Establishment of an integrated salinity intrusion data sharing system for adaptation to the climate change impacts

Deliverable 1.1 Detailed work plan

V2 12 June 2025

Prepared for CTCN and VNMC

The expert in **WATER ENVIRONMENTS**

Establishment of an integrated salinity intrusion data sharing system for adaptation to the climate change impacts in the Mekong Delta of Viet Nam

Deliverable 1.1 Implementation plan

CTCN Ref. **RFP 3100006172**

Prepared for: CTCN and VNMC and VNMC

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Approval date: DATE
Revision: Final 1.0
Classification: **Restricted:** This document may be shared within DHI whereas sharing it outside the DHI Group entities is subject to the client's prior approval.

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Contents

Figures

Tables

No table of figures entries found.

Appendices

1 Executive summary

This report pertains project that is the result of a request received by CTCN (Climate Technology Centre and Network) from Viet Nam to provide technical assistance on "**Establishment of an integrated salinity intrusion data sharing system for adaptation to the climate change impacts in the Mekong Delta of Viet Nam**".

The proponent of this technical assistance request is the Viet Nam National Mekong Committee (VNMC)/Cuu Long River Basin Commission, and the respective **CTCN project reference number is RFP 3100006172**.

Project kick-off meeting was held with the client (CTCN) and project proponent (VNMC) on 3rd of March 2025 to officially start the work on project.

This report pertains project **Deliverable 1.1 - detailed work plan** for delivery on project by DHI, as per March 2025.

The proposed technical delivery approach and plan in this report is closely aligned with the originally submitted technical proposal by DHI and is driven by the desire to provide an efficient, low-risk and timely implementation of the assignment that fully meets the client's needs in using proven technologies to build the integrated IMS, an information management system for data sharing and forecasting the status of salinity intrusion in the Mekong Delta.

This report includes:

- Proposed project implementation plan with minor updates
- Project implementation organogram, with some updates in respect to the DHI team
- Updated summary overview table of project deliverables and respective delivery timelines as per above;
- Annex A containing details on the technical scope of the IMS and model setup
- Annex B containing CVs of the newly added team members.

2 Project implementation plan

This section outlines project technical implementation plan, describing key activities, deliverables and tentative timelines.

2.1 Project technical approach

Four main phases of our technical implementation approach are described below. These will include:

1. **Inception and system scoping** – to create a full picture of the current situation on salinity monitoring data and systems in Vietnam as well as stakeholder needs and current gaps. The outcomes of this phase will inform the technical solution design and specifications as well as capacity development programme design.
2. **Development of the integrated salinity information management system** – informed by the extensive stakeholder consultations as well as data collection and research, this phase will focus on iterative development of the technical aspects of the system in close collaboration with key stakeholders.
3. **Interface development, deployment, and delivery to the client** – during this phase the dedicated interfaces for dissemination of the key results will be developed as part of the integrated salinity IMS, and the system will be deployed on the VNMC server.
4. **Training and capacity development** – during this phase the focus will be on capacitating the responsible institutions nationally to be fully versed in use and maintenance of the system as well as ensuring that the relevant stakeholders receive, understand and are able to use the salinity monitoring information generated by the system for decision-making and adaptation actions.

Each of the main phases will include a number of sub-steps which are summarized in the overview figure below.

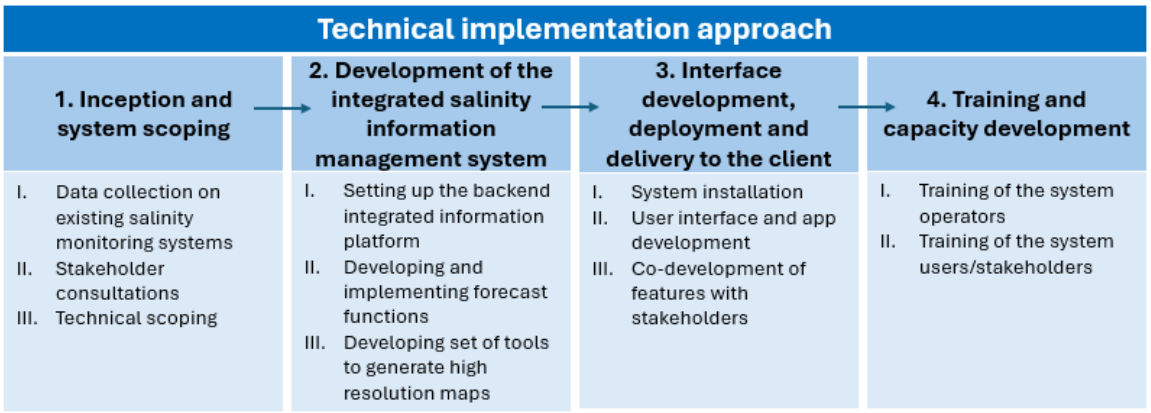

Figure 1 Technical implementation approach overview

The proposed approach will be discussed with the VNMC and stakeholder Working Group in the initial phases of the project and adjustments made if required based on the discussions.

2.2 Project activities and deliverables

2.2.1 Output 1: Development of implementation planning and periodical reporting documents

DHI has extensive experience in implementing CTCN projects and is familiar with the necessary reporting requirements. Deliverables under Output 1 will thus be prepared in the required CTCN format and according to the stipulated timelines.

Main deliverables of Activity 1.1 will be following mandatory CTCN reporting items:

*i) Detailed work plan (**this report**)*
ii) Monitoring and evaluation plan
iii) CTCN Impact Description
iv) Closure and Data Collection report
v) Project webinar
vi) Gender assessment.

Deliverables for Output 1	*Delivery timelines*
*1.1 Detailed **work plan** (delivered)*	*30 April 2025*
*1.2 Monitoring and **evaluation plan** (delivered)*	*30 April 2025*
1.3 CTCN Impact description (delivered)	*30 April 2025*
*1.4 Closure and data collection **report***	*Month 12*
*1.5 Project **webinar***	*Month 12*
*1.6 Gender **assessment***	*Month 5*

2.2.2 Output 2: Stakeholder engagement and assessment of available data and existing salinity monitoring & forecasting systems in VMD

Activity 2.1: Preparatory analysis on current infrastructure and processes regarding monitoring of salinity intrusion in VMD and relevant international best practices

This activity will include:

- Review of existing documents, protocols and agreements pertaining to salinity monitoring in the Delta.
- Bilateral meetings with key stakeholders of the project, including the VNMC, NDE and MONRE, in order to verify the full picture of current processes/protocols for the generation, provision, management and sharing arrangements of salinity forecasting & monitoring data as well as current prevailing technologies and risks associated with saline intrusion.
- National gender expert review of any aspects relating to the gender sensitivities – e.g. in how impacts of salinity intrusion are distributed among different water users, the technical capacities of the staff managing salinity data, the ability to receive and interpret salinity monitoring results and other.

Activity 2.2: Stakeholder mapping and establishment of a project working group

This activity will include:

- Mapping stakeholders involved in collecting, monitoring, sharing and utilizing the salinity data, creating an overview of all stakeholders that will need to be involved at different levels/stages during and after implementation of this project.
- Consultations with the PP, NDE and other key stakeholders to determine project working group (WG) composition. This list will be proposed to the PP and NDE for approval or amendments.
- Development of Terms of Reference (ToR) for the working group's tasks and stakeholder engagement plan for the duration of the project.
- Online working group meeting to approve the ToR and introduce the working group to the work plan and objectives of the project.

The national gender expert will advise on appropriate representation of vulnerable groups and gender-balanced representation in this working group.

Activity 2.3: Stakeholder inception workshop

This activity will include:

- DHI mission to Viet Nam to organize and join the multi-stakeholder inception workshop with PP, NDE and key project stakeholders. It is expected that the workshop will be held at the VNMC offices and will be attended by up to 20 participants.

During the inception mission, the following aspects are expected to be covered in the inception workshop agenda:

- Brief overview of the salinity intrusion challenges in VMD, their impacts on people and nature in the delta, the climate change challenges and associated need for data and better salinity data management
- Presenting the TA objectives, timeline and status to the stakeholders
- Understanding existing status of salinity monitoring, the roles of stakeholders, procedures and gaps and needs (institutional and technical)
- Collecting any feedback from stakeholders on the findings to date and proposed next steps as laid out by the technical assistance plan.

Activity 2.4: Capacity needs assessment and draft capacity development plan

This activity will include:

- Preparation of a salinity monitoring capacity needs assessment, covering both technical and human capacity aspects
- Preparation of capacity needs assessment report. The report will include findings and recommendations for strengthening the network of salinity monitoring stations, technology upgrades and the outline of technical needs for the integrated salinity monitoring system (including how it should link and operate in conjunction with existing information and DSS infrastructure in the VMD). It will also include aspects of needed human capacity building activities for current and potential future staff. The national gender expert will also be involved in this activity to ensure that the program and its contents are developed using a gender sensitive approach. The gender assessment findings will be included as a separate annex to the Capacity Needs Assessment Report
- NEW supplementary end user needs assessment for the select provinces: discuss with selected pilot province representatives on their salinity data needs, what information would be most useful, how they would use it and to inform what decisions.
- Development of a draft capacity development plan to be implemented during the project. The preparation of this plan will be based on the previous analyses conducted as well as the stakeholder inception workshop and the working group meeting outputs.

Deliverables for Output 2	*TENTATIVE Delivery timelines*
*2.1 **Report** with findings from preliminary stock-take of salinity monitoring in VMD (including a chapter on gender aspects).*	*Month 4*
2.2 TOR and minutes of the first meeting of the project working group (including composition).	*Month 4*
*2.3 Stakeholders Inception Workshop **Report**, including meeting attendees list, agenda and meeting minutes summary*	*Month 4*
*2.4.1. Capacity Needs Assessment **Report**, including finalized findings from the inception discussions and stock-taking analysis as well as gender analysis*	*Month 5*
*2.4.2: DRAFT Capacity Development **Plan***	*Month 5*

2.3 Output 3: Develop an integrated salinity monitoring IMS including database, software and application to exchange information and near-real time data on saline intrusion[1]

Activity 3.1: Develop an integrated salinity monitoring IMS including: database, software, and mobile-compatible application to exchange information and near-real time data

This activity will include:

- Development of the integrated salinity information management system (IMS). The IMS design will include database, the associated software for PC, and connection protocols to enable salinity data collection and exchange, API at back-end server for any front-end apps as well as documenting the relevant specifications for capacity development and sustainability purposes.
- Configuration of the IMS with data sharing protocols corresponding to identified salinity monitoring systems in VMD, ready-to-share near real-time monitoring data received from salinity monitoring systems **in mobile compatible WEB app** as per agreed specifications.

Activity 3.2: Forecast near real-time salinity intrusion in the VMD

This activity will include:

- Establishment of the forecasting models required to provide near real-time data on salinity intrusion in the VMD (the temporary resolution dependent on the underlying hydraulic models provided)
- Setting up the hydrological and hydraulics models for generation of forecasting and other decision support information to the VNMC that pertain to extent and severity of saline intrusion. (The underlying models will be provided by VNMC, with limited advisory support from DHI).
- Calibration of the models for salinity intrusion, and assimilation of the salinity data from the IMS.
- Setting up of forecasting model in the new IMS for near real-time running.

Activity 3.3: Develop a set of tools to generate high-res mapping of saline intrusion progress in the VMD from near real-time monitoring data

This activity will include:

- Development and testing of the integrated tools within the integrated salinity monitoring IMS to generate and store high-resolution maps (e.g. 2D interpolation map) of salinity intrusion in VMD. DHI team based in Vietnam will consult the PP and collect feedback from relevant stakeholders on the format and features desired for this type of visualization products to ensure that the salinity intrusion monitoring results are visualized and shared in the most effective way
- Development of technical/user manual information for the software and applications[2].

Deliverables for Output 3	*Delivery timelines*
*3.1 Integrated **salinity monitoring IMS/Platform** installed at existing server of VNMC.*	*Month 9*
*3.2 **Salinity forecasting models** set up and configured to the integrated salinity IMS and ready to share forecasting data in the channels and formats agreed with relevant stakeholders (e.g. via channels such as Web/Apps).*	*Month 9*
*3.3.1 **Mapping tool** configured in the integrated salinity IMS and ready-to-share high resolution maps of ongoing salinity intrusion processes of identified monitoring areas in formats agreed with the stakeholders.*	*Month 10*

[1] **See Annex A for technical details on the agreed IMS and model specifications**

[2] Professional technical manuals are already available for many of DHI's core DSS and IMS system elements. These manuals will be merged, condensed etc. as appropriate and updated with the necessary details of the customization for the selected technologies, taking into account the level of technical understanding of the users in VNMC.

*3.3.2: **Report** on establishment of a mechanism for sharing near-real-time salinity monitoring data in the VMD and related technical reports, including User's Manual of software, application, and tools*	*Month 10*

2.4 Output 4: Capacity building for the effective use of the integrated salinity monitoring IMS

Activity 4.1: Produce training materials & deliver training to VNMC and system operators

This activity will include:

- Finalizing the draft capacity development programme developed under Activity 2.4 and undertake necessary amendments and updates to ensure that training correctly reflects the final version of the integrated salinity monitoring system.
- Delivering training to VNMC and system operators on the usage and operation of the system as well as sustainability requirements. The proposed format of the training will be a face-to-face 3-day training session for a maximum of 10 participants on use of the system, assuming active involvement of the designated staff. A Manual on the system's operation will be prepared and used in the training.

Activity 4.2: Produce workshop materials and deliver a stakeholder workshop for end-users of the system and closure reports

This activity will include:

- Project closure workshop[3] with key stakeholders involved in collection and sharing of the salinity intrusion data. The proposed format of the workshop will be a half-day meeting for a maximum of 25 participants in total. Preparation of workshop materials with a view of serving as reference materials for ongoing use of the system by end users.
- Finalize the report on the capacity development, including summary of the conducted training activities of the project and material prepared for and outcomes of the technical training.
- Preparation of forms to collect feedback and evaluation from closure workshop participants, which will also be included in the closure report.
- Development of a brief project sustainability plan **(NEW ACTVITY).** It will outline further needs for technical and human capacity, including any institutional arrangements and resource needs, for future improvements and maintenance of the salinity monitoring system. It will also add budget estimates enabling use of the sustainability plan, in combination with the capacity needs development plan. The sustainability plan will be formulated to include elements that can support development future funding proposals.

Deliverables for Output 4	*Delivery timelines*
*4.1.1 **Training session** delivered to VNMC and other relevant system operators, and corresponding **training report**.*	Month 11
*4.1.2 **Manual** for system operators. The manual will be prefaced with a note on the roles and responsibilities (TOR) for designated system operators, prepared together with the respective institutions.*	Month 11
*4.2.1 Closure **stakeholder workshop** for end-users of the system, including material prepared (e.g. handouts for end-users).*	Month 11
*4.2.2 Final Capacity Development **report***	Month 11
*4.2.3 Project **closure reports** for CTCN*	Month 12

[3] Active involvement of the project proponent (VNMC) is expected in the organization of the workshop in support of the lead implementer, similarly to the stakeholder inception workshop (e.g. chairing the event, sending official invitations, and contributing to the agenda). DHI's national team located in Vietnam will help facilitate and guide these necessary preparatory activities.

*4.2.4 Signed **agreement confirming the 1-year maintenance** period after TA project concludes.*	Month 12
*4.2.5 Project **sustainability plan, final iteration (NEW DELIVERABLE)***	Month 12

3 Summary of project deliverables

Deliverables for project	Delivery timelines
Output 1: Development of implementation planning and periodical reporting document	*(tentative)*
*1.1 Detailed **work plan***	*30 April 2025*
1.2 Monitoring and **evaluation plan**	*30 April 2025*
1.3 CTCN Impact description	*30 April 2025*
*1.4 Closure and data collection **report***	*Month 12*
*1.5 Project **webinar***	*Month 12*
*1.6 Gender **assessment***	*Month 5*
Output 2: Stakeholder engagement, and assessment of available data and existing salinity monitoring & forecasting system in VMD	
*2.1 **Report** with findings from preliminary stock-take of salinity monitoring in VMD (including a chapter on gender aspects).*	*Month 4*
*2.2 **TOR and minutes** of the first meeting of the project working group (including composition).*	*Month 4*
*2.3 Stakeholder Inception **Workshop Report**, including meeting attendees list, agenda and meeting minutes summary*	*Month 4*
*2.4.1. Capacity Needs Assessment **Report**, including finalized findings from the inception discussions and stock-taking analysis as well as gender analysis*	*Month 5*
2.4.2: DRAFT Capacity Development Plan	*Month 5*
Output 3: Develop an integrated salinity monitoring IMS including database, software, mobile compatible web application to exchange information and near-real time data on saline intrusion	
*3.1 Integrated salinity monitoring **IMS/Platform** installed at existing server of VNMC.*	*Month 9*
*3.2 **Salinity forecasting models** set up and configured to the integrated salinity IMS and ready to share forecasting data in the channels and formats agreed with relevant stakeholders (e.g. via channels such as Web/Apps).*	*Month 9*
*3.3.1 **Mapping tool** configured in the integrated salinity IMS and ready-to-share high resolution maps of ongoing salinity intrusion processes of identified monitoring areas in formats agreed with the stakeholders.*	*Month 10*
*3.3.2: **Report** on establishment of a mechanism for sharing near-real-time salinity monitoring data in the VMD and related technical reports, including User's Manual of software, applications, and tools*	*Month 10*
Output 4: Capacity building for the effective use of the integrated salinity monitoring IMS	
*4.1.1 **Training session** delivered to VNMC and other relevant system operators, and corresponding **training report**.*	Month 11
*4.1.2 **Manual** for system operators. The manual will be prefaced with a note on the roles and responsibilities (TOR) for designated system operators, prepared together with the respective institutions.*	Month 11
*4.2.1 Closure **stakeholder workshop** for end-users of the system, including material prepared (e.g. handouts for end-users).*	Month 11
*4.2.2 Final Capacity Development **report***	Month 11
*4.2.3 Project **closure reports** for CTCN*	Month 12
*4.2.4 Signed **agreement confirming the 1-year maintenance** period after TA project concludes.*	Month 12
*4.2.5 Project **sustainability plan, final iteration (NEW DELIVERABLE)***	Month 12

4 Project timeline

Activities and Deliverables	Implementation work plan Months since effective start of implementation of project												
	1	2	3	4	5	6	7	8	9	10	11	12	x
Output 1: Development of implementation planning and periodical reporting documents													
Activity 1.1: Preparation of mandatory PM outputs	■	■	■	■									
D1.1 Detailed work plan		▲											
D1.2 Monitoring and evaluation plan		▲											
D1.3 CTCN Impact Description		▲											▲
D1.4 Closure and Data Collection report													▲
D1.5 Project webinar													▲
D1.6 Gender assessment				▲									
Output 2: Stakeholder engagement, and assessment of available data and existing salinity monitoring & forecasting systems in VMD													
Activity 2.1: Preparatory analysis on current infrastructure and processes regarding monitoring of salinity intrusion in VMD and relevant international best practices			■	■									
D2.1: Report : preliminary stock-take of salinity monitoring in VMD and best practices				▲									
Activity 2.2: Stakeholder mapping and establishment of a project working group			■	■									
D2.2: TOR and minutes of the first meeting of the project working group				▲									
Activity 2.3: Stakeholder inception workshop			■	■									
D2.3: Stakeholders Inception Workshop Report				▲									
Activity 2.4: Capacity needs assessment and draft capacity development plan			■	■	■								
D2.4.1 Capacity Needs Assessment Report					▲								
D2.4.2 DRAFT Capacity Development Plan					▲								
Output 3: Develop an integrated salinity monitoring IMS including database, software and application to exchange information and near-real time data on saline intrusion													
Activity 3.1: Develop an integrated salinity monitoring IMS and mobile-compatible app							■	■	■				
D3.1: Integrated salinity monitoring IMS/platform installed									▲				
Activity 3.2: Forecast near real-time salinity intrusion in the VMD							■	■	■				
D3.2: Salinity forecasting models that are set up and configured to the IMS and ready to share forecasting data									▲				
Activity 3.3: Develop a set of tools to generate high-resolution mapping of saline intrusion progress									■	■	■		
D 3.3.1: Mapping tool configured in the IMS and ready to share high res maps of salinity intrusion											▲		
D3.3.2: Report on establishment of a mechanism for sharing near-real time salinity monitoring data in the VMD											▲		
Output 4: Capacity building for the effective use of the integrated salinity monitoring IMS													
Activity 4.1 Produce training materials & deliver training to VNMC/ and system operators								■	■	■	■		
D4.1.1: Training session delivered to VNMC/ Cuu Long RBO/ relevant system operators													▲
D4.1.2: Manual for system operators													▲
Activity 4.2: Produce workshop materials and deliver a stakeholder workshop for end-users of the system												■	■
D 4.2.1: Closure stakeholder workshop for end-users of the system, including materials prepared													▲
D4.2.2: Final Capacity Development Plan report													▲
D 4.2.3 Project closure reports													▲
D4.2.4: Signed agreement from the lead implementer confirming the 01- year maintenance period													▲
D4.2.5: Project sustainability plan (NEW)													▲
								■	Activity period				
								▲	Deliverable				

5 Organisation and staffing

In the implementation of this project, DHI will draw on our in-house expertise to form a team consisting of our highly experienced international technical experts based in the DHI headquarters, who will work closely with our skilled national technical team based in DHI's Vietnam offices in Hanoi (Vietnam Head office) and Ho Chi Minh City.

The team proposed by DHI closely aligns with the requirements and staffing composition laid out in the terms of reference of the call. **Minor changes are proposed to account for staff availability changes in DHI since the original proposal submission**. The CVs of the newly added staff to the team are included in the Annex A of this report.

The proposed changes do not remove any of the initial positions in the originally submitted project organogram, but mostly constitute additions (adding new senior IE with extensive experience in Mekong River Basin, international expert with extensive salinity modelling experience in Viet Nam and new PM for coordination of work, which is DHI's long term CTCN portfolio manager.

The proposed project organisation is presented in Figure below.

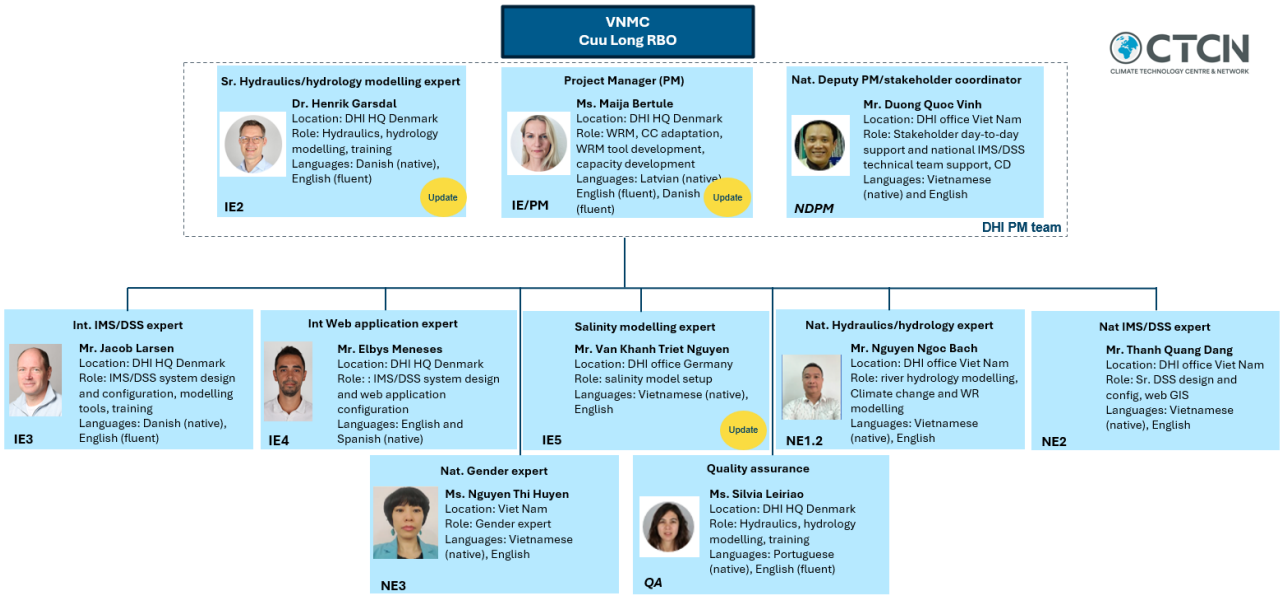

Figure 2 DHI Project implementation team

All except one (external national gender expert) are long-standing permanent DHI staff members and are used to working in multi-cultural and multi-disciplinary projects. All of the proposed team members have relevant project experience from major river basins in Vietnam and/or South-East Asia.

Appendix A Technical specifications of the IMS system and salinity models

This section of the detailed work plan outlines the proposed scope and technical specifications of the Information Management System (IMS), the technical solutions, geographic scope as well as salinity model details. It will be used as a reference point for system development and scop during the project implementation.

Appendix A.1 System setup summary

The system will be developed using DHI's technology, which is already extensively used in Vietnam and the region, including MIKE software, which is a platform to import, process, manage, and quality assure time series and GIS data, perform model calculations automatically, and disseminate results.

Our approach will be to customise DHI's well proven open-ended IMS platform to the needs of this project.

DHI proposes that the integrated salinity IMS is installed at an existing server of VNMC with the following key components:

- DHI MIKE + model
- MIKE OPERATIONS (database and tools, workbench)
- DHI Domain Services
- Mobile-compatible web application.

In view of efficiency, sustainability and resource availability, the implementation of this TA will build on already available models in VNMC and will calibrate the models for salinity intrusion modelling and forecasting.

Most importantly – the successful implementation of the project technical aspects will fully rely on availability and quality of the data provided by the relevant national stakeholders. Access to these data shall be facilitated by VNMC and the NDE of Viet Nam.

Appendix A.2 IMS specifications

In the design and development of this integrated salinity IMS, DHI will cooperate closely with the national stakeholders to understand their needs and the status of the current salinity monitoring and data sharing procedures. The project inception phase will be used to inform these activities in more detail.

After initial consultations, the project technical team will be using DHI's MIKE technology, to establish **an IMS that will be able to**:

- Collect, store, and manage information and salinity intrusion
- Apply forecast modelling on the salinity intrusion in the Viet Nam Delta
- Share information on the current situation on salinity intrusion, including high-resolution maps, to support decision-making and adaptation activities.

Work under this work stream will consist of setting up the back end of the system, where all the data exchange, data processing takes place.

The key criteria for a successful back-end development will be efficiency, sustainability and flexibility of the technical solution. **MIKE OPERATIONS will be used as the backbone component of the**

integrated salinity IMS that unifies all the components into one integrated platform. It has proven to be an efficient technology to handle similar operational systems and national stakeholders are experienced in working with this platform.

The MIKE OPERATIONS platform will then be coupled with the selected MIKE modelling software to undertake salinity modelling/forecasting exercise.

DHI Domain Services will be used for the API back-end server.

Appendix A.3 Salinity model specifications

The model complex necessary to simulate the salinity intrusion in the Delta consists of a hydrological model (rainfall-runoff), and a 1D river model with upstream boundary at Kratie in Cambodia and downstream boundary at the sea.

To forecast salinity intrusion in the Viet Nam Delta it is necessary to set up and run a near real-time model, which describes the hydrological and hydrodynamic processes as well as the transport of salt.

To do this, a hydrodynamic **MIKE+** model for flow and water level predictions as well as an advection-dispersion module to simulate and forecast salinity concentration will be included in the system, including the usage of advanced data assimilation.

The forecast model will include the components described in the following diagram:

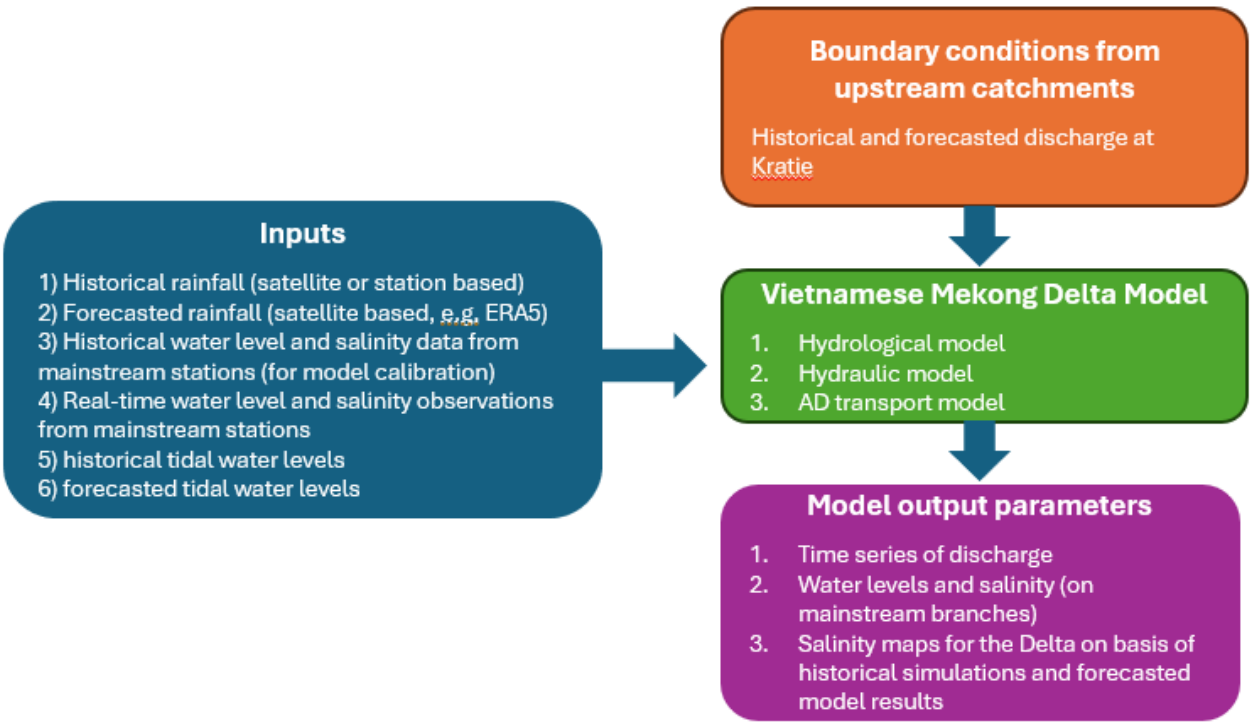

Figure 3 Modelling framework for the forecast salinity model to be included in the IMS

Forecast boundaries

The forecast boundary conditions from the upstream catchments of the Mekong Basin and the sea level at downstream will be used from existing forecasting models available at VNMC. DHI proposes that the data sources are to be linked to the integrated system to be developed where possible. This is an important data for the model results to be representative and reliable. The boundaries data include:

1. Forecast rainfall
2. Forecast discharge from upstream
3. Forecast water level at sea boundaries
4. Forecast salinity at freshwater and sea boundaries
5. Measured salinity data

The Vietnamese Mekong Delta Model for the salinity monitoring IMS will thus be composed of these following components:

1. **The hydrological model.** The hydrological model will allow computation of the discharge along the river from Kratie and downstream, as well as to provide direct rainfall on the Tonle Sap lake and Delta surfaces. The MIKE+ Rainfall Runoff module will be used. This module includes a series of surface runoff models and one continuous hydrological model. It is expected that VNMC provide a calibrated and validated rainfall model (using either satellite-based rainfall or station based data) which can be used for forecasting purpose. The model output (runoff) will then serve as input to the hydraulic model. When operating in forecast mode the model will utilize satellite-based rainfall data.
2. **Hydraulic model.** The MIKE+ River module that provides a platform for building and executing one-dimensional river models for a large variety of river-related project applications will be used for hydrodynamic modelling. A river model in MIKE+ is described with river branches, cross sections, bed roughness, culverts, weirs, gates, direct discharges. The project shall build on the already available MIKE+ model within VNMC with all pertaining information on the above (thus no new model development is expected as part of the project activities undertaken by DHI team). The model shall extend from Kratie in Cambodia to the sea in Vietnam. At the upstream end the model must receive observed discharge for any historical runs to be made. Used in forecast mode the model must receive forecasted discharge at Kratie. It is expected that VNMC provide the relevant historical data as well as facilitate the connection to possible forecast systems (RFDMC under MRC or locally in Vietnam).
3. **Advection Dispersion Model**. The Advection-Dispersion (AD) is an add-on to the MIKE+ model. It simulates the transport of dissolved substances, and suspended fine sediments in the network will therefore be used to simulate salt intrusion. The model is based on the one-dimensional transport equations for dissolved materials. The equations reflect two transport mechanisms: the advective transport with the mean flow velocity, and the dispersive transport due to concentration gradients in the water. The Advection dispersion model will be used to simulate any possible historical events for model calibration and will be used for the salinity forecast as well.
4. **Data assimilation of forecast data and measured data**. Data assimilation module will be used to update the model results to match the real-time observations and thereby improve forecast accuracy for the salinity intrusion.
5. **Automated execution of the modelling framework in the near real-time forecast system.** The system will be set up to automatically import real-time data and execute models and other related pre- and post-processing tasks. This is done in MIKE OPERATIONS, which is built on the need to support real-time operations and forecasting workflow, availing an intuitive and lightweight dedicated platform focusing on the core operations functionality. The degree to which near-real time forecasting will be possible will be determined by the quality and the access to the relevant data provided by the respective national institutions. DHI will work closely with VNMC and NDE to find the best possible solutions and alternatives for where challenges with data access or quality may arise.

In this project, the models will be inherited from VNMC. I.e. **no new model development will be undertaken as part of this TA scope – the salinity intrusion modelling work will build on the**

existing models held by VNMC. The project will utilize existing calibrated hydrodynamic models within VNMC which will be calibrated to be able to provide salinity forecasting information and maps.

Current models used by the VNMC for official monitoring and forecasting of salinity intrusion in the Mekong Delta are MIKE 11 and MIKE HYDRO River, developed by DHI (predecessors of MIKE+).

Other salinity modelling systems will also be considered, e.g. the one of the most active systems on salinity monitoring is currently being operated by the Southern Institute of Water Resource Research (SIWRR) which is based on MIKE HYDRO River and MIKE OPERATIONS.

In line with the latest developments in software, and in alignment with the regional activities under the MRC activities in the region, **it will be determined whether transition from MIKE11 to MIKE+ is appropriate for the long-term sustainability of the salinity monitoring IMS**.

It is therefore proposed that **MIKE+ (or MIKE11) together with MIKE OPERATIONS form the basis for the centralized multifunctional IMS platform**, taking advantage of the well tested and proven technology and readily available functionality for data management and integration with real-time telemetry systems, data analysis, integration with model tools, and dissemination of data.

Appendix A.4 Geographic scope

The project IMS and salinity modelling and forecasting will cover selected areas of the Viet Nam Mekong Delta – these are to be determined in discussions with VNMC depending on data availability and model coverage.

As a starting point it is suggested that the salinity model cover the entire Mekong Delta in Viet Nam. The exact detailing of the rivers and channels will depend on the MIKE+ model submitted by VNMC.

Regardless of the detailing, the salinity model will be calibrated against data from stations on the mainstream river branches in the Mekong Delta (i.e. not on the tributary channels).

Forecasted salinity will be provided on maps for the entire delta using the 1D results as predicted and will only be shown as time series for mainstream stations.

Appendix A.5 Data

One of the key objectives with the establishment of the IMS will be to consolidate the salinity data gathered by the different monitoring stations to enable more effective and strategic management of the salinity intrusion. The quality of the modelling outputs will also depend on the quality and free access to the relevant data from Viet Nam.

The project implementation success is therefore fully reliant on the data quality and free access from the relevant monitoring stations and respective data holders within Viet Nam.

The project proponent, VNMC, and NDE shall facilitate the access and agreements on data access with their national counterparts during the project implementation. DHI technical team will work closely with VNMC to guide questions on data, data quality, as well as gap-filling where such may be necessary.

All the input data will serve for the model construction, calibration, and validation and will therefore determine the quality of the salinity modelling outputs.

We foresee the following data to be required from the national institutions:

- Rainfall observations
- Observed water level and salinity from mainstream stations in the Delta as historical and real-time data
- Tidal levels at the mouth of the river branches at the sea

The inception phase of the project will be used to determine what existing salinity data will be included in the IMS. The main criteria for salinity data inclusion in the IMS will be following:

- ✓ Data access – the most critical criteria will be data access (without added cost) from the relevant national institutions
- ✓ Data quality – the data will need to have sufficient degree of temporal and spatial resolution for the project needs
- ✓ Data format and access – data will need to be made available, in a timely manner, in a format that can be utilized by the DHI project team and VNMC's salinity monitoring IMS.
- ✓ Data should cover mainstream stations in the Delta. If data from tributary channels are provided, these will be accessible through the IMS, but no comparison with model results will be made for stations on these channels under the scope of this project. This could, however, be added as an activity for next phase of the project work for future, if relevant.

Appendix A.6 System outputs

As a starting point, development of the technical functionalities for data display and sharing will focus on developing a set of tools to generate high-resolution maps of saline intrusion progress in the VMD from near real-time monitoring data.

The MIKE+ built-in 2D result mapping tools will be used to generate 2D time series intrusion maps (DFS2 format) and will be converted to another format (netCDF format) by using script as and if needed for the various stakeholders.

With this built-in tool in MIKE+, salinity will be mapped into 2D maps.

The main outputs of the IMS system will thus include following tools to support effective dissemination of the salinity intrusion data in the Viet Nam Mekong Delta:

- ✓ Automatically generated results on salinity intrusion, translated to **2D maps of salinity intrusion** in the Mekong delta.
- ✓ A **mobile-compatible web application** to support interaction with the data by the relevant technical focal points and institutions, as well as for dissemination of salinity intrusion data and forecasting amongst the relevant institutions and stakeholders in the country.

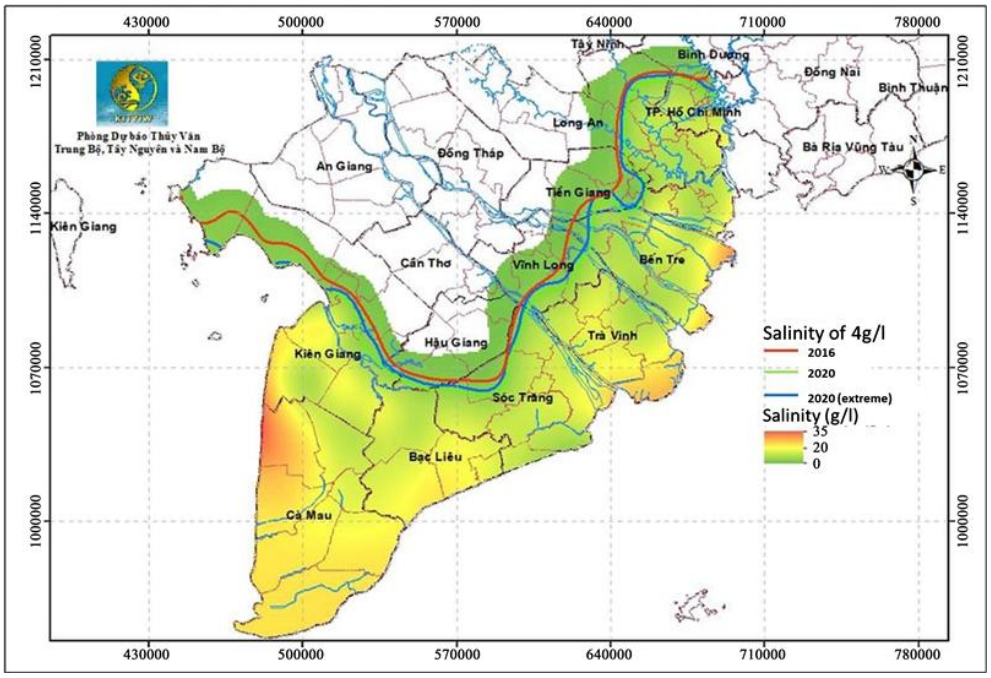

Figure 4 Example of 2D map that will be produced by the salinity intrusion IMS

The exact specifications of the integrated salinity IMS will be determined in close collaboration with the national stakeholders. This will be a participatory process where DHI will undertake consultations with relevant stakeholders, including the NDE, VNMC and organisations represented in the stakeholder working group.

Depending on the stakeholder needs, the MIKE OPERATIONS platform enables possibility for model outputs to be incorporated in report templates and published to web pages or groups of select viewers. These kinds of functionalities could e.g. be covered under training activities.

Appendix A.7 IMS user interface

The development of the integrated salinity monitoring IMS will also include the front-end interface to enable dissemination of the key results/outputs of the system.

Web page and the mobile compatible web application will be supporting salinity data dissemination. Through the web and app interfaces, users will be able to visualize, e.g. the results of latest forecast, compare to thresholds and alarms. The exact functions are to be identified and discussed together with key user stakeholders.

Dedicated interface will be co-developed to support salinity data dissemination through web-based application which will be fully mobile compatible, enabling viewing the data both on PC and mobile interfaces.

A **fully mobile-compatible web-based application** (instead of mobile application only) has been proposed in view of the cost-efficiency and sustainability of the solution. Previous experiences, including from Viet Nam, show that independent mobile applications cease to function after immediate project closure as they require frequent updating, bug fixing and upgrades. The project therefore proposes to utilize existing DHI's water tools portal framework to develop fully mobile compatible web application. This will present critical advantages of:

A. Broad mobile compatibility – web-based app that will be compatible with all mobile devices, regardless of the phone make (e.g. no need to separate android or iPhone developments)
B. Cost-efficiency (possibility to reuse many of the elements and of the tools to build better application, instead of developing from scratch); and
C. Sustainability – utilizing portal that is constantly updated and maintained ensuring potentially longer app lifetime after project closure.

Appendix A.8 Hosting arrangements

It is proposed that the **salinity monitoring IMS will be deployed on the VNMC's server**

Any direct data transmission protocols between selected salinity monitoring systems and central server, as well as the forecasting data sharing mechanisms will be agreed directly between VNMC and the respective national institutions. The agreed technical data sharing and exchange protocols for salinity data will then be configured accordingly with technical assistance from DHI.

A technical workshop will be conducted to demonstrate the operation of the salinity IMS system to stakeholders for comments and feedback for final completion. A technical manual/user guide will further be provided along with the final report.

Appendix B CVs of the added team members

Appendix B.1 Henrik Garsdal

Name of Expert:	Henrik Garsdal
Country of Citizenship/Residence	Danish/Denmark

Education:

School, college and/or University Attended	Degree/certificate or other specialised education obtained	Date Obtained
Aalborg University, Denmark	M.Sc. Environmental Engineering,	1992
University of Wisconsin, USA	Master Studies (Limnology, soil science, sediment transport in estuaries, statistics, ecology)	1990

Period	Employing organisation and your title/position. Contact information for references	Country	Summary of activities performed relevant to the Assignment
2018-present	DHI Senior Project Manager and Hydraulic Specialist For references: Oluf Zeilund Jessen, VP International Development, +45 45169200 ozj@dhigroup.com	Denmark	Senior Project Manager and Hydraulic Specialist, Modelling of inland water systems, hydraulics, sediment transport and morphology, reservoir sedimentation, flood hazard and vulnerability assessment, capacity building, project management, team leading. Sediment expert on the Ayeyarwadi River Basin project. Reservoir flushing in reservoirs in the Andes, Peru. Team Leader on Assam Integrated Flood and Erosion Management project, India. Team Leader on Mekong River Decision Support Framework and Basin planning.
2015 - 2018	DHI Head of Projects, Urban Water For references: Dr. Claus Skotner, Project Director +45 45169200, cso@dhigroup.com	Denmark	Head of Projects, Urban Water, Department Management, Project Portfolio Management, Resources Management, Urban Climate Projects, Urban Waste Water Projects.
2014 - 2015	DHI Business Development Manager For references: Dr. Kim Wium Olesen, Head of Department, +45 45169200 kwo@dhigroup.com	Denmark	Business development. Team leader on flood forecasting project in New York state, USA. River specialist on Mekong River project.
2011 - 2013	COWI A/S Chief Specialist/Market Manager For references: Henrik Winther, Senior Vice President +45 56400000, hew@cowi.com	Denmark	Team Leader on Climate Resilience Project in Maputo, Mozambique. Team Leader on Urban Drainage and Canal Modelling Project in Colombo, Sri Lanka. Project Manager on various minor water related projects.

2008 - 2010	COWI A/S Senior Project Engineer For references: Henrik Winther, Senior Vice President +45 56400000, hew@cowi.com	Denmark	Development of flood screening tool. Sedimentation consultancy in connection with larger infrastructure projects. Pollution studies of coastal areas and estuaries.
2008	DHI Water & Environment Business Area Manager and Senior Project Engineer For references: Jacob Høst Madsen, Chief Operating Officer, +45 45169200, jhm@dhigroup.com		Reservoir sedimentation studies, primarily in India. Project management.
2006 - 2008	DHI Water & Environment Senior Project Engineer For references: Jacob Høst Madsen, Chief Operating Officer, +45 45169200 jhm@dhigroup.com		River morphology studies, reservoir sedimentation. Project management and specialist on Baglihar Reservoir Sedimentation study, Himachal Pradesh, India. Project management.
2000 - 2006	DHI Water & Environment (A merger between Danish Hydraulic Institute and VKI Institute for the Water Environment) Project Engineer For references: Kim Wium Olesen, Head of Department +45 45169200, kwo@dhigroup.com		Project management and model specialist input on a number of Mekong River projects in Cambodia. Project management and hydrology/hydraulic specialist input on river basin studies in Cambodia and on Hydropower studies and water resource studies in Vietnam. Sediment specialist on Klang River project in Kuala Lumpur, Malaysia. Flood management and -modelling on the Swan River, Himachal Pradesh, India. Specialist input on Dhaka Water Supply Project, Bangladesh.
2000	Part time DHI Water & Environment, part time Danish Technical University, Denmark Research assistant For references: Kim Wium Olesen, Head of Department +45 45169200, kwo@dhigroup.com		Ph.D-study on river width adjustment.
1992 - 1999	Danish Hydraulic Institute Hydraulic Engineer For references: Kim Wium Olesen, Head of Department +45 45169200, kwo@dhigroup.com		MIKE model development, development of water quality and sediment transport modules for MOUSE (MIKE Urban). Hydraulic river modelling studies, numerous surface water studies. Sediment modeller on Elbe River and Port of Hamburg studies, Hydrologist on Songkhla Lake project in Thailand; Hydraulic Engineer on Melaka River study in Malaysia.

Membership in Professional Associations: Danish Society of Civil Engineers (IDA)

Language Skills:

Language	Reading	Speaking	Writing
Danish	Native	Native	Native
English	Excellent	Excellent	Excellent
German	Good	Good	Fair
French	Fair	Fair	Poor

Overview of relevant past projects:

Flood Forecasting and Integrated Flood Risk Management Planning for Beki, Buridehing, Jiadhal sub-basins of Brahmaputra River in Assam.

Year: 2024-

Location: Assam, India **Client**: WB

Main project features: The World Bank supports The Government of Assam with the project Assam Integrated River Basin Management Program (AIRBMP) to reduce flood and river erosion risks and adopt integrated water resources management in the state. The project focuses on strengthening institutions, filling critical knowledge gaps, and implementing integrated solutions to tackle the current challenges of floods and erosion, and to seize opportunities for climate resilient growth and improved livelihoods. **Position held:** Flood Forecasting expert.

Activities performed: Responsible for setting up hydrological and hydraulic flood forecast models in three sub-basins to the Brahmaputra basin and testing on one year monsoon data, as well as providing capacity building of counterpart staff.

Flood and Riverbank Erosion Risk Management along the Brahmaputra in Assam, India. Knowledge Product

Year: 2023-2024

Location: Assam, India **Client**: WB

Main project features: Desk study to develop a concise summary of all foregoing projects and experience gathered in Assam for integrated flood and erosion management in a single document: Knowledge Product. **Position held:** Flood and Erosion Specialist.

Mekong River Proactive Planning and Initial Basin Plan project

Year: 2023-2024

Location: Mekong River Basin

Client: Mekong River Commission

Main project features: The Mekong River Commission and its member countries wish to develop proactive and adaptive basin planning as well as short term operational planning.

Position held: Team Leader **Activities performed:** Responsible for the project as well as team management. Two workstreams are defined in the project: A Decision Support Framework DSF workstream aiming at a Mekong Basin DSF which encompasses all the features and functionalities to constitute an operational state-of-the-art user platform to: 1) Share and exchange data and information; 2) Understand river system behaviours; 3) Formulate and assess scenarios and planning development strategies; and 4) Provide Mekong River Commission with the capacity to undertake scientifically based decision support.

Medium and long-range flood and drought forecasting at RFDMC

Year: 2022 – 2023

Location: Cambodia

Client: Mekong River Commission Secretariat

Main project features: Development and implementation of a medium- and long-range flood forecast system for the lower Mekong Basin.

Position held: Team Leader

Activities performed: Responsible for the project as well as team management. Development of concept and methodology for incorporation of a medium and long-range flood and drought forecast and outlook system at the Regional Flood and Drought Forecast Management Centre (RFDMC) of the Mekong River Commission (MRC). The forecast system provides flood and drought risk indicators for the entire Lower Mekong River on a 1 month as well as 3-6 months' time scale.

Assam Integrated Flood and Riverbank Erosion Risk Management Investment Program (AIFRERMIP)
Year: 2020
Location: India
Client: Flood and River Erosion Management Agency of Assam (FREMAA)
Main project features: Establishment of an integrated flood and riverbank erosion risk prediction system.
Position held: International Team Leader and River Engineering Advisor
Activities performed: Responsible for overall execution of the extension phase of the project with the following activities: 1) Finalization of the Flood and Erosion Management Plan. 2) Develop and verify the Pilot Embankment Breach Risk Assessment and Prediction Model along with associated surveys. 3) Maintain, improve and further develop the new Flood Forecasting Model, e.g. improve snow melting, extend 2D modelling and more. 4) Cross Section Survey for River Brahmaputra. 5) Operationalization of the GIS enabled Management Information System and integrate the FF system and the embankment breaching system. 6) On-the-job training in the developed tools and capacity building as required. 7) Develop operational MOUs with National/International Institutions. 8) Conduct International Study tours. 9) Continued construction supervision and furnishing support for AWC building.

Development of the Ayeyarwady Decision Support System and Basin Master Plan
Year: 2018 - 2020
Location: Myanmar
Client: Directorate of Water Resources and Improvement of River Systems
Main project features: Strengthening of planning and informed decision making in the management of the Ayeyarwady River Basin
Position held: River Sediment Specialist
Activities performed: Responsible for providing advice on river sediment transport and morphology. The work included soil erosion assessment, reservoir sedimentation assessment, river hydraulics and sediment transport modelling for investigation of the effect of upstream dams, the impact of sand mining and the implications for river navigation. Different development scenarios and climate change were considered.

City Climate Vulnerability Assessment and Identification of Ecosystem Based Adaptation Interventions - Lao PDR
Year: 2016 - 2017
Location: Laos
Client: CTCN
Main project features: The project embraces the following activities: - Climate Change Vulnerability assessment at city level in 6 cities in Lao PDR - Ecosystem Services assessment in the 6 cities including assessment of the capacity of these to provide services under future climate scenarios - Identification and overall costing of ecosystem-based adaptation interventions that are able to respond to the climate risks faced.
Position held: Team Leader and Project Manager
Activities performed: The project included several visits and workshops as well as site inspections in Lao PDR. As a project Manager the work further included coordination work with CTCN, UNEP and the Ministry of Natural Resources and Environment, Department of Disaster Management and Climate Change.

Study of the Impact of Mainstream Hydropower Dams on the Mekong
Year: 2014 - 2015
Location: Vietnam
Client: Viet Nam National Mekong Committee, Government of Viet Nam
Main project features: Assessment of downstream impact of construction of a cascade of 12 hydropower Dams on the Mekong mainstream.
Position held: Modelling Expert
Activities performed: The assessment included impacts of various scenarios: normal operation and Dam breaks (including cascade breaks) of twelve dams in Lower Mekong and several even larger dams in the upstream Chinese parts of the river as well as Climate Change impacts. Impacts were assessed on various socioeconomic sectors, agriculture, navigation, fishery, as well as on the river morphology and on the environment. The project utilised basin models, one-dimensional river models for the Mekong mainstream and the Delta (MIKE11 Delta model), as well as two-dimensional river and reservoir models. These models were developed on basis of digital elevation models.

Responsible for conduction of all model activities for the Delta modelling using one-dimensional modelling. Supervision of hydraulic modellers on the team.
Flood Warning System for NYSCC **Year:** 2014 **Location:** USA **Client:** The New York State Canal Corporation **Main project features:** Development and implementation of flood warning and operating system **Position held:** Project Manager and Team Leader **Activities performed:** The main objective of the project was to deliver and implement a Flood Warning and Operating System to NYSCC for the Mohawk, Oswego and Upper Hudson watersheds that seamlessly work within NYSCC operations and provide guidance and warnings to internal and external users. Additional objectives included: To utilize the existing gaging system in the area and provide guidance how to increase quality of monitoring system through the installation (by NYSCC) of additional monitoring sites; To collect existing topographical, operational and supporting data; To collect any missing topographical and topological data; To create a-priori and real-time flood inundation maps; To develop web pages for internal and external users to determinate observed and forecasted data (such as bridge clearances and inundation maps) as well as operational information; To transfer technology to the future operational team; To provide training on the usage of FWOS outputs (e.g., warning and inundation maps) to internal and external stakeholders; To support the operations of the FWOS during the project period; To ensure sustainability of the FWOS for after the project completion.
Increasing climate resilience in Maputo - GIS tool for urban adaptation to climate change and flood risk. **Year:** 2011 - 2013 **Location:** Mozambique **Client:** Nordic Development Fund **Main project features:** The aim of the project was to increase the capacity and preparedness of the Ministry of Environment (MICOA) and the National Disaster Management Institute (INGC) for urban adaptation to climate change and flood risk. **Position held:** Team Leader and flood specialist **Activities performed:** The main activities of the project were topographical scanning (LiDAR) of Maputo city, data collection and -analysis, development and implementation of a GIS based planning tool to be used for risk assessment in a climate adaptation context. Knowledge transfer and capacity enhancement within the project enables MICOA and INGC to apply the developed GIS tool for present and future development scenarios under different climate conditions as well as to apply the tool in similar flood prone areas in Mozambique. Overall Management and Administration of the Project ensuring the project was implemented as per agreement with Client; Quality control; Liaison with all relevant authorities and stakeholders
Update/upgrade of the Hydrologic-Hydraulic Model and New Urban Micro-Drainage System Model for Greater Colombo Basin **Year:** 2011 - 2013 **Location:** Sri Lanka **Client:** World Bank **Main project features:** The aim of the project was to enhance the data basis of, and establish hydraulic models for the canal and drainage system of the Greater Colombo Basin as well as to provide preliminary designs for flood intervention schemes. **Position held:** Team Leader and hydraulic specialist **Activities performed:** Comprehensive hydrographical surveys of the canal system as well as the urban drainage system were carried out. Topographical survey of the Greater Colombo Basin is carried out using airborne LiDAR scanning. An existing MIKE11 model for the canal system in Colombo area was upgraded with recent survey data as part of the project. An urban drainage model (MIKE Urban) was established for the Colombo city area and coupled to the canal model. The models were used for analysis of the hydraulic conditions, particularly during flood events, as well as water quality conditions of the system. The project included review of existing designs as well as preliminary designs of flood intervention schemes. Cost benefit analysis were made for the preliminary designs. A real time control strategy was defined. Overall Management and Administration of the Project ensuring the project was implemented as per agreement with client. Responsible for hydraulic modelling in the project.
River basin and water use studies

Year: 2006
Location: Cambodia
Client: Ministry of Water Resource and Meteorology, Cambodia
Main project features: In order to strengthen the capacity within integrated water resource management of provincial departments of Ministry of Water Resource and Meteorology in Cambodia, the planning process for improving the water resource management in two sub-catchments around the Tonle Sap lake was supported by a technical study financed by Asian Development Bank (ADB) and Agence Française de Développement (AFD).
Position held: Hydrologist
Activities performed: The consultant carried out an assessment of the various components of the water resource, including domestic and irrigation water uses, as well as the requirements of ecological flows. Stakeholder analysis and - meetings, as well as detailed hydrological analysis and modelling of present and future conditions were carried out.

Swan River Flood Management and Land development Project, Himachal Pradesh
Year: 2005
Location: India
Client: Government of India. Implemented by Nippon Koei Ltd. for Japan Bank for International Coorporation (JBIC)
Main project features: Technical study to assess the flood dynamics and flood prone area of Swan river.
Position held: Flood management expert
Activities performed: The Japan Bank for International Coorporation (JBIC) and The Government of India set up a project for development of an integrated flood and land use management plan. The plan included reconstruction and finalization of the flood embankments, land use issues, landownership and compensation strategies. The consultant applied carried out a technical study to assess the flood dynamics and flood prone area for various layouts of embankments. The results were applied in the integrated flood and land use management plan, which was presented for the local Government in Himachal Pradesh.

Hydrodynamic Modeling of the Sesan river
Year: 2004 - 2005
Location: Vietnam
Client: Electricity of Vietnam
Main project features: Detailed analysis and modeling of the Sesan river and reservoir operation
Position held: Project manager and river modeller
Activities performed: The Sesan river is a transboundary river as the lower part of the river enters Cambodia and finally discharges into the Mekong river. EVN had asked the consultant to provide detailed analysis and modelling of the river and reservoir operation with the aim to optimize the hydropower production and at the same time minimize the adverse downstream effects. The proposed operation strategies aimed at reducing downstream flooding during high flows, while maintaining ecological minimum flows during the dry season. The outcome of the project was facilitated by the consultant by a joint knowledge transfer program, in which both Vietnamese and Cambodian counterparts took part.

Support to Capacity Building of Water Resources Institutes
Year: 2002 - 2005
Location: Vietnam
Client: MARD
Main project features: On-the-job training, supervision and consultancy
Position held: Hydraulic specialist and Trainer
Activities performed: A four-year Danida capacity building program was targeted at supporting water sector institutes in Vietnam to increase their capacities within the water sector. The consultant provided on-the-job training, supervision and consultancy for a number of teams on demonstration projects carried out by Water Resource Institutes in Vietnam. The projects were mainly located in Mekong Delta, Saigon River, and Red River, and dealt with flood protection, salinity intrusion and water quality improvement. Training and consultancy was given in modeling of hydrodynamic, water quality and GIS, for flood management and environmental assessment purposes. Further, a specialized training workshop on one- and two-dimensional modeling principles for flood and sediment transport/morphological modeling was carried out.

MIKE 21C training course, Ho Chi Minh City

Year: 2004
Location: Vietnam
Client: Sub-Institute for Water Resources Research, Ho Chi Minh City
Main project features: A one week training course in MIKE 21C is provided for SIWRR, HCMC, Vietnam. Software sales of MIKE 21C included.
Position held: Morphological Modeling Specialist
Activities performed: Training course in morphological modeling using MIKE 21C. Advice on actual case studies.

Advanced MIKE 21C training course, Hanoi
Year: 2004
Location: Vietnam
Client: River Engineering Research Center, Hanoi
Main project features: MIKE 21C training course
Position held: Morphological Modeling Specialist
Activities performed: Advanced Training course in morphological modeling using MIKE 21C. Advice on actual case studies on Red River.

Long Xuyen area of the Bassac River, Mekong Delta
Year: 2004
Location: Vietnam
Client: ADICO, Long Xuyen
Main project features: Training in MIKE 21C including the Long Xuyen area as a case study with a bifurcated river system, various permanent and semi-permanent river islands, clay banks, tidally affected and exposed to a high discharge variation from dry- to wet season. Specific project advice were given to the client on how to study and deal with the various mechanisms for bank erosion and failure in the model.
Position held: Morphological Modeling Specialist
Activities performed: Training course in morphological modeling using MIKE21C including project advice on actual project case.

Integrated Basin Flow Management Mekong River
Year: 2004
Location: Cambodia
Client: Mekong River Commission Secretariat. Funded by the World Bank
Main project features: A part of the Water Utilization programme (WUP) at MRC, is concerned with development of water sharing rules for the Mekong river. This particular project s examines the details of the cause and effects of one important part of the river, namely the flow reversal in the Tonle Sap river.
Position held: River specialist
Activities performed: In the process of implementing the Mekong River Agreement the Mekong River Commission Secretariat (MRCS) looked into the feasibility and practical definitions of various declarations within the agreement. The consultant was engaged to guide the process of moving from political declarations to their practical implementation and definitions. One of the key declarations in the Mekong Agreement was to maintain the reverse flow conditions in the Tonle Sap river, as this controls the dynamics of the water level in the Tonle Sap Lake, and hereby the hydrological, ecological and economical state and development potential of the lake, a most valuable part of the Mekong basin. As a hydrologist and hydraulic specialist, the consultant contributed to the practical rule formulation for the implementation of the Mekong Agreement that was to be agreed upon among the member countries.

Tonle Sap Lake & Vicinities Project
Year: 2002 - 2004
Location: Cambodia
Client: Mekong River Commission
Main project features: In order to increase the local capacity and to facilitate long-term water resource planning in Cambodia, a project was initiated by Government of Japan comprising a comprehensive data collection, analysis and model activities of the Tonle Sap Lake and flood plains along the Mekong River in Cambodia. The work included collection of water level and discharge data from flood plains and at strategic locations along the main river branches of the Mekong River system in Cambodia continuously in a two-year period.
Position held: Project manager and River specialist
Activities performed: The consultant was engaged in a subsequent analysis (hydraulic data in the

rivers and flood plains and flood inundation extent using satellite images) and modeling of the flood dynamics of the rivers and flood plains of Cambodia. The project established valuable water resource data for the Cambodian Government and increased the capacities of the line agencies belonging to the Ministry of Water Resources, via training programs. The established mathematical model was used to test the effect of various development options due to climate change, different embankment layouts for flood protection and possible increase in irrigated land areas due to rehabilitation of 'colmatage' channels along the Bassac River. The hydrological roles of the various compartments of the flood plains including detailed water balances were established as part of the study.

Mekong River Flood Mapping

Year: 2003
Location: Cambodia
Client: Mekong River Commission Secretariat
Main project features: The dissemination of daily flood forecasting data for the flood prone area of the Mekong Delta is an essential activity of the Mekong River Commission. The mathematical model (MIKE11) established as part of the WUP-JICA study by the consultant was used to replace the existing model in the Cambodian Flood plains.
Position held: River specialist
Activities performed: The consultant developed an automatic system for Mekong River Commission Secretariat which integrated the flood plain model with GIS to produce daily flood maps

Mekong River Modeling (WUP-JICA)

Year: 2001 - 2003
Location: Cambodia
Client: Mekong River Commission
Main project features: The Water Utilization Program (WUP) of the Mekong River Commission (MRC), one of the core programs at MRC, aimed at developing procedures for water use that could be agreed upon by the four governments of the Lower Mekong Basin. A part of the WUP was supported by JICA and concerned with data collection and analysis, establishment and application of a hydraulic model (MIKE11) for the lower Mekong River, and advice concerning notification, prior consultation and agreement as well as maintenance of flows on the Mekong mainstream.
Position held: River modeller
Activities performed: The consultant was responsible for the establishment and application of a mathematical model for the entire Mekong delta in Cambodia, and to disseminate the results to the member countries via a series of workshops and training programs. The river model was calibrated and validated against water level data at key stations in the river system as well as against discharges measured using ADCP technology at strategic locations in the rivers.

Appendix B.2 Maija Bertule

Date of Birth:	19 December 1986
Country of Citizenship/Residence	Latvia/Denmark

Education:

Name of educational institution	Attended	Degree/diploma obtained
Roskilde University, Denmark	2009-12	MSc in Technological and Socio-Economic Planning (programme in Environmental policy)
Roskilde University	2006 - 2009	BSc in International Development and Technological and socio-economic planning

Employment record relevant to the assignment:

Period	Employing organization and your title/position. Contact info for references	Country	Summary of activities performed relevant to the Assignment
2018 - present	**Employer:** UN Environment Programme -DHI Centre on Water and Environment **Position Held:** Senior Technical Advisor	Denmark	Technical inputs to UNEP-DHI work programmes with focus on nature-based solutions in water management, implementation of integrated water resources management, identification and prioritization of climate change adaptation technologies, monitoring and reporting on SDG 6, and gender mainstreaming in water resources management. Development of project portfolio, donor project proposal development and management of small to mid-size projects.
2013 to 2018	**Employer:** UN Environment Programme -DHI Centre **Position Held:** Program Advisor	Denmark	Technical inputs to execution of UNEP-DHI projects, including managing the global data collection for SDG Indicator 6.5.1 (IWRM implementation) and incoming data verification and analysis. Development of UNEP-DHI knowledge products on nature-based solutions and green infrastructure. Ongoing project management, technical inputs to projects on indicator use, climate change adaptation and ecosystem-based water resources management, as well as tool development for improved use of water indicators in river basins.
2010-2013	**Employer:** UNEP Risø Centre on Energy, Climate and Sustainable Development (National Renewable Energy Laboratory). **Positions Held:** Research Assistant and student assistant	Denmark	Research assistant in the climate finance research group. Responsible for data analysis and inputs to the Clean Development Mechanism Pipeline – the UNEP Risø flagship project tracking status of the global status of clean development projects, and certified emission reduction issuances and status. Also in charge of development of results-based management system.

2010	**Employer:** Consia Consultants, **Position Held:** Intern	Denmark	Support to EoI and Proposal preparation, workshop organization, primarily focusing on topics of environmental management and road safety in South-East Asia.

Membership in Professional Associations:
IDA – the Danish Society of Engineers
DANSIC – Social Innovation supporting organization in Denmark

Language	Reading	Speaking	Writing
Latvian	Native	Native	Native
English	Fluent	Fluent	Fluent
Danish	Fluent	Fluent	Fluent

Reference to Prior Work/Assignments that Best Illustrate Capability to Handle the Assigned Tasks
Name of assignment or project: Nature-based solutions (NBS) tools for Generation Restoration project cities (20+ cities) **Year:** 2024 - ongoing **Location:** Global (20+cities and metropolitan areas) **Client:** UNEP **Main project features**: Developing EO-based tool to support NBS monitoring and upscaling in the Generation Restoration project cities, including earth observation based indicators for assessment and monitoring of NBS, as well as modelling-derived analytics to address key climate issues using NBS. **Position held:** Project manager **Activities performed**: Stakeholder engagement with UNEP project cities, project management, concept and functionality development, NBS advisor on tool data and indicator contents.
Name of assignment or project: The River Basin Flood Mitigation Master Plan Study at Kudat District, Sabah, Malaysia **Year:** 2023 - 2024 **Location:** Malaysia **Client:** PERUNDING SCK **Main project features**: Perunding SCK was appointed by the Government of Malaysia through Jabatan Pengairan dan Saliran Malaysia (JPS) to carry out the river basin flood mitigation master plan for Kudat district under the project titled “Kajian Pelan Induk Tebatan Banjir Lembangan Sungai di Daerah Kudat, Sabah”. DHI supports this work on hydrological modelling and assessment aspects, including analysis of feasibility of application of nature-based solutions and other non structural interventions for flood mitigation. **Position held:** Nature-based solutions advisor **Activities performed**: Identification of nature-based and non-structural responses to flood mitigation and stormwater management.
Name of assignment or project: Review of Integrated River Basin Management (IRBM) Plan for Sungai Melaka Basin, Melaka**,** Malaysia **Year:** 2023 - 2024 **Location:** Malaysia **Client:** Department of Irrigation and Drainage (JPS) via Wan Husin & Associates Sdn Bhd **Main project features**: Review previous Sg. Melaka river basin management plan, undertake detailed basin studies and formulate and produce an Integrated River Basin Management Plan (IRBM) that will fulfil the IRBM key objectives. **Position held:** IWRM advisor **Activities performed**: Quality assurance of integrated project interim reports, recommendations on in IWRM aspects relating to the integration of the project study and modelling outcomes.
Name of assignment or project: Capacity development to catalyze actions and commitments at the national and global level to reduce plastic pollution including in the marine environment **Year:** 2023 - ongoing **Location:** 18 countries + global **Client:** UNEP **Main project features**: Support to UNEP’s GPML (Global Partnership On Plastic Pollution and Marine Litter) on development of the GPML Digital Platform technical development, capacity development activities and coordination of global communities of practice. **Position held:** Project manager + lead on capacity development, data harmonization and communities of practice **Activities performed**: Project management activities and stakeholder management, leading work stream on plastic indicator selection and incorporation in the GPML Data Hub including interactions with data providers and coordinating

global communities of practice on plastic data harmonization, development and implementation of capacity development activities in support of 18+ countries working with national plastic source inventories and plastics strategy development.
Name of assignment or project: Sustainable Flood Management and Risk Reduction Action project in Somalia **Year:** 2023 - 2024 **Location:** Indonesia **Client:** CTCN **Main project features**: The objective of this technical assistance (TA) is to identify and design climate-smart agriculture (CSA) technologies and associated system for enhancing climate change adaptation in agriculture sector in Indonesia. **Position held:** PM/dpt PM **Activities performed:** PM tasks, QA of national expert technical outputs, support in development of the national training materials.
Name of assignment or project: Sustainable Flood Management and Risk Reduction Action project in Somalia **Year:** 2021 - 2022 **Location:** Somalia **Client:** UNEP **Main project features**: Assisting the National Task Force on Flooding and related Stakeholders with flood risk assessment data, information and tools and web-portal for a sustainable flood management and policy development. Research and analysis of feasibility of application of nature-based solutions for flood and drought hazard mitigation. **Position held:** Nature-based Solutions expert **Activities performed**: Identification, analysis and prioritization of nature-based solutions for flood and drought management and assessing their potential for mitigation of climate hazards in the Juba-Shabelle basin. Quality assurance of project outputs from UNEP-DHI to FAO and FCDO (donor).
Name of assignment or project: Nature-Based Solutions for Asia Pacific **Year:** 2021 **Location:** Global **Client:** CTCN /UNEP **Main project features:** Assignment by CTCN to undertake investigation on NBS relevance for climate change adaptation in the Asia and the Pacific region, convening expert panel and producing a report. **Position held**: Project manager and lead author. **Activities performed:** Project management, management of the drafting team and global expert panel, report drafting and quality assurance of outputs on case studies.
Name of assignment or project: Second global data collection for Sustainable Development Goal Indicator 6.5.1 **Year:** 2020-2021 **Location:** Global **Client:** UNEP **Main project features:** Second global data collection and monitoring on UN Member State reporting on SDG indicator 6.5.1 **Position held**: Head of country support and data analyst. **Activities performed:** In charge of the communication with all UN Member States on indicator, and the incoming data QA (from 193 UN Member States). Managing data QA, country communication, supporting drafting of the global findings report, leading development and updates of the associated IWRM Data Portal and country factsheet development..
Name of assignment or project: Earth Observation for the Sustainable Development Goals **Year:** 2018. **Location:** Global/Uganda **Client:** European Space Agency **Main project features**: Developing and applying appropriate methods and tools to facilitate regular monitoring of progress on the SDGs through Earth Observation. **Position held:** SDG Indicator expert. **Activities performed**: Identification of the relevance of EO data and where EO can most significantly contribute to improvement of the SDG monitoring framework, given current EO technological capabilities and the nature of SDG indicators. Identification of how EO can contribute to achievement of the SDGs.
Name of assignment or project: Pilot Training Programme in Flood and Drought Management Tools for Climate Resilience and GCF Concept Note Development in Cambodia **Year:** 2018. **Location:** Cambodia **Client:** CTCN/UNEP **Main project features**: Developing and implementing a training programme on application of flood and drought management tools in Cambodia. **Position held:** Course facilitator **Activities performed**: Presentation and training exercise facilitation on indicator tools within Floods and Droughts management portal in Cambodia.
Name of assignment or project: Climate Bonds Water Infrastructure Criteria standard development for nature based water management infrastructure investments **Year:** 2017 - 2018. **Location:** Global **Client:** Climate Bonds Initiative **Main project features**: Development of nature-based water infrastructure certification criteria for climate certified climate bond compliance. **Position held:** Technical working group member **Activities performed**: Review and contributions to the development of the climate bond global standards targeting nature based and hybrid water management infrastructure that would allow certification of the infrastructure for climate bonds.

Name of assignment or project: City Climate Vulnerability Assessment and Identification of Ecosystem based Adaptation Interventions in Lao PDR. **Year:** 2016-2017. **Location:** Lao PDR. **Client:** CTCN **Position held:** Ecosystem-based adaptation expert. **Main project features:** CTCN requested technical assistance (TA) to undertake city level climate vulnerability assessment of people and ecosystems at Laos' six most socio-economically important cities. This technical assistance is required so that city specific ecosystem-based adaptation (EBA) responses can be identified and subsequently implemented in a larger scale project. **Activities performed**: Transferring the assessment of ecosystem services damaged by flooding problems in the selected cities, and the climate vulnerability analysis to an assessment of ecosystem-based adaptation interventions in specified sites in each city. Technical input preparation for a funding proposal, development of methodology for stakeholder engagement, consolidating assessment of climate data, ESS data and EBA adaptation intervention selection and prioritization.

Name of assignment or project: Global data collection for Sustainable Development Goal Indicator 6.5.1.

Year: 2016 – 2018. **Location:** Global **Client:** UNEP **Main project features:** Global data collection of data for SDG Indicator 6.5.1 on the degree of implementation of IWRM in countries. **Position held:** Head of country support **Activities performed:** In charge of the data collection activities and communication with UN Member States at the UN Environment – DHI centre. Managing the global data collection of SDG Indicator 6.5.1 (Degree of implementation of IWRM in countries) data from all UN Member states (190+), including direct follow up with governments, data collection, incoming data quality and assurance and analysis, for later analysis and submission to the UN.

Name of assignment or project: UN World Water Development Reports 2018: Nature-based solutions for water**. Year:** 2018. **Location:** Global **Client:** UN World Water Assessment Programme/UNEP. **Main project features**: World Water Development Report production. **Position held:** Team Member

Activities performed: Member of drafting and review group for the report production and drafting inputs to selected chapters.

Name of assignment or project: Transboundary Waters Assessment Programme River Basins component (TWAP RB). **Year:** 2013 – 2016. **Location:** Denmark/global scope. **Client:** GEF. **Position held:** Assistant project manager. **Main project features:** First of its kind global indicator-based assessment of all 286 trans-boundary river basins assessing the relative risks of the river basins for more than 20 indicators. **Activities performed**: Concept author and development and leading the development of the tool and its launch activities. The tool is accessible online and contains comprehensive database of IWRM related policy resources for majority of world countries, as well as the most comprehensive online IWRM dataset globally http://iwrmdataportal.unepdhi.org/ .

Name of assignment or project: Sustainable Development Goal 6 targets and indicators.

Year: 2013-2015. **Location:** Global **Client:** UN Environment/UN Water **Main project features:** UN Water Recommendations for a Post-2015 Agenda and a dedicated goal on Water, including proposed formulation of SDG Goal 6 targets and development of target appropriate indicators for the global data collection. Following this also technical inputs to working groups working on selection and refinement of the target specific indicators. **Position held:** Technical team member at UNEP-DHI. **Activities performed:** As a technical team member, provided analysis and inputs to formulation of indicator under proposed dedicated SDG Goal for water (now – SDG 6 on Water and sanitation), as part of the UN Water's consultation process, and primarily for inputs to the UN Water's technical advice to the UN (report titled *A Post-2015 Global Goal for Water: Synthesis of Key Findings and Recommendations from UN-Water*, published in January 2014). Further to this also ad-hoc inputs to the technical working groups on Indicator methodology formulation – primarily focusing on Water efficiency, Sustainable withdrawals and IWRM.

Name of assignment or project: The Climate Technology Centre and Network (CTCN). **Year:** 2014 – 2020 **Location:** Global (country specific project support to date: Ghana, Cote d'Ivoire, Dominican Republic, Indonesia, Mauritius, Thailand, Guinea, Laos) **Client:** The Climate Technology

Centre and Network (CTCN). **Main project features:** CTCN promotes transfer of environmentally sound technologies for low carbon and climate resilient development at the request of developing countries. This includes technology solutions, capacity building and advice on policy, legal and regulatory frameworks tailored to the needs of individual countries. As core CTCN consortium member and global lead on water, UNEP-DHI is providing expert support to technology transfer activities via CTCN network. **Position held:** Project Manager at UNEP-DHI. **Activities performed:** Project management at DHI, coordination of expert input to country requests, assessment and inputs to the design of CTCN Knowledge Management System. Lead responsible in development of outreach and capacity building material on water adaptation technologies (including online capacity building sessions and publication). Technical inputs as ecosystem-based adaptation expert to CTCN activities in Laos. Quality assurance of deliverables.

Appendix B.3 Van Khanh Triet Ngueyn

Name of Expert:	Van Khanh Triet Nguyen
Date of Birth:	18 April 1984
Country of Citizenship/Residence	Vietnamese / Germany

Education:

Name of educational institution	Attended	Degree/diploma obtained
University of Potsdam, Germany	2015-2021	Ph.D. Hydrology
IHE Delft Institute for Water Education, The Netherlands	2009-2011	M.Sc. Water Resources Management
Water Resources University, Vietnam	2002-2007	B.Sc. Water Resources Engineering

Employment record relevant to the assignment:

Period	Employing organisation / Title / Contact for references	Country	Summary of activities performed relevant to the Assignment
01/2023-Present	DHI-WASY GmbH Advisor	Germany	1D-2D flood modelling.
04/2019-10/2022	Ruhr University of Bochum Research Scientist	Germany	1D hydrodynamic and saltwater intrusion modelling for Mekong Delta with MIKE11 HD & AD as part of the VIWAT project.
10/2014-03/2019	German Research Centre for Geoscience (GFZ) Research Scientist	Germany	Numerical simulation of saltwater intrusion dynamics in the Mekong Delta as part of the CATCH-MEKONG project.
07/2007-09/2014	Southern Institute of Water Resources Research Research Scientist	Viet Nam	Flood hazard and risk assessment for the southern region of Vietnam. Hydrodynamic modelling of saltwater intrusion in the Mekong Delta

Language skills:

Language	Reading	Speaking	Writing
Vietnamese	Native	Native	Native
English	Fluent	Fluent	Fluent
GermanClick or tap here to enter text.	Fair	Fair	Fair

Reference to Prior Work/Assignments that Best Illustrate Capability to Handle the Assigned Tasks
Name of assignment or project: RTS Phase 3 Follow Up Modelling. **Year**: 2024–2025. **Location**: United Kingdom of Great Britain and Northern Ireland. **Client**: Binnies UK Limited. **Main project features**: The River Thames Scheme (RTS) aims to reduce flood risk near Heathrow by constructing an 8.3 km flood relief channel divided into two sections: the Runnymede Channel (4.5 km) and the Spelthorne Channel (3.8 km). The channels will pass through an ecologically significant area with numerous lakes, some designated under the South West London Waterbodies Special Protection Area (SPA) and others classified under the Water Framework Directive (WFD). The project's main objective is to assess potential changes in lake water quality, particularly regarding nutrient-rich water and sediment inflow from the River Thames, which could affect eutrophication and algal blooms. Additionally, the scheme's impacts on water balance, evaporation, groundwater leakage, and flood risk are under evaluation, including potential effects on groundwater and surface water abstractions. There are also concerns about its impact on landfill sites and their surroundings. **Position held**: Project assistant. **Activities performed:** Surface-groundwater modelling with MIKE Hydro River and MIKE SHE, post-processing modelled discharge, surface- and ground- water level, water qualily and lake water balance with Python. **Name of assignment or project**: Update Lausitzer Neiße Model incl. Merge Oder Model. **Year**: 2023–2025. **Location**: Brandenburg, Germany. **Client**: Landesamt für Umwelt Brandenburg. **Main project features**: As part of the Flood Risk Management Directive, flood hazard and risk maps for the Brandenburg section of the Lausitzer Neiße are being updated. This process follows the request for proposals issued by the Brandenburg State Office for the Environment (LfU) on August 1, 2023, for "Hydronumerical Modeling of the Lausitzer Neiße." The update is part of the second stage in the three-stage directive framework: (1) preliminary flood risk assessment, (2) preparation of flood hazard and risk maps, and (3) development of flood risk management plans. The study area includes the Lusatian Neisse from the Podrosche 3 gauge to the Oder estuary, along with three tributaries: Moaske, Briesniger Vorflut, and the Malxe-Neiße-Kanal from Mulknitz. Based on LfU's specifications, DHI has developed a methodological approach to update the hydronumerical model and create the required flood hazard and risk maps. **Position held**: Project team. **Activities performed:** Convert the project's 1-2D numerical model from MIKE 11/MIKE FLOOD to MIKE+. Update the 1-2D model with new survey data, extend the model to the Sachsen region, run simulations, and generate inundation maps for various flood events ranging from HQ10 to HQ200. **Name of assignment or project**: MRC DSF Upgrade - WR Modelling. **Year**: 2023–2024. **Location**: Lao People's Democratic Republic. **Client**: Mekong River Commission Secretariat. **Main project features**: Proactive and adaptive basin planning as well as short-term operational planning for the basin. The main activities involved the development of two products: (1) the Mekong Decision Support Framework, an operational state-of-the-art platform and (2) the Initial Adaptive Basin Plan. **Position held**: Project team. **Activities performed**: Convert the 1D-2D numerical model of the Mekong River Commission to MIKE+. **Name of assignment or project**: Integral concept for municipal flash flood risk management in Markt Hirschaid. **Year**: 2024–2025. **Location**: Germany. **Client**: Markt Hirschaid Commue. **Main project features**: Markt Hirschaid is highly susceptible to flash floods caused by intense, short-duration rainfall, often resulting in flooded streets, waterlogged cellars, and damage to infrastructure and farmland. To mitigate these risks and enhance flood prevention, the municipality plans to develop a comprehensive flash flood risk management concept. This initiative will be implemented under Bavaria's special funding program, "Integral Concepts for Municipal Flash Flood Risk Management." A key feature of this initiative is the creation of flood hazard and risk maps for infrastructure under different rainfall events, including HQ10, HQ50, HQ100, and HQ-Extreme. **Position held**: Project team. **Activities performed**: Developed a 2D numerical model for the town of Markt Hirschaid using MIKE+. Conducted flood hazard and risk assessment under extreme rainfall events. **Name of assignment or project**: DE_Suederelbe - Flow Technical Studies. **Year:** 2024–2025**. Location**: **Germany**. **Client**: Deutsche Bahn AG. **Main project features**: Investigate changes in flow dynamics, ecological conditions, and morphological characteristics of during both the construction phase and the final phase of the new train bridge crossing the Elbe River near Hamburg-Harburg.

Position held: Project team. **Activities performed**: Setup 3D-numerical model to assess flow and mophological dynamics. Technical analysis of ice-jamming potential.

Name of assignment or project: Amaala Marine Life Operation Facility Discharge Modelling. **Year:** 2023–2024. **Location**: Saudi Arabia. **Client**: King Abdullah University of Science and Technology (KAUST). **Main project features**: Assessment of marine impacts related to a Marine Life Operations Facility intake/outfall at Amaala in the Red Sea. The modelling study considered impacts from extreme wadi flows of fresh waterand sediments on the intake as well as environmental impact from the facility's outfall. **Position held**: Project team. **Activities performed**: Setup 3D hydrodynamic modelling of the dispersion of brine plumes using MIKE 3FM**.**

Name of assignment or project: Jubail IWP 4 and 6 Recirculation Modelling. **Year**: 2023–2024. **Location**: Saudi Arabia. **Client**: Future Water and Power Consulting (FWPC). **Main project features**: The purpose of this contract is to conduct a numerical modeling study on the potential dispersion of a brine plume resulting from the marine disposal of brine discharged by the proposed Jubail 4 IWP Plant. **Position held**: Project team. **Activities performed**: Setup 3D hydrodynamic modelling of the dispersion of brine plumes using MIKE 3FM.

Name of assignment or project: ViWat-Mekong-Planning - Integrated Solutions for Sustainable Development in the Mekong Delta. **Year**: 2019–2022. **Location**: Viet Nam**. Client**: Bundesministerium für Bildung und Forschung – BMBF. **Main project features**: The Mekong Delta in Vietnam is among the regions most impacted by climate change, threatening the livelihoods of 17.5 million people. The Viwat-Mekong-Planning project, led by Environmental Engineering and Ecology in Civil Engineering, aims to develop sustainable water management strategies to mitigate these challenges. Funded by the German Federal Ministry of Education and Research (BMBF) with approximately two million euros, the project focuses on identifying land and water use conflicts, assessing key issues, and proposing viable solutions. The ultimate goal is to contribute to a forward-looking regional development plan for the Mekong Delta. **Position held**: Project team. **Activities performed**: MIKE11 HD/AD hydrodynamic and saltwater intrusion modelling for part of the Mekong Delta in the westeren of Bassac River. Mapping of surface flow and saltwater dynamics in wet and dry season. Flood and agricultural drought risks analysis.

Name of assignment or project: Sustainable and Transboundary Management of Natural Water and Soil Resources in the Mekong Delta (CATCH-MEKONG). **Year**: 2018–2019. **Location**: Viet Nam. **Client**: Bundesministerium für Bildung und Forschung – BMBF. **Main project features**: The overall objective of the Catch-Mekong project is to provide innovative research and technologies for a sustainable and transboundary management of the natural water and land resources in the Mekong Delta. The project focuses on the following objectives: (1) Establishment of a profound data and information base for scientists, planners, and decision makers to help address development challenges. (2) Filling knowledge gaps in the key themes water availability, saltwater intrusion, land use, river morphology, and coastal erosion.(3) Transfer of know-how and technology, through the development of innovative hydrologic sensor technologies and measurement stations and (4) Support planning and decision making progresses by increasing the capacity for data sharing and communication through novel web-based information technology. **Position held**: Project team. **Activities performed**: Modelling saltwater intrusion in the Mekong Delta (MIKE11 AD) under climate change, sea level rise and basin development scenarios.

Name of assignment or project: Strengthening Flood Resilience in the Mekong Delta. **Year:** 2013–2014. **Location**: Viet Nam. **Client**: The Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH. **Main project features**: The programme aims to build on existing urban planning, disaster management, early warning systems, and climate change adaptation by exploiting synergies between these fields. This is achieved by cooperating with the national government and local authorities to update the national policy and provincial regulations as well as flood modelling and multi-hazard mapping, combining and integrating sectoral and thematic efforts of different organisations and donors active in the project areas. Improving cross-sectoral and institutional co-operation will set the framework for a more integrated urban flood management approach and help to implement the national legal and policy framework. **Position held**: Project team. **Activities performed**: Set up a numerical model using MIKE11 HD & AD to evaluate flood dynamics and saltwater intrusion in the Long Xuyen Quadrangle of the Mekong Delta. Optimize the operation schemes of hydraulic structures for effective flood and saltwater intrusion control.

Name of assignment or project: Flood protection for Hochiminh City, Vietnam. **Year**: 2011–2013. **Location**: Hochiminh City, Viet Nam. **Client**: Ministry of Science and Technologie, Vietnam. **Main project features**: Investigate the inundation situation in Ho Chi Minh City caused by rainfall, river flow, and tidal-induced flooding. Create flood hazard maps and develop an operational scheme for flood control structures to mitigate pluvial and fluvial-induced flooding. **Position held**: Hydraulic modeller, Project leader. **Activities performed:** Setup nummerical model to model compound fluvial and pluvial flood for Hochiminh City. Develop operation scheme of flood defence structures. Coordinate project works. Quality assurance of deliverables.

Name of assignment or project: Water quality assessment of freshwater aquaculture in Cantho, Mekong Delta. **Year**: 2011–2013. **Location**: Viet Nam. **Client**: Department of Agriculture and Rural Development. **Main project features**: Investigate surface water pollution caused by agricultural activities in Can Tho and propose effective mitigation measures. **Position held**: Project leader, Hydraulic modeller. **Activities performed**: Hydrodynamic and water quality modelling to evaluate of pollution risks from rice and fish farming in Cantho. Coordinate project works. Quality assurance of deliverables.

Name of assignment or project: Water Quality Assessment of the Thi Vai River in Vietnam. **Year:** 2008–2009. **Location**: Viet Nam. **Client**: Minstry of Natural Rescources and Environment, Vietnam. **Main project features**: Assess the potential environmental impacts of industrial parks and ports along a 30 km stretch of the Thi Vai River in Dong Nai, Vietnam. **Position held**: **Project team. Activities performed**: Set up a numerical model to assess flow and water quality dynamics in the Thi Vai River. Evaluate the potential environmental risks associated with the development of industrial parks and ports.

Publications:

Horton, A. J., Triet, N. V. K., Hoang, L. P., Heng, S., Hok, P., Chung, S., Koponen, J., and Kummu, M.: The Cambodian Mekong floodplain under future development plans and climate change, Nat. Hazards Earth Syst. Sci., 22, 967–983, https://doi.org/10.5194/nhess-22-967-2022, 2022.

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Triet, N. V. K., Dung, N. V., Hoang, L. P., Duy, N. L., Tran, D. D., Anh, T. T., Kummu, M., Merz, B., and Apel, H.: Future projections of flood dynamics in the Vietnamese Mekong Delta, Science of The Total Environment, 742, 140596,https://doi.org/10.1016/j.scitotenv.2020.140596, 2020

Triet, N. V. K., Dung, N. V., Merz, B., and Apel, H.: Towards risk-basedflood management in highly productive paddy rice cultivation - conceptdevelopment and application to the Mekong Delta, Natural Hazards andEarth System Sciences, 18, 2859-2876,https://doi.org/10.5194/nhess-18-2859-2018, 2018

Duy, N. L., Triet, N. V. K., Nguyen, D. V., Tran, A. T., Nguyen, H. T., Heidbüchel, I., Merz, B., and Apel, H.: Groundwater dynamics in the Vietnamese Mekong Delta: Trends, memory effects, and response times, Journal of Hydrology: Regional Studies, 33, 100746,https://doi.org/10.1016/j.ejrh.2020.100746, 2021.

Nguyen, V. K. T.: Flood dynamics in the Vietnamese Mekong Delta: Current state and future projections. PhD Thesis, University Potsdam, Potsdam,https://doi.org/10.25932/publishup-51283, 2021