholders to improve community disaster preparedness, raise awareness, and ensure ownership.

The activities and achievements of the project have been documented in the twelve (12) deliverables produced. The Final Report from December 2022 summarizes the project achievements, findings, and outputs. The pilot project under the AASCTF came to an end in April 2023 concluding in the preparation of a Final Roadmap for the Baguio FEWS Consolidation Phase.

1.2.1 CAPACITY BUILDING AND TRAINING PROGRAM

The Targeted Capacity Building Program to Enhance Delivery of a Sustainable FEWS, implemented under the pilot project, started at the end of December 2021 and ended in November 2022. Its main objective was to garner increased confidence in the ability of the project intervention to foster long-term sustainability of the established FEWS by securing the required local capacity for operating and utilizing the FEWS as an active risk mitigation instrument beyond the timeframe of the pilot project.

The targeted training and capacity building program consisted of the following key elements:

1. **3-module online training program:** This component was led by DHI and supported by Ramboll. It focused on giving the participants in the training program a general understanding of Flood Early Warning Systems and training in the different types of DHI software used in the specific FEWS being implemented under the "Baguio City Smart Flood Warning, Information and Mitigation System" pilot project. The training program was carried out as online (self-paced, instructor-led, and expert advice) modules based on the ACADEMY by DHI eLearning platform.
2. **On-the-job (OTJ) training:** This was led by Ramboll and included specific hands-on training and support related to the Baguio flood models and the specific FEWS developed by Ramboll in collaboration with the LGU.

A total of thirteen (13) professionals were selected to participate in the training and capacity building program following nomination from the LGU. The selected participants are presented in Appendix A. Seven (7) staff members from the LGU participated in the program, and they constitute the "core group," who has the main responsibility for operation and maintenance of the FEWS. A "peer group" consisting of six (6) professionals outside of the LGU were also selected to participate in the program. The peer group participants come from local public institutions which include three (3) participants from two (2) universities, one (1) from PAGASA, one (1) from DOST-CAR, one (1) from the District Engineering Office (BCDEO), and their main role will be to support the core group. The participant team composition changed during initial phase of the program with the addition and replacement of a few trainees. From May 2022, the participant team remained intact with ten (10) trainees, six (6) core group members and four (4) peer group members, participating in the program activities outlined.

The training activities and program effectiveness of the Targeted Capacity Building Program to Enhance Delivery of a Sustainable FEWS have been documented in four reports prepared under the pilot project: Scoping and Training Course Design Report, Capacity Building Program Module 1 Evaluation Report, Capacity Building Program Module 2 Evaluation Report, and Capacity Building Program Module 3 Evaluation Report.

1.3 BAGUIO FEWS CONSOLIDATION PHASE

Following the completion of the pilot project in April 2023, the Baguio FEWS Consolidation Phase kicked off in May 2023.

The activities of the consolidation phase build on what has been achieved and delivered under the pilot project. It covers activities supporting the Baguio LGU with continued technical assistance throughout the 2023 monsoon, which includes testing, running, troubleshooting throughout the monsoon, as well as finetuning the system during the post-monsoon phase. The 2023 monsoon test has been the first full-scale test of the Baguio FEWS during real-time operation.

Furthermore, the consolidation phase builds on the technical capacities within the Local Government Unit (LGU) through on-the-job (OTJ) training and implementation and testing of the prepared FEWS standard operating procedures (SOPs). Further enhancement of system governance and support for partnership agreement will strengthen the foundation for effective and sustained operation and maintenance of the system. The activities further enhance the LGU's capacity to utilize the FEWS as an active risk-mitigation tool serving as an integral element within the overall vision of Baguio City to become a truly resilient, dynamic, and smart city.

The main activities are divided in three phases following the operational phases of the FEWS: pre-monsoon, monsoon, and post-monsoon. The main activities and deliverables of the Consolidation Phase are outlined in Table 1 1. The roadmap for the consolidation phase is seen in Figure 1 1.

Table 1.1: Deliverables and activities for Baguio FEWS Consolidation Phase

Stage	Deliverables	Timeline
D1 Pre-Monsoon Assessment and Report	• Development of bias correction factors for weather and rainfall (WRF) forecast data and update FEWS • Improvement of model data assimilation and error calculation in real-time operation • Online capacity building sessions in SOPs • In-person OTJ training for SOPs to prepare the FEWS O&M team for real-time operation	Delivered September 2023
D2 Monsoon Assessment of FEWS operation and post-monsoon system updates, city graduation and SOP updates report	• Daily operation, maintenance, and troubleshooting of FEWS, and training in real-time monsoon SOPs • Conduct system performance assessment based on real-time operation and complete system updates including data adjustments of rainfall-runoff (NAM) parameters and other required system updates • Complete updates to SOPs and operation and maintenance framework based on learnings from • real-time operation • In-person OTJ training in SOPs for assessment of system performance and completion of post-monsoon system updates • Post-monsoon operation coordination including gold city graduation and scale-ups as necessary • Assessment of additional technical support required	December 2023
D3 Training Report for real-time operation of the FEWS (this report)	• Documentation of training activities • Assessment of team performance and program effectiveness • Assessment of local ability to operate the system beyond 2023	November 2023

Source: Ramboll

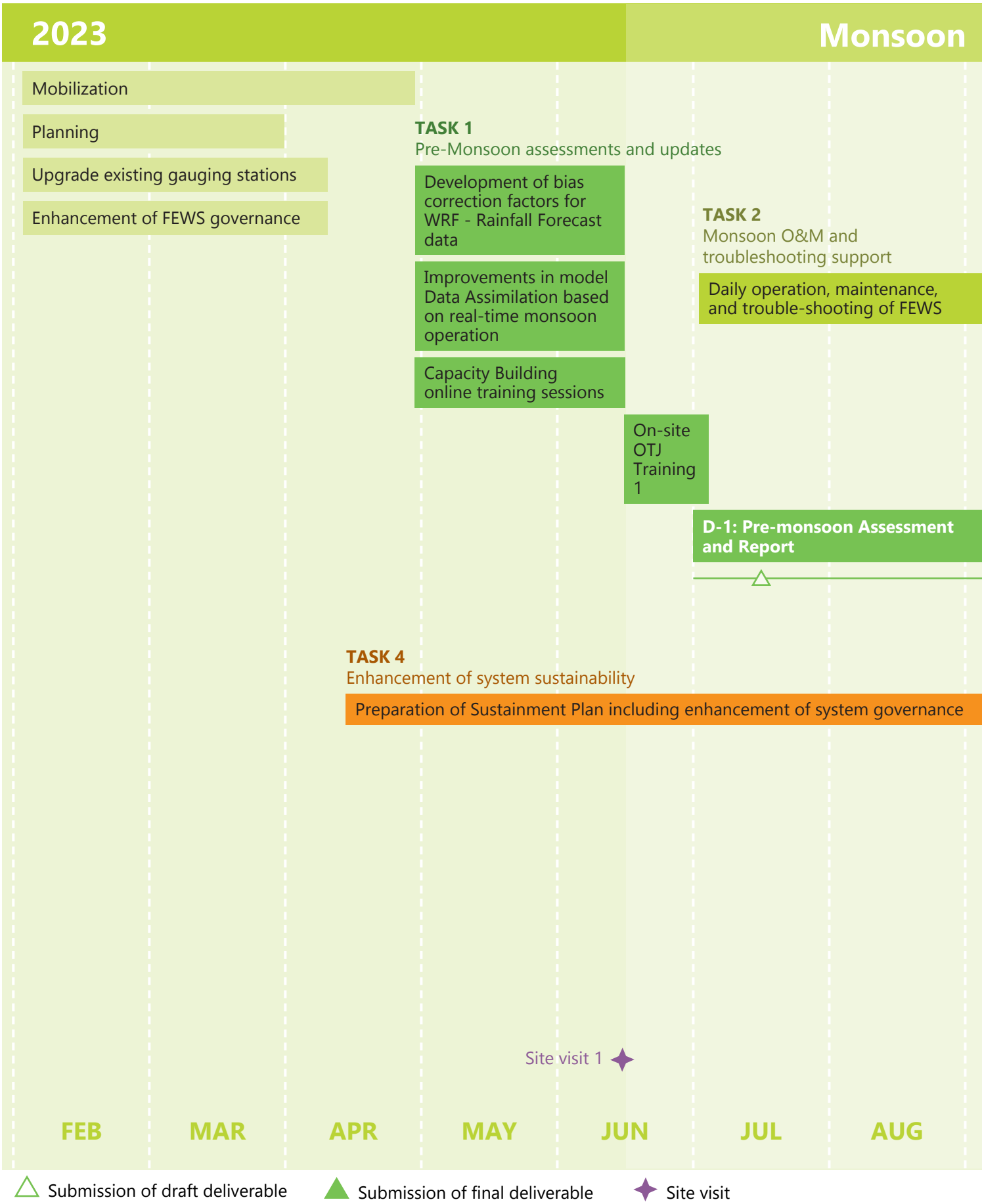
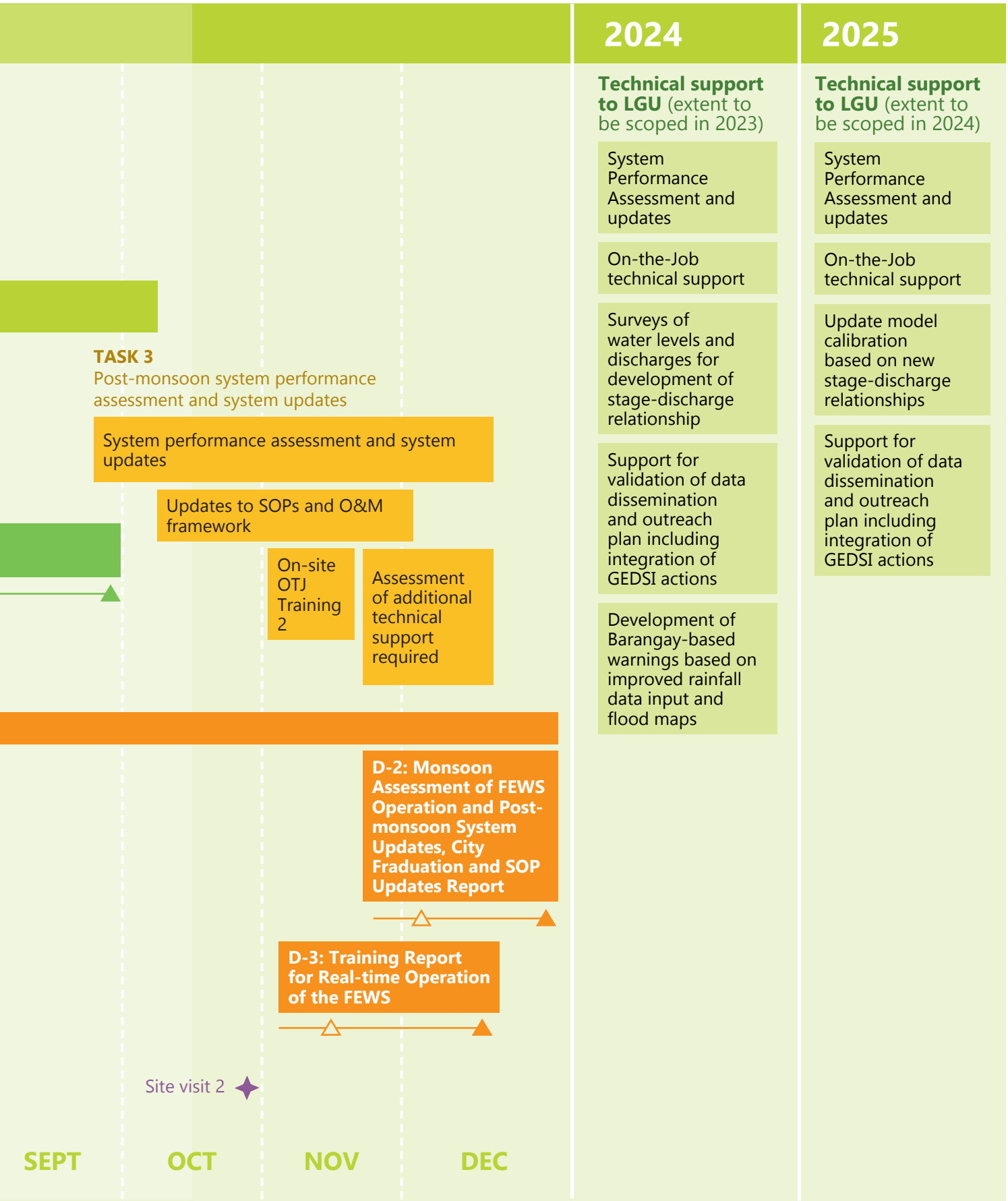


Figure 1.1: Overview of the consolidation phase for Baguio FEWS
Source: Ramboll


2024
2025
Technical support to LGU (extent to be scoped in 2023)
System Performance Assessment and updates
On-the-Job technical support
Surveys of water levels and discharges for development of stage-discharge relationship
Support for validation of data dissemination and outreach plan including integration of GEDSI actions
Development of Barangay-based warnings based on improved rainfall data input and flood maps
Technical support to LGU (extent to be scoped in 2024)
System Performance Assessment and updates
On-the-Job technical support
Update model calibration based on new stage-discharge relationships
Support for validation of data dissemination and outreach plan including integration of GEDSI actions
TASK 3
Post-monsoon system performance assessment and system updates
System performance assessment and system updates
Updates to SOPs and O&M framework
On-site OTJ Training 2
Assessment of additional technical support required
D-2: Monsoon Assessment of FEWS Operation and Post-monsoon System Updates, City Fraduation and SOP Updates Report
D-3: Training Report for Real-time Operation of the FEWS
Site visit 2
SEPT
OCT
NOV
DEC

1.4 REPORT STRUCTURE

This Training Report is the last report out of three reports to be produced in the Baguio FEWS Consolidation Phase. The report builds on the achievements documented in the twelve (12) reports produced in the Baguio City Smart Flood Early Warning, Information and Mitigation System pilot project and in the first report (D1) of the Baguio FEWS Consolidation Phase. The primary intended audience comprises technical personnel from the LGU and ADB. Other intended audiences comprise policymakers, city planning officials and the broad general audience with knowledge and/or interest in smart flood early warning systems, real-time monitoring systems, city resilience, data storage and management.

The aim of this report is to provide an overview of the 2023 Baguio FEWS Training Program and to demonstrate the program effectiveness as well as the ability of the Baguio LGU to operate and maintain the system.

- Section 1 introduces the AASCTF program, describes the project rationale and overall activities;
- Section 2 introduces the rationale behind the training program;
- Section 3 describes the main activities of the training program;
- Section 4 presents an evaluation of program effectiveness;
- Section 5 summarizes the conclusions and ability of the LGU to operate and maintain the system and recommended next steps for training.

A member of the Baguio FEWS Operations and Maintenance (O&M) Team cleans the solar panel inside Sadjap Station
Source: Ramboll

2. CAPACITY BUILDING PROGRAM IN THE BAGUIO FEWS CONSOLIDATION PHASE

The team prepares for a station visit in Baguio
Source: Carlo Valdez

2.1 PURPOSE OF CONTINUED CAPACITY BUILDING

The capacity building activities of the consolidation phase builds on the completed *Targeted Capacity Building Program to Enhance the sustainable delivery of FEWS* and OTJ training completed in 2022. Towards the end of the pilot project in 2022 it was apparent that there was a need for improved capacity of Baguio City to better utilize the established FEWS to facilitate appropriate, applicable, and timely early warning through completion of necessary finetuning, troubleshooting, and testing of the system and enhancement of FEWS governance.

The purpose of the 2023 Baguio FEWS Training Program implemented under the Baguio FEWS Consolidation Phase was therefore to strengthen local capacity for independent operation and maintenance of the FEWS in parallel with implementing, testing, and refining the system. The goal was to increase the confidence level within the locally established FEWS Operation and Maintenance (O&M) Team in operating and maintaining the FEWS.

2.2 FEWS O&M TEAM ROLES AND RESPONSIBILITIES

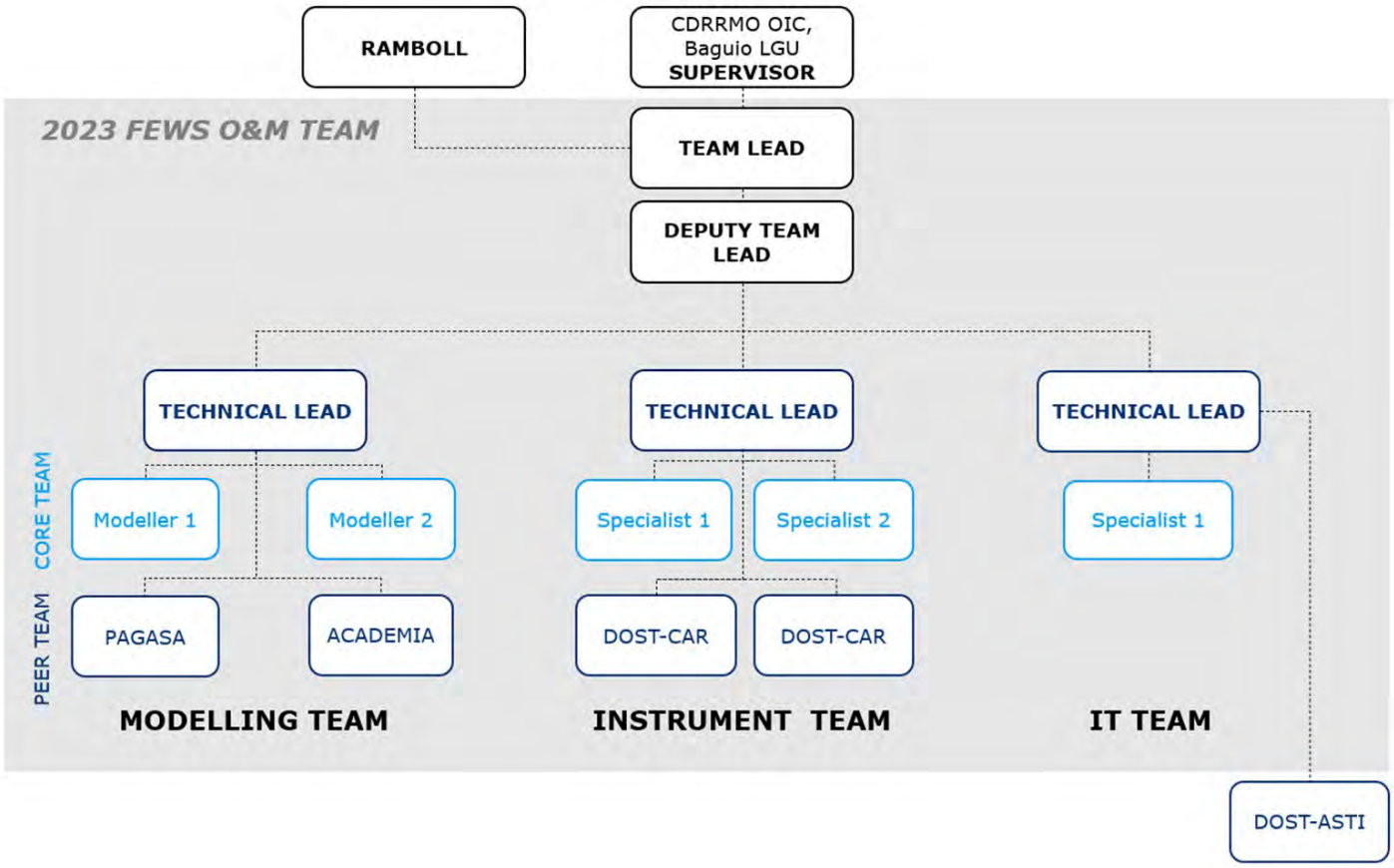
To enable effective operation and maintenance of the FEWS for Baguio, a FEWS O&M Team has been formed comprising professionals who has participated extensively in the FEWS training activities. The ownership of the FEWS is anchored at the Local Government Unit (LGU) and thus, the O&M core team consists of LGU staff with support from a peer team of representatives from academia and selected relevant partner agencies (i.e., PAGASA, DOST-CAR).

The O&M team oversee operation and maintenance of the FEWS throughout all operation phases:

- Preparation phase: Pre-monsoon period (expected April)
- Application phase: Monsoon period (expected May – October)
- Assessment phase: Post-monsoon period (expected November – March)

The organizational structure of the O&M team can be seen in Figure 2 1. The well-defined team structure provides guidance to all team members by outlining the official reporting relationships that govern the workflow of the team and enhances the foundation for efficient operation and communication. The team consists of twelve (12) professionals, the ten (10) participants from the capacity building program, an additional new technician hired in the LGU to support the instrument team, and an additional professional from DOST-CAR. The members of the O&M team are presented in Appendix A. Overall supervision of the FEWS O&M team is with the Officer-in-Charge (OIC) at the CDRRMO who has the mandate to coordinate directly with high-ranking government officials and guide in decision-making. The O&M team is led by the Team Lead supported by the Deputy Team Lead. The team is sub-divided in three smaller teams: the Modelling team, the Instrument team, and the IT team. Each team has a team lead and core team specialists from the LGU. Peer support is defined for each team.

Figure 2.1: Structure of the FEWS Operation and Maintenance (O&M) team



Source: Ramboll

To secure effective operation of the FEWS, Standard Operating Procedures (SOPs) have been prepared. The purpose of a SOP is to carry out operations correctly and always in the same manner. The SOPs contribute to enhancing sustainability by outlining specific activities and tasks to be undertaken and serving as a guide throughout the different operational phases. The responsibilities for the operation and maintenance tasks and implementation of their respective SOPs are distributed separately between the roles/teams as outlined in Table 2 1.

Table 2.1: O&M roles and responsibilities

Team Lead			**Deputy Team Leader**		
The Team Lead is responsible for the operation and maintenance of the FEWS through **management of team members** and provision of **effective guidance.** The team lead is expected to be **supervising, managing, and motivating team members** through all operational phases.			The Deputy Team Leader is responsible for supporting the Team Lead in all day-to-day activities and will be the point of contact for any issues when the Team Lead is not available. They will provide advice, guidance, and project and task oversight for team members.		
Technical Lead of the Modelling Team	**Modelling Team**	**Technical Lead of the Instrument Team**	**Instrument Team**	**Technical Lead of the IT Team**	**IT Team**
The Technical Lead of the Modelling Team is responsible for managing the Modelling Team and ensuring completion of all SOPs assigned to the Modelling Team. The Technical Lead will provide guidance for members of the Modelling Team and ensure that the team has the required knowledge and skills to complete their assigned tasks. The Technical Lead will communicate directly with the Team Lead on task progress and concerns.	The Modelling Team is responsible for completing the SOPs assigned to the Modelling Team with guidance from their Technical Lead. The team is responsible for maintaining all hydraulic and hydrodynamic models and undertake troubleshooting in case of model failures. The team members will communicate directly with the Technical Lead of the Modelling Team on task progress and concerns.	The Technical Lead of the Instrument Team is responsible for managing the Instrument Team and ensuring completion of all SOPs assigned to the Instrument Team. The Technical Lead will provide guidance for members of the Instrument Team and ensure that the team has the required knowledge and skills to complete their assigned tasks. The Technical Lead will communicate directly with the Team Lead on task progress and concerns.	The Instrument Team is responsible for completing the SOPs assigned to the Instrument Team. The team is responsible for maintaining all real-time monitoring stations and undertake troubleshooting in case of any station failures. The team members will communicate directly with the Technical Lead of the Instrument Team on progress and issues.	The Technical Lead of the IT Team is responsible for managing the IT Team and ensuring completion of all SOPs assigned to the IT Team. The Technical Lead will provide guidance for members of the IT Team and ensure that the team has the required knowledge and skills to complete their assigned tasks. The Technical Lead will communicate directly with the Team Lead on task progress and concerns.	The IT Team is responsible for completing the SOPs assigned to the IT Team. The team is responsible for maintaining the IT infrastructure including the front-end and back-end systems of the FEWS. The team members will communicate directly with the Technical Lead of the IT Team on progress and issues.

Source: Ramboll

The 2023 training program was directed at the team members of each of the three sub-teams (not focused on the team leader roles). The scope was to train the O&M team members as superusers by bringing them confidence in operating and maintaining the respective parts of the FEWS they are responsible for within their team, through the three operation phases. Part of this also included understanding the roles and responsibilities of the other O&M sub-teams.

2.3 LOGIC OF THE TRAINING DESIGN

In line with the 2022 training activities, the 2023 Baguio FEWS Training Program consisted of a mix of online training sessions and on-the-job (OTJ) training.

The program consisted of the following training modes:

1. **Instructor-led online training sessions:** These sessions took place during the pre-monsoon phase and focused on giving the participants a recap of modelling, data, and instruments (from the 2022 program).
2. **On-site OTJ training:** These sessions took place during the pre- and post-monsoon phases. The focus of the first session was preparation for real-time operation, understanding SOPs and roles and responsibilities throughout the monsoon, and the second session focused on post-monsoon SOPs, system assessment and updates, and planning for system sustainment.
3. **Real-time operation of the FEWS:** This took place during the monsoon season where the O&M team operated and maintained the system in real-time with support from the technical project team. This training aiming at enhancing the teams' experience in FEWS operation and troubleshooting and ability to apply their technical skills acquired.

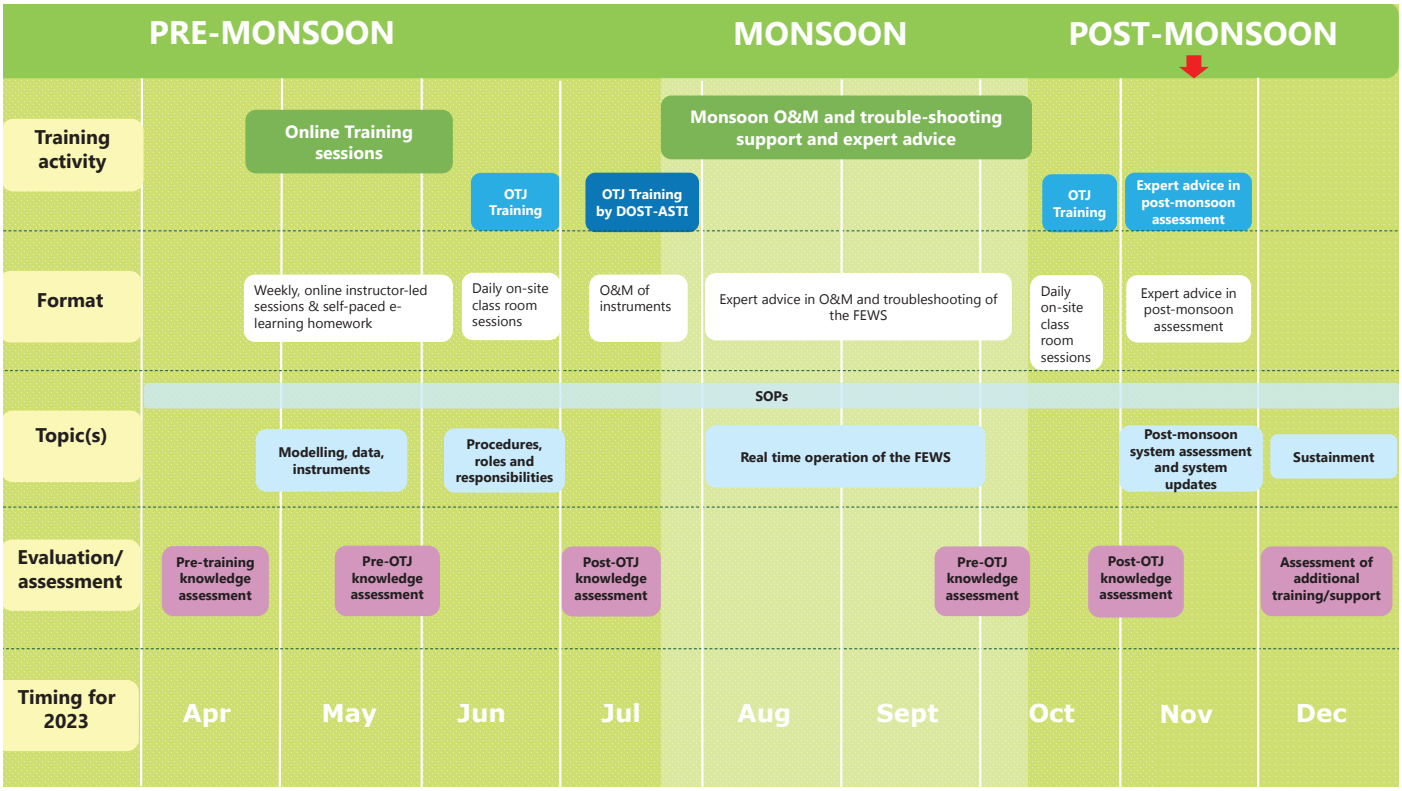
The training formats were varied and consisted of site visits, online and in-person presentations, live demonstrations, Q&A discussions, peer-to-peer presentations, workshops, quizzes, live testing of SOPs, real-time operation and troubleshooting, and hands-on exercises with the Baguio models and data.

The training program sessions were tailored to the three O&M sub-teams to ensure that the content presented is relevant for the individual participant's responsibility as part of the team. Thus, the participants of the different teams covered different topics throughout the program.

Furthermore, participants still had access to the DHI ACADEMY eLearning platform established as part of the 2022 training, and modules from here are used as homework/preparation for the instructor-led training sessions in 2023 and for repetition when suitable for trainees.

An overview of the 2023 Baguio FEWS Training Program is seen in Figure 2 2.

Figure 2.2: Overview of the 2023 Baguio FEWS Training Program.



Source: Ramboll

2.4 KNOWLEDGE ASSESSMENT AND EVALUATION

TA fundamental component of the training design was the use of knowledge assessment surveys throughout the 2023 training program. Data from these surveys enabled an ongoing alignment with and adjustment to the changing needs of the participants.

The surveys were combined with the standard evaluation questions defined in the AASCTF Monitoring and Evaluation (M&E) framework, which focus on general participation level, gender disaggregation, overall knowledge increase and satisfaction. However, the knowledge assessments dove deeper into the specific topics and experiences relevant to the training sessions they related to.

With the added level of more detailed survey questions, the assessments were in particular used in order to:

- Document and keep of track the participants' knowledge level within specific topics;
- Evaluate the participants' experience of engaging with the training sessions;
- Capture any questions or concerns the participants might have in relation to their O&M role.

Table 2.2: Example of knowledge assessment survey
with indications of standard M&E questions (in grey)

Section 1 **Basic info**	Section 2 **Evaluation of training sessions**	Section 3 **Knowledge assessment** (specific topics for each team)	Section 4 **Conclusion**
#1 Please state your name. [optional]	#1 I have been able to attend all the OTJ training sessions. [yes/no]	#1 Please assess your current knowledge and understanding in relation to the following topics: [insert relevant topics] [very good <> very poor]	#1 Please provide your overall feedback for the training completed so far. [text]
#2 Which of the following most accurately describe(s) you? • Male • Female Another gender (please specify):	#1-1 You have answered that you have not attended all sessions, please elaborate how many and why. [text]	#2 I feel confident discussing the mentioned topics within the O&M team. [strongly agree <> strongly disagree]	#2 How can the technical experts from Ramboll best guide and support you and the O&M team throughout the monsoon? [text]
#3 I identify as belonging to a (select all that apply): • Minority ethnic group (e.g., indigenous / First Nations) • Minority religious group • Migrant group • Refugee or internally displaced person • Another minority group (please specify): • I do not belong to a minority group. • Prefer not to state.	#2 The OTJ training sessions have helped me build understanding of operating and testing the FEWS. [strongly agree <> strongly disagree]	#3 I know which standard operating procedures (SOPs) to follow in the monsoon phase of the FEWS. [strongly agree <> strongly disagree]	#3 Please note any questions or concerns you may have related to the FEWS O&M. [text]
#4 Would you describe yourself as a Person with Disability (PwD)? [yes/no]	#3 The OTJ training sessions have addressed topics relevant to my role in the Baguio FEWS O&M team. [strongly agree <> strongly disagree]	#4 I understand the overall purpose and main tasks of the three operational phases of the FEWS (pre-monsoon, monsoon, post-monsoon). [strongly agree <> strongly disagree]	
#4-1 If yes, is your disability related to the following? (select all that apply) • Walking • Seeing • Hearing • Cognition • Self-care • Communicatio • Upper body functioning	#4 The format of the OTJ training sessions (presentations, hands-on exercises, peer-to-peer discussions, and Q&A time) has supported my learning. [strongly agree <> strongly disagree]	#5 I can explain my own role and responsibilities as part of the O&M team to others within my organization. [strongly agree <> strongly disagree]	
	#5 The OTJ training sessions met my needs and expectations. [strongly agree <> strongly disagree]	#6 I understand how to carry out the responsibilities of my role within my work week. [strongly agree <> strongly disagree]	

Section 1 **Basic info**	Section 2 **Evaluation of training sessions**	Section 3 **Knowledge assessment** (specific topics for each team)	Section 4 **Conclusion**
	#5-1 You have answered your expectations were not met, please provide some feedback on why and what could have been done differently. [text]	#7 I know which agencies/partner organizations are providing real time and forecast data for the FEWS. [strongly agree <> strongly disagree]	
	#6 The instructor was well-qualified and had adequate technical knowledge. [strongly agree <> strongly disagree]	#8 I know where to find help and further insights related to my tasks. [strongly agree <> strongly disagree]	
	#7 I have felt comfortable contributing and asking questions during the OTJ sessions. [strongly agree <> strongly disagree]		
	#8 I have used the knowledge and understanding gained from the online training sessions during the OTJ training sessions. [strongly agree <> strongly disagree]		
	#9 Completing the OTJ training I feel well-prepared for the test of the Baguio FEWS during the monsoon season. [strongly agree <> strongly disagree]		

Source: Ramboll

Knowledge assessment surveys were conducted both prior to and following each training block to evaluate the effectiveness of the training, and to assess the increase in knowledge before and after the training sessions. These surveys were instrumental in measuring program effectiveness and team performance and providing valuable insights into the impact of the training on the participants' knowledge levels. Completing the knowledge assessments were also an occasion for participants to reflect on what they had learned and for trainers to align their expectations with those of the participants.

In total, five surveys have been completed by the participants in 2023 (also shown in Figure 2 2):

- Pre-online training survey (early-May 2023)
- Pre-monsoon pre-OTJ training survey (June 2023)
- Pre-monsoon post-OTJ training survey (June 2023)
- Post-monsoon pre-OTJ training survey (October 2023)
- Post-monsoon post-OTJ training survey (October 2023)

To ensure robust response rates, participants were provided with dedicated time to complete the surveys and reflect on their learnings during both the initial and final training sessions of each module. This method was put in place to ensure that all participants carried out the survey with the necessary care. The results were subsequently analyzed by comparing changes in satisfaction, knowledge, and confidence levels before and after the training. These data were utilized to fine-tune the training sessions and gain insight into participants' specific focus areas, needs, and expectations. This pre- and post-training module analysis empowered participants to have a voice in shaping the training to better suit their preferences. After completing all the training sessions, a holistic analysis was performed to assess the overall learning during the program.

Results from the training assessments are shared in the coming sections of this report.

Figure 2.3: The participants of the O&M team during an OTJ training session in October 2023.

Source: Ramboll

2.5 COMMITMENT LETTER

Prior to initiating the 2023 training program, all participants and their direct managers were asked to sign a commitment letter. By signing the letter, both participants and managers, agreed to commit to the program for a total amount of training hours as well as to ensure continued time availability/commitment of the participant beyond 2023 to the extent needed to ensure proper and optimal functioning and long-term sustainability of the Baguio FEWS.

Signing the commitment letter was important to ensure the full availability/flexibility of the participant's working time, to accommodate the foreseen level of engagement and to make sure that roles and responsibilities were clear to both participants and their direct managers.

Mr. Alvaro Fonseca from the Ramboll team addresses the Baguio FEWS O&M Team during an in-person training session in Baguio
Source: Carlo Valdez

3. 2023 BAGUIO FEWS TRAINING PROGRAM

The Ramboll team poses with the Baguio FEWS O&M Team at Sadjap Station
Source: Ramboll

Building on the 2022 training activities, the consolidation phase training consisted of varied training formats aimed enhancing the local technical capacity as well as the participants ability to apply their technical skills acquired in previous trainings and utilize these to operate and maintain the FEWS. The training program logic is described in Section 2.3.

Twelve (12) members of the FEWS O&M team participated in the training program. Most of the team members participated in the FEWS training activities since the training kick-off in 2022. The selection of training program participants is presented in the Scoping and Training Course Design Report for the Targeted Capacity Building Program to Enhance the sustainable delivery of FEWS.

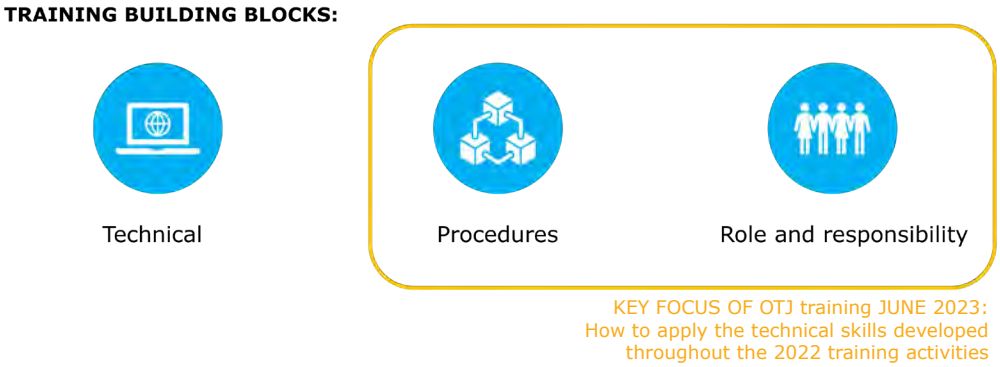
The training activities of the consolidation phase were aligned with the operational phases of the FEWS to ensure alignment with the full-scale test of the system including the real-time operation and maintenance tasks. The training activities of the program are further described in the sections below.

3.1 PRE-MONSOON TRAINING

The first part of the 2023 training program commenced in May during the pre-monsoon period. The aim of this pre-monsoon training was to prepare the FEWS O&M team for operating the FEWS through the full-scale real-time test of the system with expert guidance and support from the technical project team.

The pre-monsoon training activities have been built around three main areas: enhancement of technical capacity, improved understanding of SOPs, and improved understanding of role and responsibility. The enhancement of technical skills was a key focus area in the pre-monsoon online training sessions, and the primary focus of the pre-monsoon OTJ training was building an understanding of SOPs and roles and responsibilities, as illustrated in Figure 3 1.

Figure 3.1: The pre-monsoon training components.



Source: Ramboll

3.1.1 ONLINE INSTRUCTOR-LED SESSIONS

The online training sessions served to prepare the team for the on-site OTJ training, as feedback from the 2022 training activities highlighted enhancement of learnings from the OTJ training due to online sessions. The sessions covered topics from the 2022 capacity building program to refresh their knowledge and skills ahead of the hands-on OTJ training implementation of SOPs.

The online training sessions were divided into two primary tracks: Modelling and IT/Instrument. Furthermore, a dedicated instrumentation training session focusing on operation and maintenance of the monitoring stations was facilitated in collaboration with DOST-CAR, DOST-ASTI, and Alexan (supplier of station equipment). O&M team members only attended the sessions that were relevant for their responsibilities as part of the FEWS O&M team.

In agreement with the participants, the online training sessions took place weekly on Thursdays at 3 PM – 5 PM between end-April and mid-June to ensure that the trainees could plan their other work responsibilities around the training sessions.

Table 3.1: Overview of conducted online training sessions.

No	Focus	Agenda	Participating team
Sessions facilitated by Ramboll			
Session 1	River systems of Baguio-catchments and their description	• Understanding on hydrology of Baguio city • Flood prone sites • Rainfall and water level station distribution • Discussion session	Modelling
	IT systems and MIKE OPERATIONS framework	• Current IT system used in Baguio FEWS • Database, MIKE Software and License • Components of MIKE OPERATIONS and their connectivity with database • Creation of Database, Backup/Restore	IT, Instrument
Session 2	Rainfall data and analysis	• Discussion session • Various types of rainfall data • Comparison of forecast & observed data • Creating model input	Modelling Instrument
	Floodwatch folder	• Use of Floodwatch folder • Floodwatch folder structure • Connectivity and purpose of batch files	IT
Session 3	Cross section data and derivation of Q	• Discussion session • Collection of cross-section data • Creating model input • Need of discharge data • Estimation of Q from Waterlevel	Modelling Instrument
	One time setup processes and data inputs	• Explanation on FEWS components • Connectivity of various components	IT
Session 4	Back-end models setup	• Recap of setting up of the model • Discussion session	Modelling
	Real time data download, processing, and input file generation	• Downloading and processing of Real Time Data • Use of API for downloading data • Generation of Time Series from json format	IT, Instrument

No	Focus	Agenda	Participating team
Session 5	Model Calibration	• Various calibration parameters • Recap of calibrating the model • Discussion session	Modelling
Session 6	Evaluation of results	• Extraction of results • Understanding the results • Estimation of skill of a forecast • Discussion session	Modelling
	WRF data download, processing and input file generation	• Downloading and processing of WRF data • Conversion of grib files to netCDF • Generation of Time Series from netCDF	IT, Instrument
Session 7	Bringing the backend models to forecasting mode – inclusion of DA	• What is forecasting mode • What is data assimilation • Setting up model in forecast mode • Discussion session	Modelling
	MO setup and triggering scenario runs	• Model registration in MIKE OPERATIONS • Connectivity of real time and forecast data with model • Running of Model in forecast mode	IT
Session 8	Improvements of WRF data in real time	• Algorithms of bias correction • Method included for our system • Analysis of results • Discussion session	Modelling
	Alerts and logs	• Setting of Job Manager for running system in automation • Scheduling of jobs in MIKE OPERATIONS	IT
Session 9	Improving in DA to WL	• How DA works • DA methodology used • Analysis of results • Discussion session	Modelling
	Email warnings when thresholds are crossed	• Discussion on Alerts and Logs • How Alert and logs will work • Warning Emails generation	IT
Sessions facilitated by DOST-ASTI, DOST-CAR and Alexan			
Session 1	Training on the Maintenance of Early Warning System Devices	• Introduction to stations • Introduction to data storage • Introduction to station maintenance	All
Session 2	Training on the Maintenance of Early Warning System Devices (In-person training at CDRRMO, full-day training from 9 AM – 4 PM)	• Hydromet devices introduction and demonstrations • Hydromet data visualization tools • Inventory and assessment of stations • Station maintenance	All

Source: Ramboll

3.1.2 ON-SITE ON-THE-JOB TRAINING

The pre-monsoon OTJ training was conducted over the last two weeks of June 2023 at the CDRRMO. Nine (9) out of twelve (12) OTJ trainees attended all training sessions from 9 AM – 4.30 PM during the eight-day course. Three (3) OTJ trainees from the peer team, were only able to attend some of the planned training program activities. The training provided in-depth hands-on experience in FEWS monsoon standard operating procedures (SOPs), in order to build confidence in the team in a more efficient manner than traditional classroom trainings or online e-learning modules.

The OTJ training was built around the three main areas:

- Technical
- Procedures
- Role and responsibility

The key focus of the June 2023 OTJ training was to learn how to apply the technical skills that had been acquired in the operation and maintenance of Baguio FEWS. The goal of the training was for the participants to be able to operate and maintain the FEWS during the 2023 monsoon with technical support and guidance from the project team.

The training consisted of site visits, presentations, live demonstrations, Q&A discussions, peer-to-peer presentations, live testing of SOPs, and hands-on exercises with the Baguio models and data. Gathering the trainees in-person at the same location allowed for enhanced interaction and collaboration between trainees and for the trainees to work together as a team.

Table 3.2 gives an overview of the full day sessions facilitated by Ramboll experts and of the topics covered during the training.

Table 3.2: Pre-monsoon OTJ training

Date	Time	Topic	Location
Tuesday 20th June	09:00 AM – 4:30 PM (incl. breaks)	Technical Excursion / Site Visit to stations and river locations	CDRRMO + sites along rivers
Wednesday 21st June	09:00 AM – 4:30 PM (incl. breaks)	Introduction and overview of FEWS	CDRRMO
Thursday 22nd June	09:00 AM – 4:30 PM (incl. breaks)	Setup of FEWS	CDRRMO
Monday 26th June	09:00 AM – 4:30 PM (incl. breaks)	Refresher sessions	CDRRMO
Tuesday 27th June	09:00 AM – 4:30 PM (incl. breaks)	SOPs	CDRRMO
Wednesday 28th June	09:00 AM – 4:30 PM (incl. breaks)	SOPs, troubleshooting, and FEWS testing	CDRRMO
Thursday 29th June	09:00 AM – 4:30 PM (incl. breaks)	SOPs, troubleshooting, and FEWS testing	CDRRMO
Friday 30th June	09:00 AM – 4:30 PM (incl. breaks)	Training Closing and Evaluation	CDRRMO

Source: Ramboll

3.1.2.1 PRE-OTJ ASSESSMENT

On the first day of the OTJ training all participants were asked to self-assess their current knowledge level. This survey was designed to evaluate the efficacy of the online training sessions, gauge their comprehension of the technical aspects of the training and assess their current grasp of procedures and roles and responsibilities, which constituted the primary emphasis of the training. There was a survey for each of the three teams (IT, modelling, instrument) in order to ask questions more directed at the topics relevant to them.

It emerged that participants appreciated the content and format of the online training sessions. However, there was a need to revisit several training topics and introduce more hands-on activities. Consequently, these findings prompted the inclusion of an entire training day devoted to reviewing previous topics and incorporating additional practical sessions. Results from the assessment are further presented in Section 4.

3.1.2.2 POST-OTJ ASSESSMENT

On the last day of the OTJ training all participants were also asked to self-assess their current knowledge level. The scope was to evaluate the concluded OTJ training sessions and assess the level of confidence going into the real-time operation of the FEWS during the monsoon. A survey was again prepared for and tailored to each of the three teams (IT, modelling, instrument).

The survey included questions to assess the participants' understanding of their own role and responsibilities, their understanding of the SOPs, and their insights of the data sources feeding into the FEWS. Results show that prior to the training, participants had a moderate understanding of the procedures to follow and their respective roles and responsibilities. However, following the OTJ training, there has been a large increase in confidence levels across all teams. Thus, the high confidence levels demonstrate that the OTJ training format and content successfully contributed towards achieving the training goals. Participants also expressed the desire to have more hands-on sessions and practical exercises in the next training. Results from the assessment are further presented in Section 4.

3.2 MONSOON REAL-TIME OPERATION AND MAINTENANCE

The 2023 monsoon marked the first real-time operation and maintenance of the FEWS by the O&M team, supported and guided by the technical project team.

In the 2023 monsoon, all aspects of the operational FEWS were tested in real-time by implementing procedures defined in the SOPs. The system was tested on three main parameters, and thus, the O&M team received guidance and advice in these:

1. **Technical performance** – this entails assessment of station performance, WRF performance, model performance and performance of the automations in the system.
2. **Effectiveness of SOPs** – this entails assessment of the procedures for maintenance and operation as defined in the SOPs and to log any gaps and improvements that are identified during the real-time operation.
3. **Team performance** – the entails the team's effectiveness in communication and understanding of roles and responsibilities while implementing the SOPs. This aspect of the test is closely linked to the preparation of the system sustainment plan and the assessment of additional support and training needed beyond 2023.

3.2.1 MONSOON O&M AND TROUBLE-SHOOTING SUPPORT AND EXPERT ADVICE

During the 2023 monsoon, support was given the sub-teams in the FEWS O&M team in carrying out their respective monsoon SOPs. To enable a thorough knowledge transfer and test the team members ability to operate and maintain the system, the O&M team members executed their stipulated responsibilities with on-call as-needed online support, guidance and backing from the technical project team. This expert advice as-needed training format was implemented to test the team's ability to operate and maintain the system.

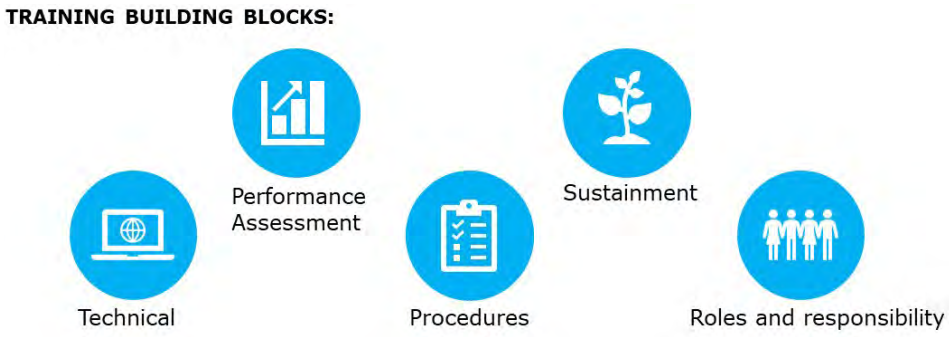
The FEWS O&M team initiated real-time operation of the FEWS and implementation of monsoon SOPs on Friday June 30, 2023, following the completion of the 8-day in-person OTJ training program in Baguio. The real-time test was completed on September 30, 2023.

3.3 POST-MONSOON TRAINING

The last part of the 2023 training program commenced in October during the post-monsoon phase following the completion of the real-time system operation and maintenance. The aim of the post-monsoon training was to enhance the FEWS O&M team's understanding of system performance assessments and the resulting required system updates as well as the components of system sustainment.

The post-monsoon training activities were built around five main blocks: technical, performance assessment, procedures, sustainment, and roles and responsibilities, as seen in Figure 3 2. In response to feedback from previous training sessions, these training sessions placed a strong emphasis on hands-on learning and centered on learning-by-doing tasks on updating the 2023 system.

Figure 3.2: Post monsoon training components



Source: Ramboll

3.3.1 ON-SITE ON-THE-JOB TRAINING

The planned post-monsoon on-site OTJ training took place at Baguio City Hall in end-October and focused on building capacities in post-monsoon standard operating procedures. The aim of the post-monsoon OTJ training was for the FEWS O&M team to gain experience in assessment of FEWS performance and to reach an understanding of the resulting required system updates. This aligns with the ultimate goal for the participants to operate and maintain the FEWS with limited technical support.

During the training a Sustainment workshop was hosted with the aim of touching on the five main building blocks and discussing how to ensure long term sustainability in the following four project areas:

- Technical
- Financial
- Human resources
- Institutional

The sustainment workshop specifically focused on recurring yearly activities connected to O&M, the budget for these activities, potential risks and further needs for support.

Table 3 3 gives an overview of the full day sessions facilitated by Ramboll experts and the topics covered during the training.

Table 3.3: Post monsoon OTJ training

Date	Time	Topic		Location
		Modelling/ Instrument	IT	
Monday 23rd October	09:00 AM – 4:30 PM (incl. breaks)	Recap of FEWS/ Review of system performance and logs/Feedback on SOPs and introduction to Post-monsoon SOPs		CDRRMO
Tuesday 24th October	09:00 AM – 4:30 PM (incl. breaks)	Recap of modelling theory	Recap of MIKE operations	CDRRMO
Wednesday 25th October	09:00 AM – 4:30 PM (incl. breaks)	Fine-tuning of model	Script and system update	CDRRMO
Thursday 26th October	09:00 AM – 4:30 PM (incl. breaks)	FEWS setup/ Updating the dashboard/ Sustainment workshop		CDRRMO
Friday 27th October	09:00 AM – 4:30 PM (incl. breaks)	CDRRMO		CDRRMO

Source: Ramboll

3.3.1.1 PRE-OTJ ASSESSMENT

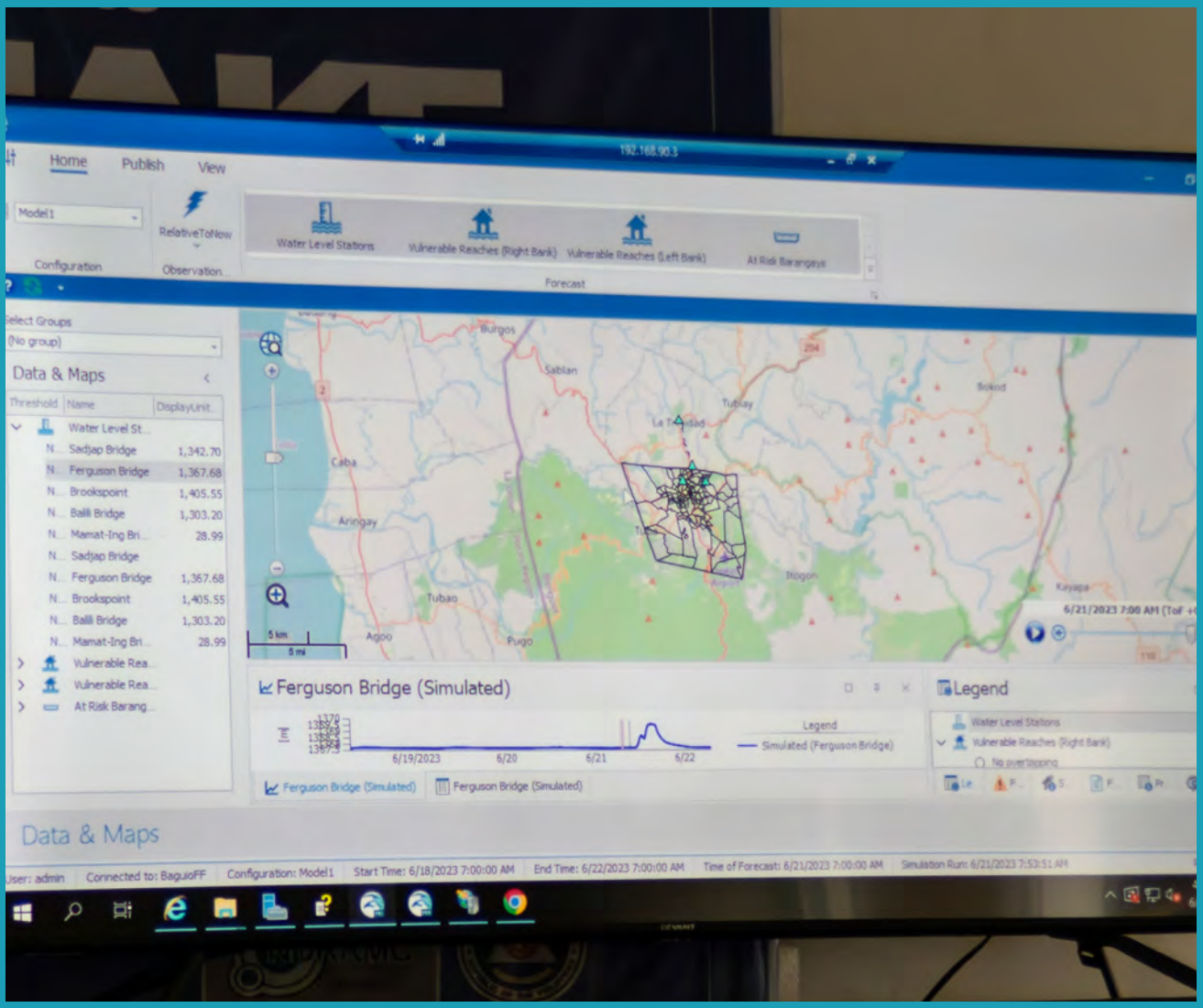
Pre-OTJ training, the participants were asked to complete a self-assessment survey which paid special attention to gathering insights from participants regarding their knowledge gaps, any content they felt was lacking in previous training sessions, and the primary challenges they encountered while maintaining and operating the FEWS as this was the final planned training session. It emerged that all the aspects relevant to operation and maintenance of the FEWS were covered during the training. Nevertheless, participants expressed that their main challenges were associated with model calibration, and a desire for additional emphasis on this aspect in the final training session, which was accommodated in the training.

3.3.1.2 POST-OTJ ASSESSMENT

The post-OTJ self-assessment by the participants demonstrated that the participants' knowledge levels improved as they progressed through the training. Their confidence in understanding their roles and readiness to operate and maintain the Baguio FEWS with limited technical support also increased. Since this was the final training session, a series of questions were posed to gauge their desire for further training and specific areas of interest.

The majority of participants emphasized the significance of ongoing training and expressed interest in increasing their knowledge into various topics such as data correction, model calibration and hardware and software components of the system. They suggested having yearly training sessions to revisit previous topics and explore new ones. Results from the assessment are further presented in Section 4.

4. ASSESSMENT OF PROGRAM EFFECTIVENESS AND SATISFACTION



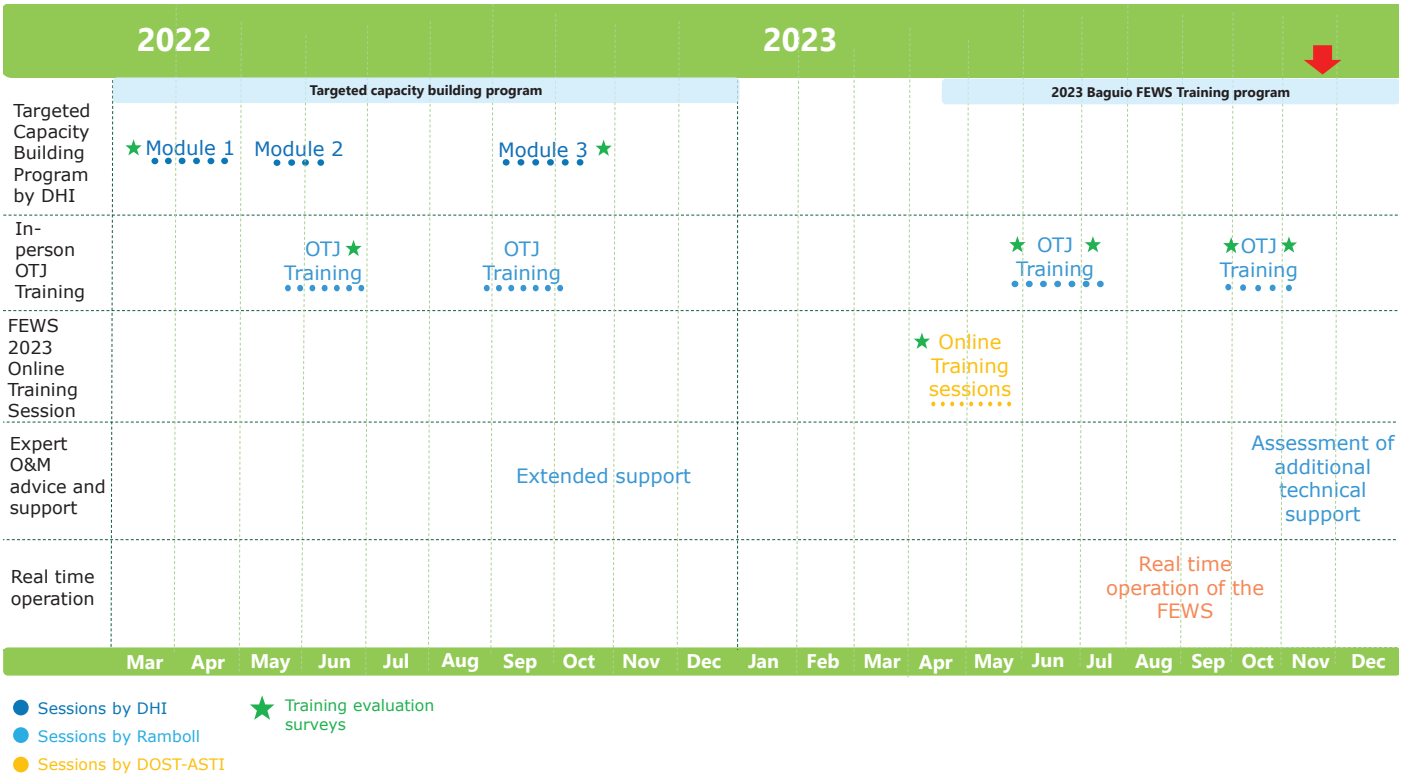
Presentation of FEWS back-end setup
Source: Ramboll

To gauge the effectiveness of the 2023 Baguio FEWS training program, knowledge assessment surveys were conducted before and after each training module as described in section 2.4. These surveys aimed to provide insights into participants' confidence levels and their understanding of the training module topics. The data from these surveys have been aggregated with the survey data from the targeted capacity building program implemented in 2022.

The initial knowledge assessment survey, held in March 2022, established the participants' baseline before the training began. In July 2022, a mid-training evaluation survey was distributed to monitor progress, followed by a final evaluation survey in November 2022 to assess the conclusion of the training.

In May 2023, a pre-training knowledge assessment was conducted before the kick-off of the 2023 Baguio FEWS training program. The results served as the new baseline for the 2023 capacity building activities. Subsequent to the online training, new surveys were carried out before and after each OTJ training session (Figure 4 1) with the final survey in October 2023 to conclude the training program.

Figure 4.1: Timeline of the 2022-2023 training activities

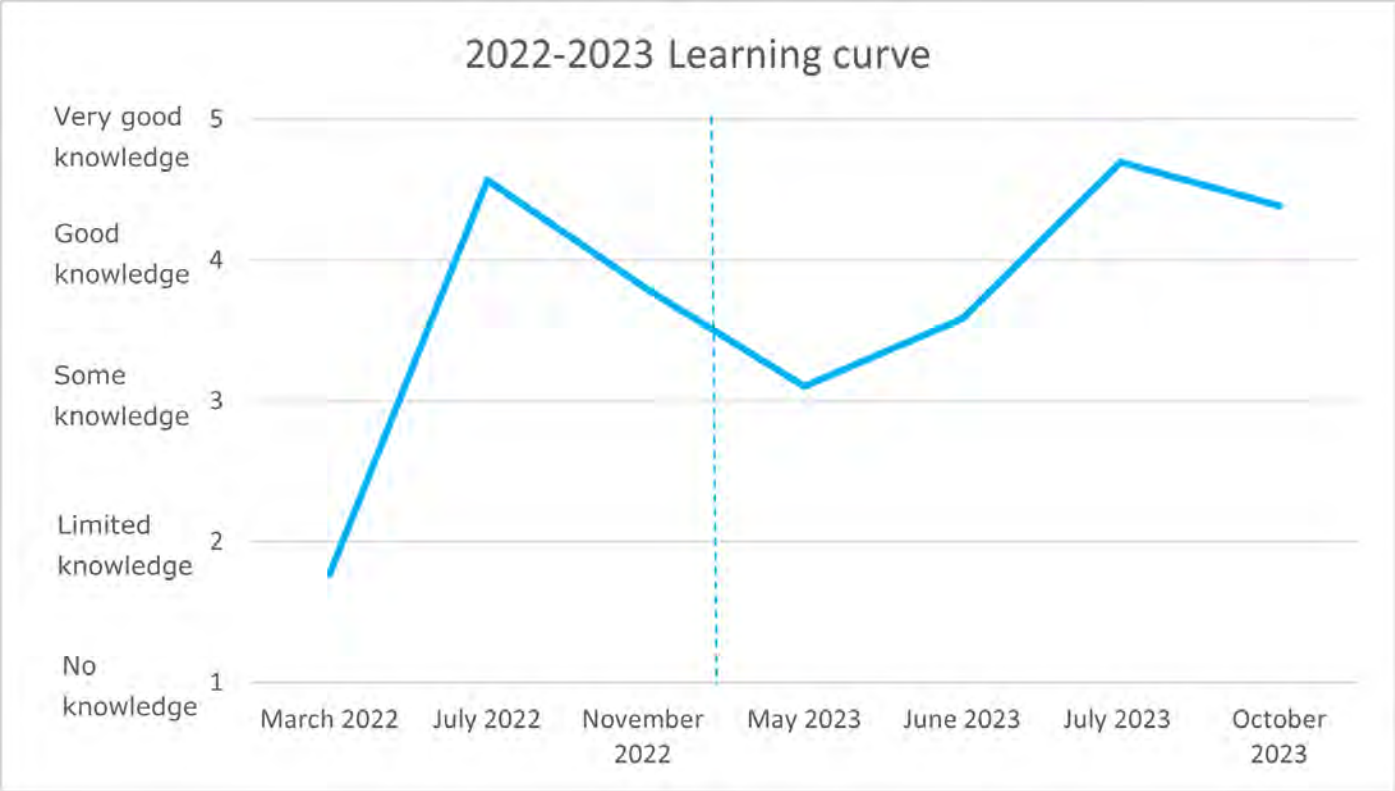


Source: Ramboll

4.1 ASSESSMENT OF OVERALL TRAINING PROGRAM EFFECTIVENESS AND TEAM PERFORMANCE

Looking across both 2022 and 2023 training programs it has been possible to assess the development in the participants' self-assessed knowledge level from beginning to end. Before and after every training module, participants were asked to rate their understanding of the core training topics on a scale from 1 to 5 (with 1 meaning "no knowledge and 5 meaning "very good knowledge"). Figure 4 2 shows the average of the self-assessment surveys for all three teams across 2022-2023. previous training sessions, these training sessions placed a strong emphasis on hands-on learning and centered on learning-by-doing tasks on updating the 2023 system.

Figure 4.2: 2022-2023 learning curve



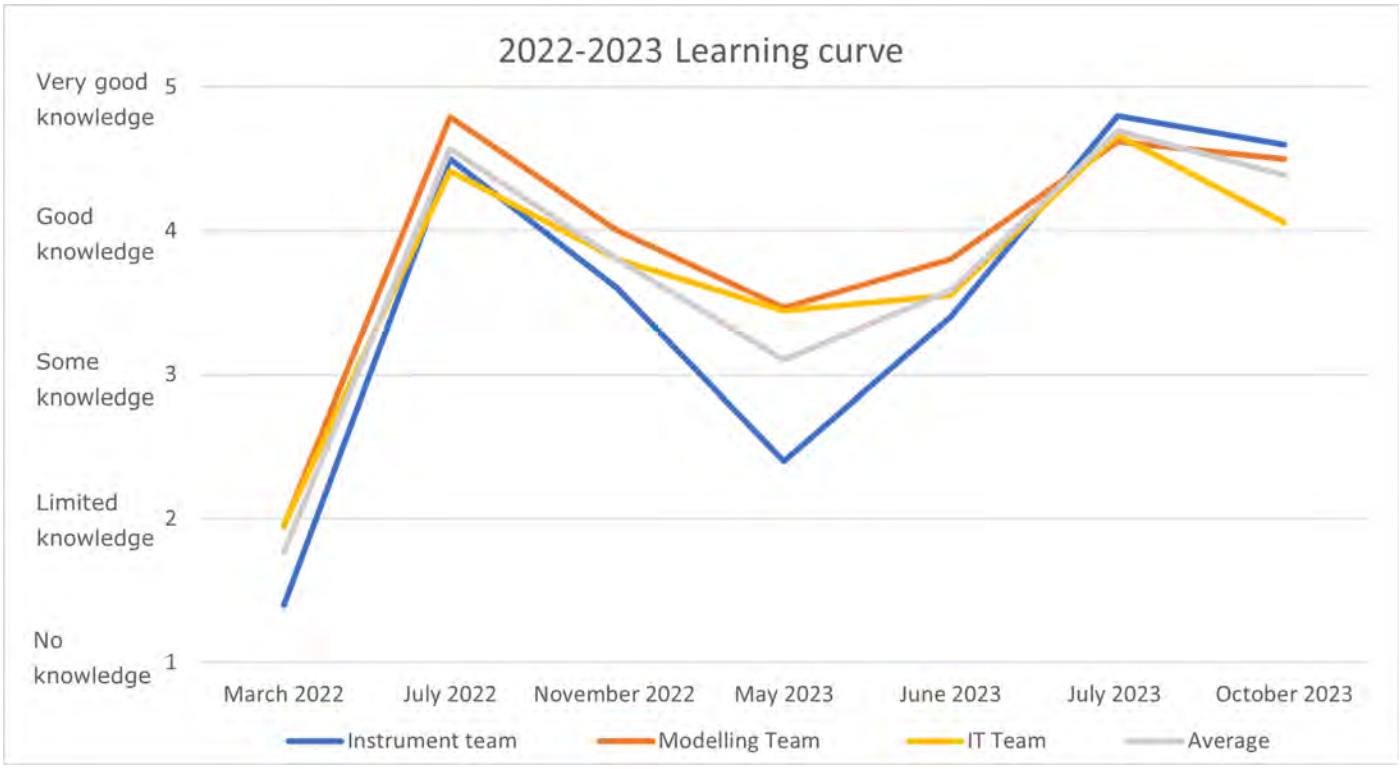
Source: Ramboll

Figure 4 2 shows that the average participant, prior to the start of the training in 2022, had 'no knowledge' or 'limited knowledge' within the fields of hydrology, hydraulics, the modelling tools and MIKE OPERATIONS, which are core elements of the new FEWS established in Baguio. This confirms the participant assessment during the interviews prior to the start of the training. Furthermore, the participants, on average, have had a steep learning curve as they have gained 'good knowledge' or 'very good knowledge' of most of the topics covered by the program. This is very positive and indicates that the training program has been very effective.

According to the results from the May 2023 pre-training survey, there was a decrease in knowledge levels from November 2022, where the 2022 training activities came to an end, to May 2023. The decrease in knowledge levels among participants was expected, considering that they were not actively operating and maintaining the system and applying their knowledge.

Figure 4 3 provides a team's breakdown for the same timeframe and shows that the knowledge decrease in May 2023 was experienced by all three teams with the Instrument team having the biggest decrease. As a result, the online sessions of the 2023 training program were scoped to include recapping of the central flood-related topics covered in the 2022 training program.

Figure 4.3: 2022-2023 learning curve



Source: Ramboll

The learning curve in 2023 is seen to be increasing and the average knowledge level among participants is self-assessed to be between 'good' and 'very good' in end-July 2023 post-OTJ training. However, there was a minor decrease in knowledge between July 2023 and October 2023, possibly due to participants becoming more aware of their knowledge, including what they know and don't know, and the complexity of operating and maintaining the FEWS in real-time.

In the span of 19 months, there was an overall substantial increase in knowledge levels, particularly before and after the consolidation phase. Specifically, the instrument team after a steep knowledge decrease in May 2023, is the team that concluded the training with the highest knowledge level. Similarly, also the modelling and IT teams completed the training having a "good knowledge" or a "very good knowledge" of the core training elements.

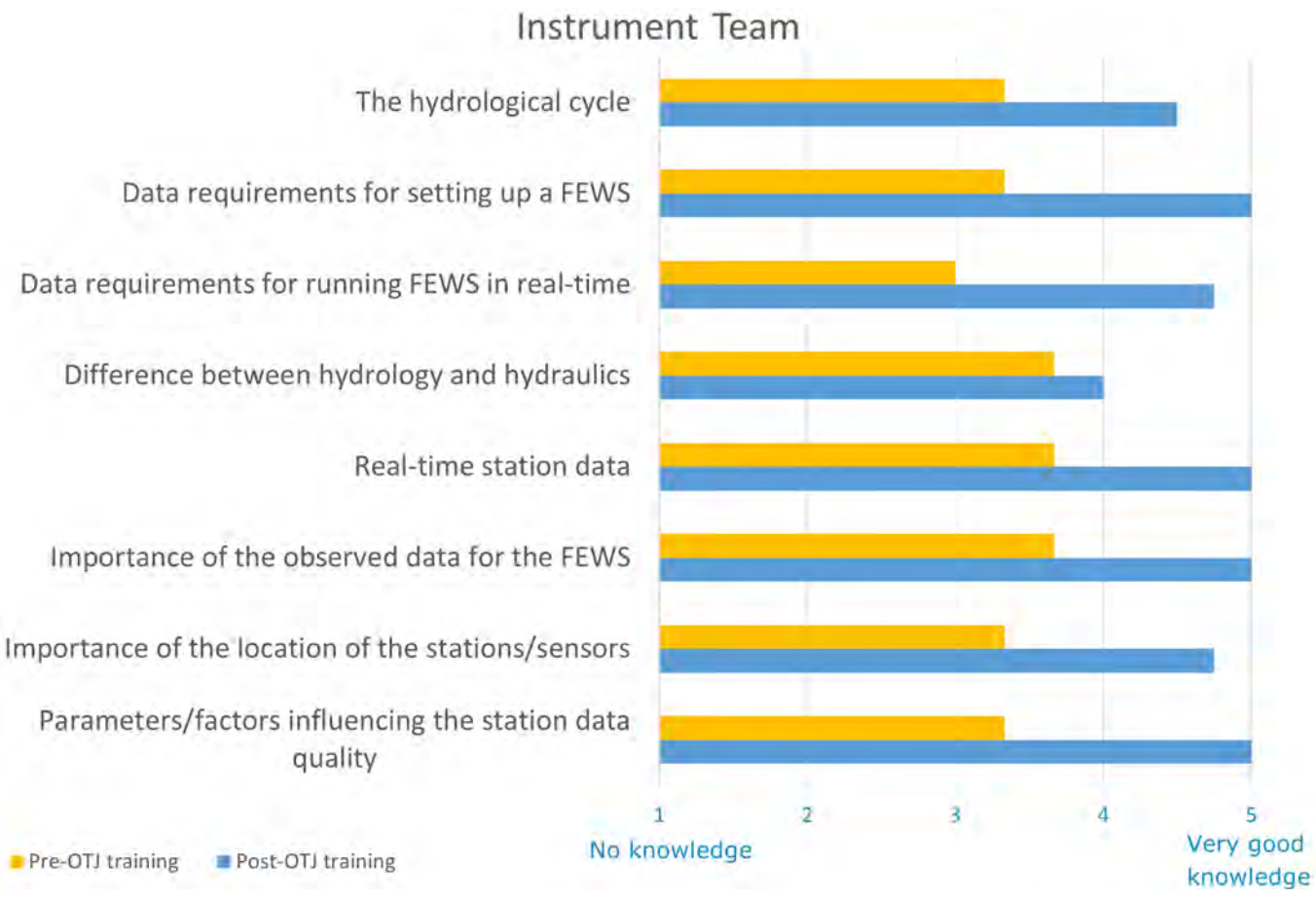
4.1.1 PRE-MONSOON OTJ TRAINING

The first pre-monsoon OTJ knowledge assessment was carried out between the end of the online training and the start of the OTJ training. A second survey was carried out after the completion of the pre-monsoon OTJ training to measure the training's impact on participants' knowledge levels.

As the training modules were tailored to meet the specific requirements of each team, the knowledge assessment evaluation was conducted separately for each team. Before starting the OTJ training participants followed nine (9) online training sessions to better prepare them for the upcoming training.

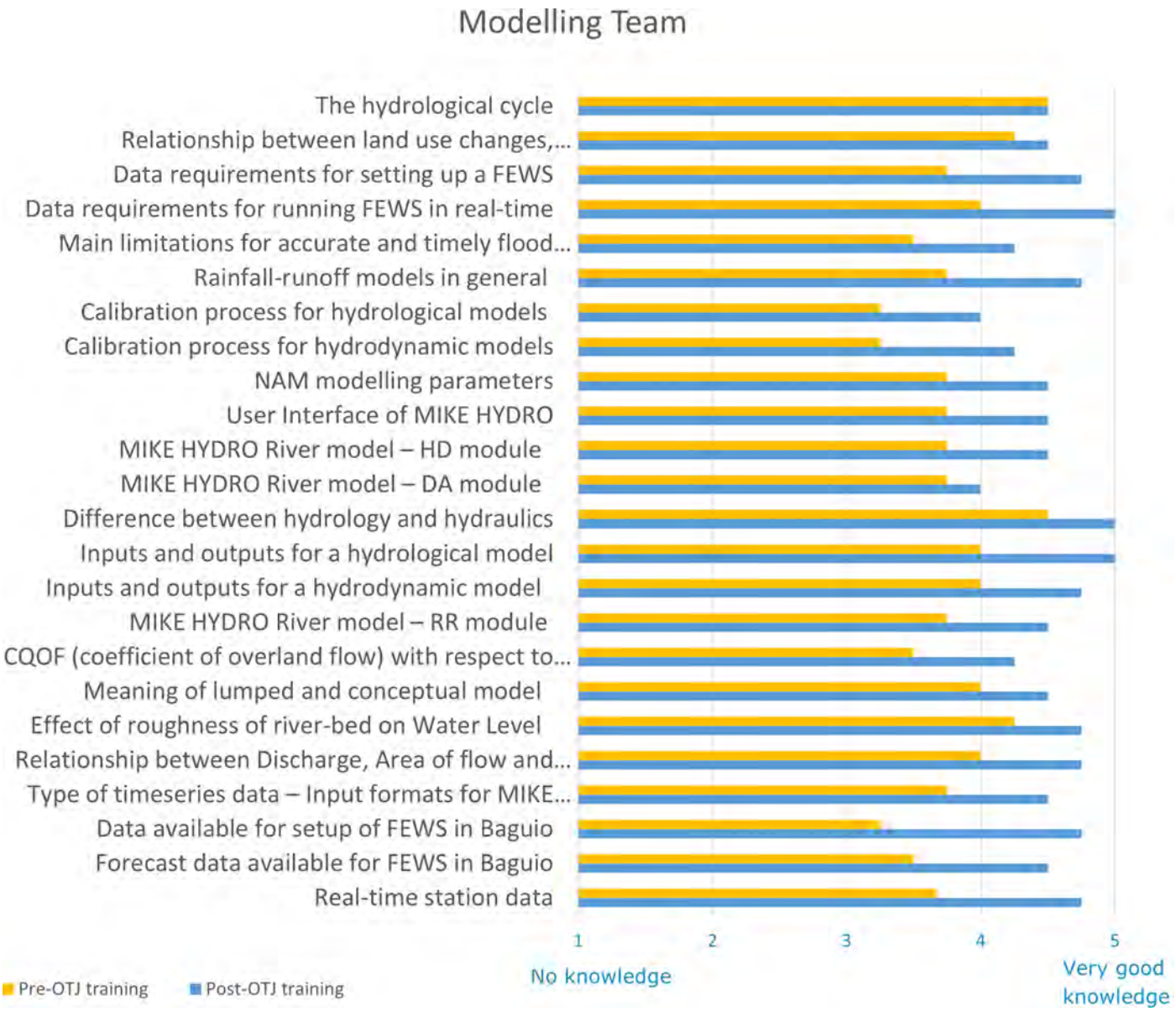
Figure 4 4, Figure 4 5 and Figure 4 6 compare knowledge levels for all three teams before and after the pre-monsoon OTJ training. Looking at the pre-OTJ survey results, the three teams improved their understanding of relevant topics compared to the May 2023 results (see Figure 4 3). Their knowledge returned to the same levels of July 2022, meaning that the online training had the expected results and well prepared the participants well for the OTJ training sessions.

Figure 4.4: Pre and post knowledge



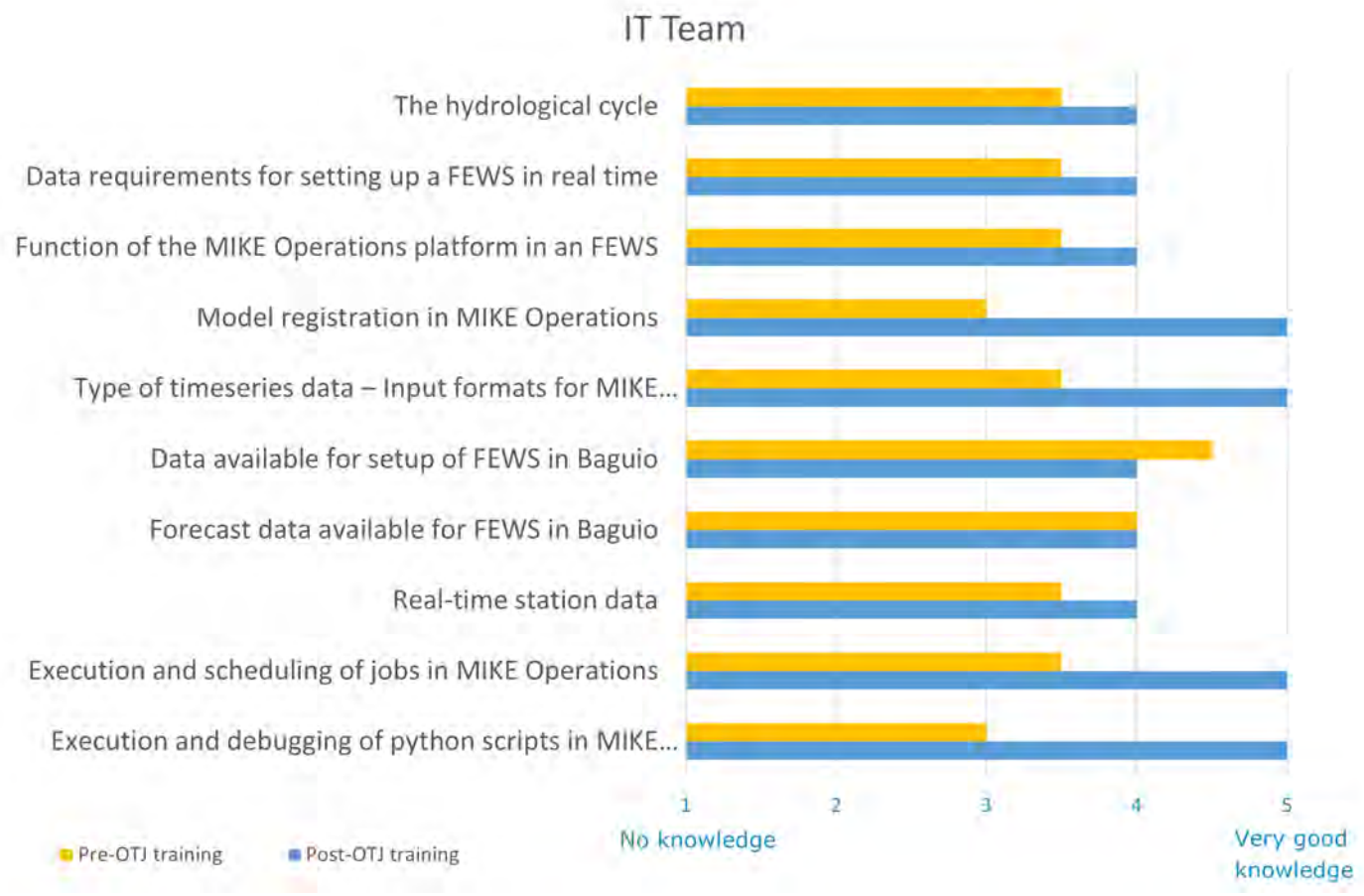
Source: Ramboll

Figure 4.5: Pre and post knowledge assessment results for the Modelling Team



Source: Ramboll

Figure 4.6: Pre and post knowledge assessment results for the IT Team



Source: Ramboll

The post-OTJ training knowledge assessment was carried out on the last day of the training to both evaluate the OTJ training sessions and to assess the level of preparation before the real-time operation of the FEWS during the monsoon. The knowledge assessment evaluation has been conducted individually for each team to better assess team performance.

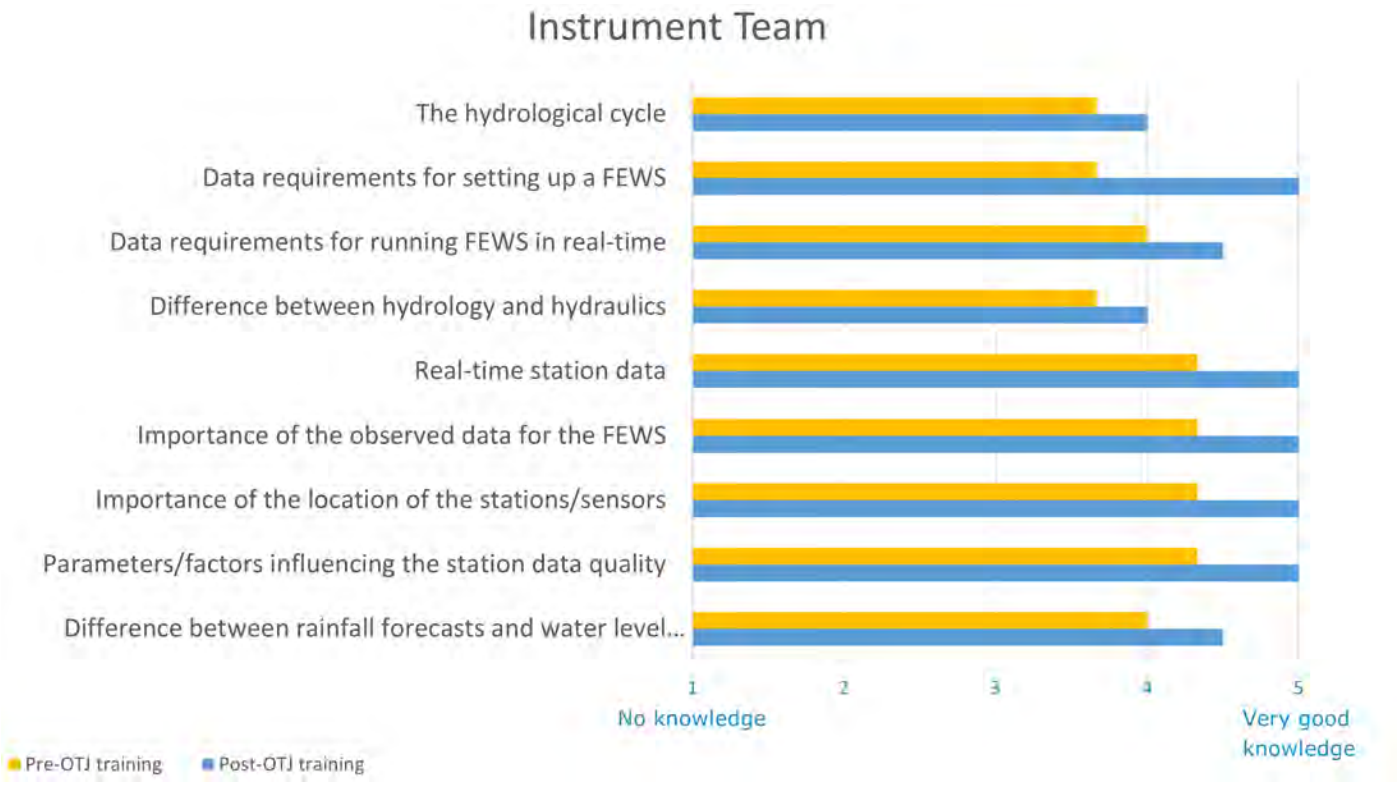
The OTJ training resulted in a general increase in knowledge compared to the pre-OTJ levels. Specifically, both the Instrument and IT teams experienced substantial improvements in their knowledge levels. While the modelling team's knowledge levels were already relatively high, they still saw a noticeable increase, although not as substantial as the other two teams. After the OTJ training all teams have "good" or "very good" knowledge of the core elements of the Baguio FEWS and are expected to be ready for the monsoon phase.

4.1.2 POST-MONSOON OTJ TRAINING

The first post-monsoon OTJ knowledge assessment was carried out on the first day of the OTJ training with the purpose participants' knowledge levels after the end of the operation and maintenance of the FEWS during the monsoon season and to identify the main challenges and areas that needed revision within the training. A second survey was carried out after the completion of the post-monsoon OTJ training to measure the training's impact on participants' knowledge levels.

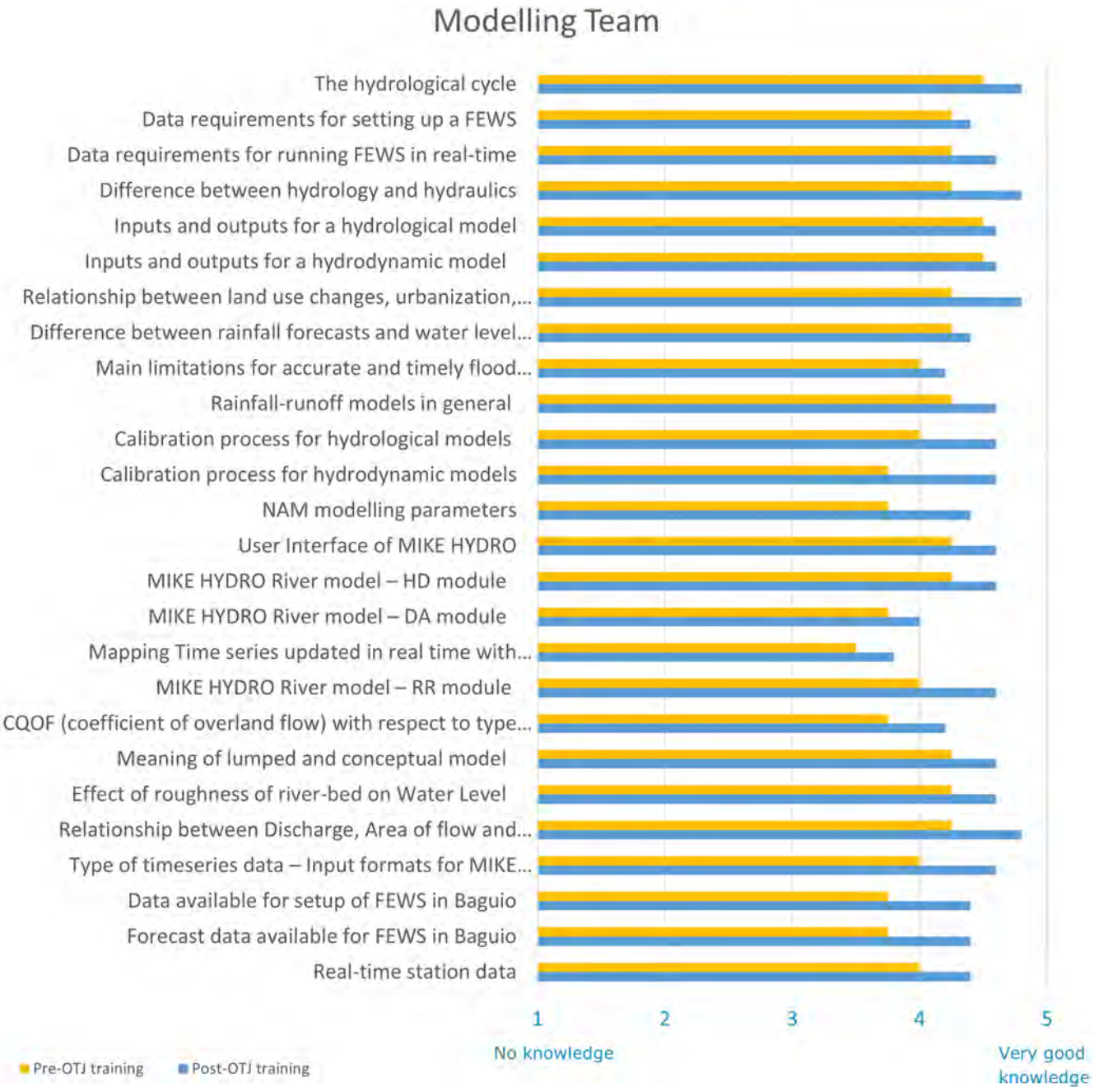
Figure 4 7, Figure 4 8, and Figure 4 9 compares the knowledge assessment results before and after the OTJ training and show a general increase in knowledge compared to the pre-OTJ levels. All the three teams started at a quite high level, having "some knowledge" or "good knowledge" of most of the topics.

Figure 4.7: Pre and post knowledge assessment results for the Instrument Team.



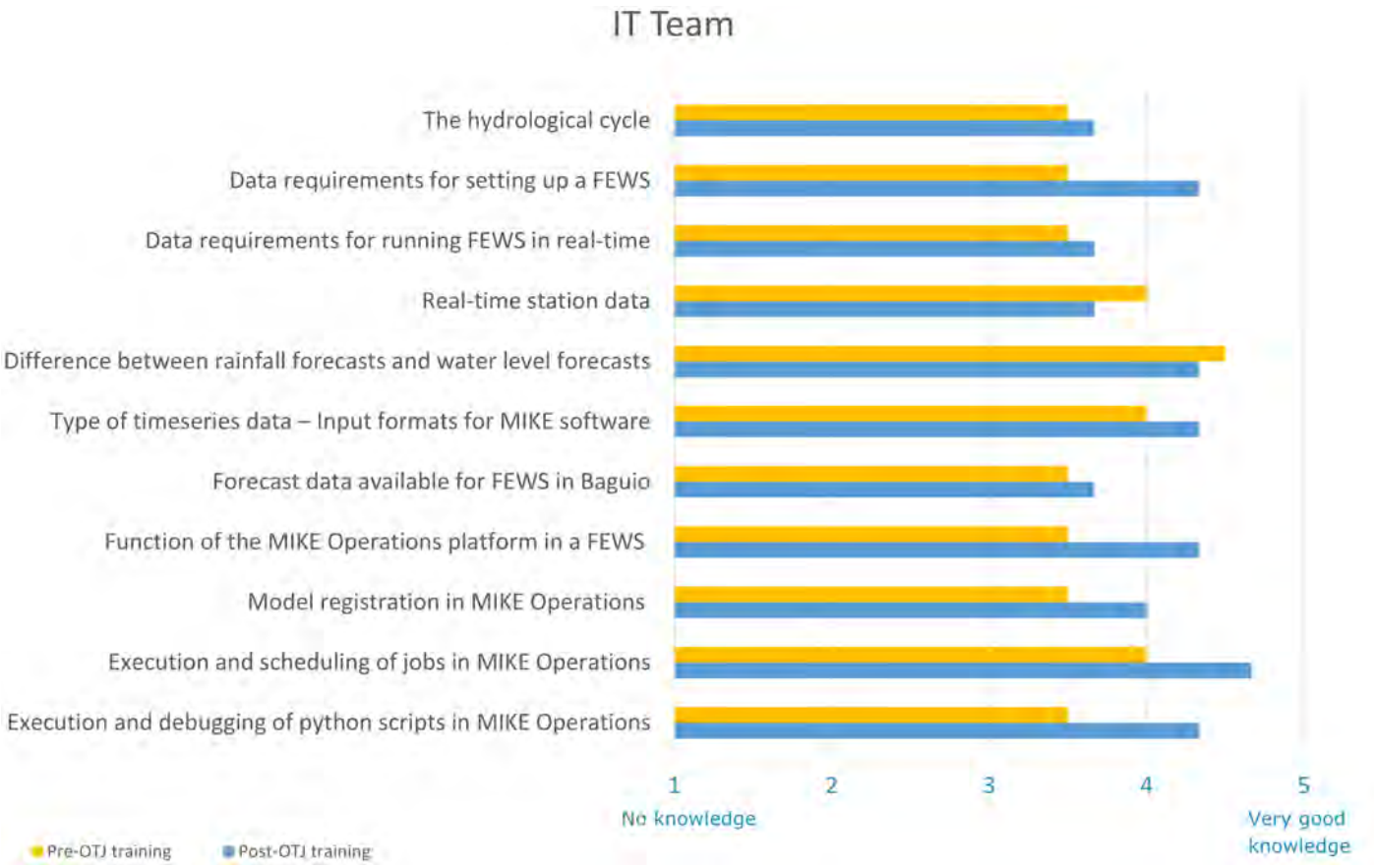
Source: Ramboll

Figure 4.8: Pre and post knowledge assessment results for the Modelling Team



Source: Ramboll

Figure 4.9: Pre and post knowledge assessment results for the IT Team

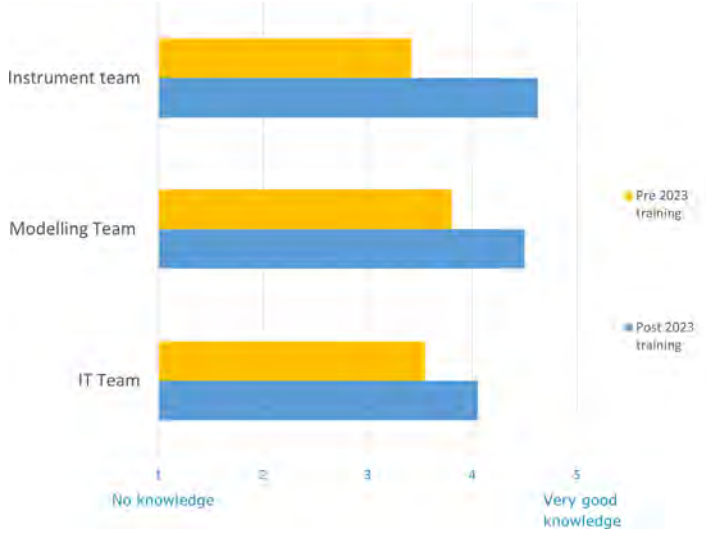


Source: Ramboll

Overall, after the OTJ training all teams have "good" or "very good" knowledge of the core elements of the Baguio FEWS. The only instance of a slight decrease was observed in the IT team for the questions related to questions "Real time station data" and "Difference between rainfall forecast and water level forecasts". This is also shown in the 2022-2023 learning curve (Figure 4 3) and suggests that they may have become more aware of what they do not know and of the areas where they may require additional support.

The increase in knowledge throughout the consolidation phase for each team is clearly shown in Figure 4 10, highlighting the difference in aggregated knowledge levels across individual topics for each team before the pre-monsoon on-the-job training (after the end of the online training sessions) and after the post-monsoon on-the-job (OTJ) training. Notably, the instrument team achieved the most significant increase in knowledge, although substantial improvements were observed across all three teams.

Figure 4.10: Comparison of knowledge levels before and after the 2023 training



Source: Ramboll

4.2 TRAINING EVALUATION AND PARTICIPANT SATISFACTION

The results from the baseline knowledge assessment (May 2023), indicate a very high level of participant satisfaction, signaling the well-received nature of the training (Figure 4 11). The knowledge acquired during the 2022 FEWS training has been moderately applied, which aligns with the decrease in knowledge levels prior to the consolidation phase (Figure 4 2). However, there has been a significant increase in the application of this knowledge during the pre- and post-monsoon trainings.

Figure 4 11 shows participant satisfaction levels during the baseline knowledge assessment, pre-monsoon on-the-job (OTJ) training, and post-monsoon OTJ training. Given that the baseline knowledge assessment took place before the training commenced, it lacks questions directly related to the training, such as the instructor's effectiveness and coverage of relevant topics. Similarly, the post-monsoon OTJ survey omits questions related to time and resources, as they are not pertinent to the final survey.

Figure 4.11: Assessment of participants satisfaction and expectations before the OTJ after the pre monsoon OTJ and after the post monsoon OTJ

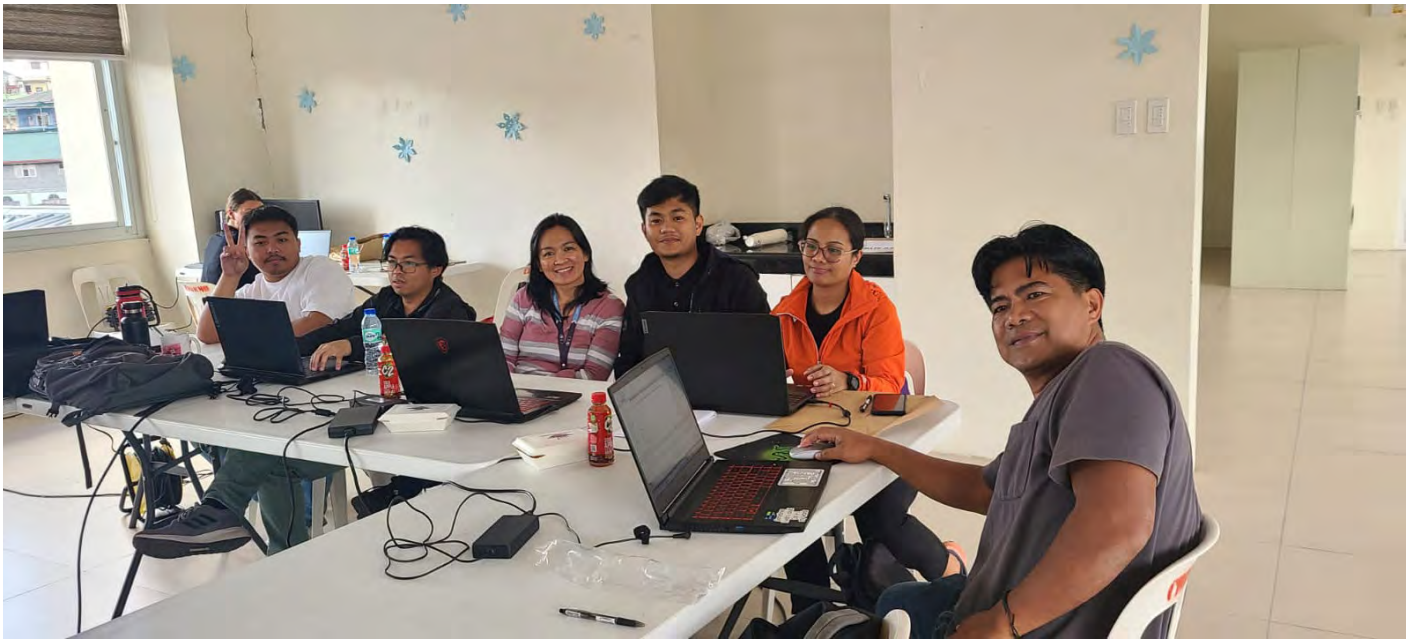
Source: Ramboll

Moreover, from the baseline knowledge assessment it appears that the time requirements for the 2023 training program moderately clashed with participants' previous work commitments, although this issue appears to be resolved during the pre- monsoon training. In this context, the submission of commitment letters becomes crucial for clearly outlining expectations before training commences. Participants also express agreement regarding the training's relevance, understanding its objectives, and recognizing the significance of topics covered in the OTJ sessions in relation to their roles.

Participants were also encouraged to provide written feedback, and many pointed out that the training greatly improved their understanding of the project, allowing them to concentrate more effectively on their individual responsibilities. They also stressed the invaluable role of hands-on experience in facilitating the learning process. The practical and experiential nature of the training was instrumental in strengthening their comprehension and skill development.

After the completion of the post-monsoon OTJ training participants stated that "The training was great. There is always so much learning each time from the covered topics and also from each other." The training has been defined as "rigorous and technical" but "the instructors are flexible enough to level themselves and adjust to the capability of each member of the O&M team." Overall participants express that they feel "proud of themselves in coming this far in understanding the FEWS".

Figure 4.12: O&M team members during an OTJ training session in October 2023



Source: Ramboll

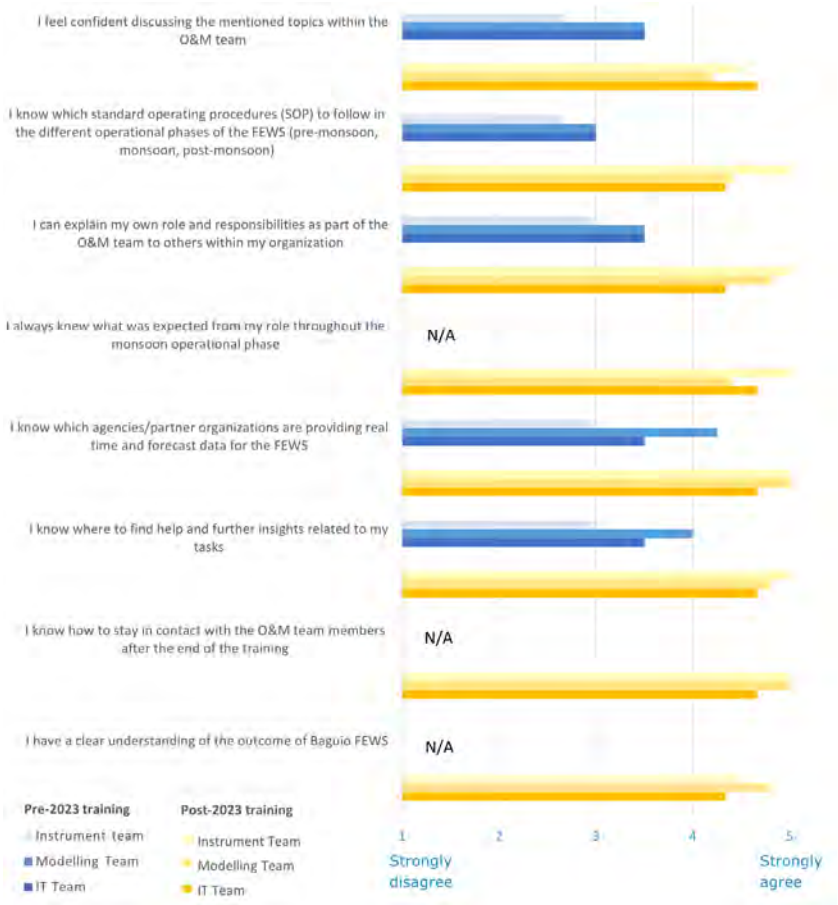
4.3 SUSTAINMENT OF O&M TEAM AND TECHNICAL CAPACITY

One of the main goals of the training was to enhance participants' confidence in following standard operating procedures and understanding their roles and responsibilities. Ensuring a clear comprehension of these procedures and responsibilities, is a first step towards the self-sufficiency of the O&M team in the long run.

Figure 4 13 provides a visual representation of the change in confidence levels for each team before the start of the 2023 program and after the conclusion of the program. Prior to the training, participants had a moderate understanding of the procedures to follow and their respective roles and responsibilities. However, following the OTJ training in the consolidation phase, there has been a large increase in confidence levels across all teams. Confidence levels especially increased regarding confidence in understanding standard operating procedures (SOPs) and knowing where to seek assistance. Thus, the high confidence levels demonstrate that the format and content of the 2023 training program has successfully contributed towards achieving the training goals. The results show that the team has gained experience in working as an O&M team in operating and maintaining the FEWS throughout the monsoon season.

Given that the pre-2023 training survey took place before the training commenced and served to establish a knowledge baseline ahead of the consolidation phase, it lacks questions related to topics addressed throughout the 2023 training, as indicated by "N/A" in the figure below. These include understanding expectations for their role during the monsoon phase, knowledge of how to stay in contact with the O&M members and having a clear understanding of the outcomes of Baguio FEWS.

Figure 4.13: Pre and post OTJ confidence levels



Source: Ramboll

In addition to the general improvement in knowledge and confidence levels, all teams acknowledge the significance of ongoing external support from the project team. When asked about how the technical experts from the project team can best assist and support them and the O&M team during the monsoon phase, their responses emphasized the importance of receiving assistance during this critical period from multiple monsoon seasons. They also expressed the need for continuous guidance and training to ensure optimal performance and to maintain the FEWS in the future.

4.4 FEEDBACK FROM THE PROJECT TEAM AND ON-SITE OBSERVATIONS

Throughout the entire training program, the team has showed high motivation and dedication. It was observed that, all O&M team members feel a great personal connection to the FEWS and understand the positive impact the system can have on Baguio City. The team feel a sense of ownership and want to see the project succeed which is demonstrated by the effort they make in all training sessions.

An aspect that has become evident throughout the consolidation phase is, that the team is starting to work together as a team. The participants come from different backgrounds and departments/organizations and has not worked together before. It takes time and effort from all participants to build a strong team. The team members need to establish trust and relationships between one-another to truly come together and lift the complex task of sustaining the FEWS. In the training sessions throughout the consolidation phase, and particularly in the post-monsoon OTJ training, the project team observed a good team collaboration and a sense of trust and honest communication between team members. Everyone seems to feel safe in the team and the tone of communication has become more informal; the members seem to get along well and requested a social team building activity as part of the OTJ training program to strengthen the sense of team spirit. The team members were willing to share where they see their self-identified personal knowledge gaps and express concerns clearly. Furthermore, the team demonstrates transparent communication of concerns and questions to the trainers from the project team. The establishment of a safe communication space within the O&M team is key to sustainment of team.

The O&M team members can present their work and tasks to their peers in a concise manner, demonstrating that they understand the tasks to be completed. The team members express that they understand why certain tasks need to be performed and their importance for the overall system operation. Furthermore, they ask complex technical details related to system parameters and their impact, which underlines their advanced knowledge of the topics related to FEWS.

The team has a lot of knowledge and are not starting to apply this knowledge. The coming monsoon seasons will be crucial for the team as they need to further utilize their learnings from the 2023 full-scale test and initiate the real-time operation in the upcoming years. The team members need to find a way to sustain their knowledge and skills and come together to plan the upcoming operational phases. To guide the team in sustaining the system, the system sustainment plan is being drafted based on inputs from the O&M team. The O&M team participated in a sustainment workshop during the post-monsoon OTJ training to provide input on components to be included in the sustainment plan. The outcomes of the workshop highlight that the team demonstrates very good knowledge of the system and the efforts required to sustain it. As a group, they are aware of the areas where the system is advanced and the areas where there is a need for further work to ensure sustainment.

During all site visits to Baguio and in weekly communication with the FEWS O&M team, it has been observed that the LGU staff have many work commitments, long workdays, and high workloads. The CDRRMO are anchoring many projects and their commitment and dedication to enhancing resiliency in Baguio is widely recognized. The CDRRMO hosts many national and international visitors from other LGU's, ADB, embassies, etc. The CDRRMO have limited resources and the work pressure on the available resources is extremely high. Although LGU staff have a strong will to learn and push the FEWS forward, it is evident that they cannot cope with the complexities of the FEWS if their workload remains the same. This is a big risk to the long-term system sustainment, as the LGU staff may not have the time required to maintain and operate the FEWS due to limited resource availability. There is a need for additional resources at the CDRRMO to sustain the FEWS as there is a risk of staff burn-out due to high workloads. The risks related to system sustainment and the recommended mitigation actions are further described in D2 Monsoon Assessment of FEWS operation and post-monsoon system updates, city graduation and SOP updates report.

Figure 4.14: The O&M team receiving guidance from one of the trainers during an OTJ training session.

Source: Ramboll

4.5 ASSESSMENT OF THE O&M TEAM'S ABILITY TO INDEPENDENTLY OPERATE AND MAINTAIN THE FEWS

There is a need to test the FEWS throughout multiple monsoon seasons to trouble-shoot, adjust and calibrate the system, which requires experience and expertise in FEWS. During feedback sessions, the O&M team has expressed concerns about being unable to meet expectations and are anxious to be "left alone" without technical support beyond 2023.

As expected, the program effectiveness assessment shows that the capacities of the FEWS O&M team have increased through on-the-job training and implementation of standard operating procedures in 2023 throughout the consolidation phase. There is a high potential for the system to be sustained and the team is starting to work well together, however, the team does not yet have the experience to independently operate and maintain the FEWS. The team can fully undertake most of the SOPs but need sparring for quality assurance and complex trouble shooting. Furthermore, the team also need experience in planning and executing the various activities throughout the operational activities. Thus, further technical support for finetuning, testing, and operating the system will be needed beyond 2023.

5. CONCLUSION AND RECOMMENDED NEXT STEPS

Ms. Vilakshna Parmar of the Ramboll team during an in-person training session in Baguio
Source: Carlo Valdez

This report provides an overview of the 2023 Baguio FEWS Training Program and describes the training results from all training activities completed in the operational phases of the FEWS: pre-monsoon, monsoon, and post-monsoon.

The aim of '2023 Baguio FEWS Training Program' is to strengthen local capacity for independent operation and maintenance of the FEWS in parallel with implementing, testing and refining the system. The pre-monsoon training activities were built around three main areas: technical, procedures, and roles and responsibilities. The pre-monsoon activities have been two-fold: online sessions (9 sessions from end-April to June) and OTJ training (8-day program in June). After completing the pre-monsoon training, the O&M team operated the FEWS throughout the monsoon with support from the technical project team and then participated in a post-monsoon OTJ training. The post-monsoon training was built around five main areas: technical, performance assessment, procedures, sustainment, and roles and responsibilities. Furthermore, the post-monsoon training aimed at assessing the team's ability to operate the system and identifying the extent of any additional technical support.

5.1 TAKEAWAYS FROM THE CONCLUDED TRAINING

The results from satisfaction and knowledge surveys demonstrate that the training program successfully achieved its objective of increasing the local capacity to operate and maintain the FEWS. The knowledge level for the average participant improved from 3.1/5 prior to the training kick-off in April 2023 to 4.4/5 after completion of all training activities in October 2023. The participant satisfaction has remained high throughout the training program.

A key lesson from this training is the significance of maintaining ongoing and transparent communication between trainers and participants. Employing surveys before and after each training session enabled participants to self-assess their knowledge, express their needs, and enabled trainers to adjust the sessions based on the feedback received.

Furthermore, the training highlighted the importance of bringing participants together in a single location for OTJ training. This approach significantly enhances interaction and fosters collaboration among the O&M team members. The in-person setting encourages the exchange of ideas and the sharing of experiences, ultimately leading to more effective teamwork and knowledge transfer.

Lastly, it is crucial to remember that learning is a continuous and evolving journey that requires consistent nurturing and investment. The level of technical knowledge and skills can fluctuate over time and need continuous training and practical application to produce meaningful and lasting transformations.

Figure 5.1: Graduation and certificate awarding ceremony following the completion of the 2023 Baguio FEWS training program in October 2023

Source: Ramboll

5.2 NEEDS ASSESSMENT FOR CONTINUOUS TRAINING ACTIVITIES

The capacities within the FEWS O&M team steadily increased during the 2023 Baguio FEWS training program, however, they are not yet at the professional level required to enable the team to be fully responsible for the operation and maintenance of the FEWS. Thus, further training and technical support for finetuning, testing, and operating the system will be needed beyond 2023.

The following annual training activities are recommended for 2024-2025:

- Pre-monsoon: online expert advice sessions and guidance in completion of pre-monsoon SOPs and pre-monsoon in-person OTJ training to ensure proper initiation of real-time monsoon operation
- Monsoon: expert advice and as-needed support in real-time operation, maintenance and troubleshooting of the FEWS
- Post-monsoon: online expert advice as-needed and guidance in completion of post-monsoon SOPs and post-monsoon in-person OTJ training to ensure proper assessment of system performance and implementation of post-monsoon SOPs

The extent of the additional technical support required is further described in D2 Monsoon Assessment of FEWS operation and post-monsoon system updates, city graduation and SOP updates report.

The Ramboll team and the Baguio FEWS O&M Team during the field visit at Balili River
Source: Carlo Valdez

APPENDIX A

Table A.1: Participants' name, team and gender

No.	Name	Team	Gender	Organization
1.	Carlo Jay S. Valdez	Modelling Team	Male	University of the Cordilleras (UC)
2.	Chester Moling Comicho	Modelling Team	Male	Baguio LGU, City Engineering Office (CEO)
3.	Francis Camarao*	(IT Team)	Male	Baguio LGU, Management Information and Technology Division (MITD)
4.	Hansi Dinumla	Instrument Team	Female	DOST-CAR
5.	Janice Kaye L. Aquino	Modelling Team	Female	Saint Louis University
6.	King B. Gunid	Instrument Team	Male	Baguio LGU, City Disaster Risk Reduction Management Office (CDRRMO)
7.	Mark Jenesis Laory**	Instrument Team	Male	DOST-CAR
8.	Michael Edwin Eugenio	IT Team	Male	Baguio LGU, Management Information and Technology Division (MITD)
9.	Rensz Isaac G. Pinlac	Instrument Team	Male	Baguio LGU, City Disaster Risk Reduction Management Office (CDRRMO)
10.	Shan-ry Roberts	IT Team	Male	Baguio LGU, Management Information and Technology Division (MITD)
11.	Steven Ramirez**	Instrument Team	Male	Baguio LGU, Management Information and Technology Division (MITD)
12.	Stephanie Pinkisan Trinidad	Modelling Team	Female	Baguio LGU, City Disaster Risk Reduction Management Office (CDRRMO)
13.	Larry H. Esperanza	Modelling Team	Male	PAGASA, Baguio Station
14.	Serge Carlo Guevarra Parocha*	-	Male	Department of Public Works and Highways Baguio City District Engineering Office (DPWH-BCDEO)
15.	Nathaniel Vincent Lubrica*	-	Male	University of the Cordilleras (UC)
* Left the capacity building program in 2022, did not participate in the 2023 Baguio FEWS Training Program ** Joined the FEWS O&M team in 2023				

Source: Ramboll

ABOUT THE ASEAN AUSTRALIA SMART CITIES TRUST FUND

The ASEAN Australia Smart Cities Trust Fund (AASCTF) assists ASEAN cities in enhancing their planning systems, service delivery, and financial management by developing and testing appropriate digital urban solutions and systems. By working with cities, AASCTF facilitates their transformation to become more livable, resilient, and inclusive, while in the process identifying scalable best and next practices to be replicated across cities in Asia and the Pacific. The Trust Fund is supported by the Government of Australia through the Department of Foreign Affairs and Trade, managed by the Asian Development Bank, and implemented by Ramboll.

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