強靭性 革新 伝統

UNDERSTANDING RISK GLOBAL FORUM 2024

TRADITION • INNOVATION • RESILIENCE

Tackling the ‘impossible’: long lead time flood warnings in very fast-responding basins in a low-capacity context – West African experiences

Speakers:

Murray Dale. JBA Consulting

(Thomas Lebbie. National Disaster Management Agency of Sierra Leone)

Moussa Sidibe. World Bank Group

Session overview

1. Introduction – Murray Dale, JBA
2. Flooding in Freetown: real time challenges – Thomas Lebbie, National Disaster Management Agency of Sierra Leone
3. World Bank views on flash flood risks – Moussa Sidibe, WBG
4. Q&A session:
    i. What solutions have audience members found are effective?
    ii. How should the technology and communication challenges be moved forward?

Why ‘impossible’?

1. Sufficient lead time - 6 hours to 3 days - needed to prepare for floods and take actions. Even 2 hours lead time can be useful.
2. In heavy convective downpours in west Africa, 100mm (4 inches) of rain can fall in one or two hours.
3. In urban areas, especially steep ones, flooding occurs **minutes** after heavy rain.

Why ‘impossible’ (2)?

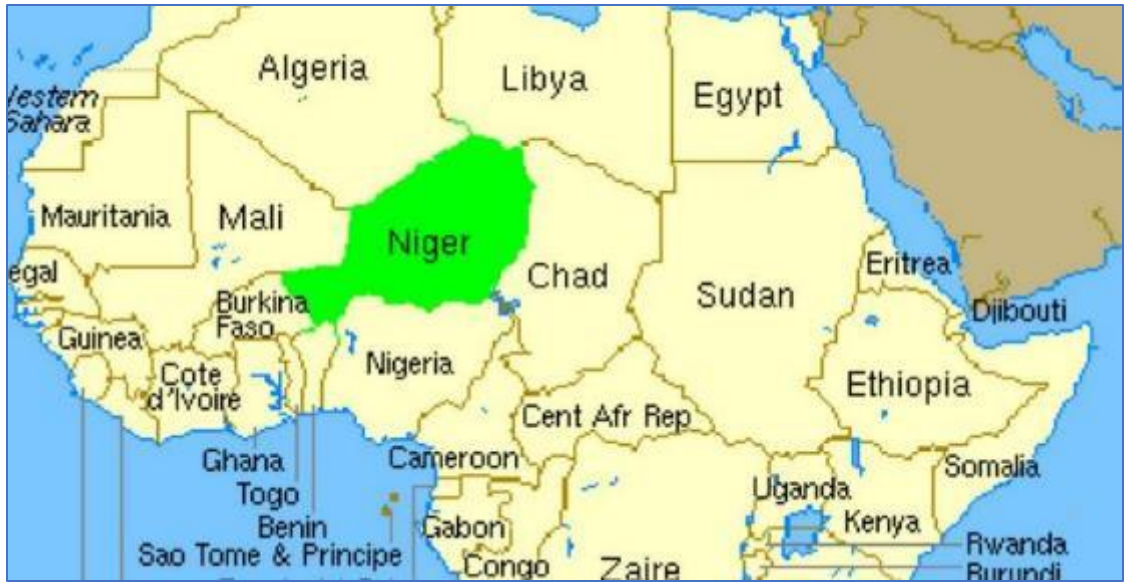
Flood

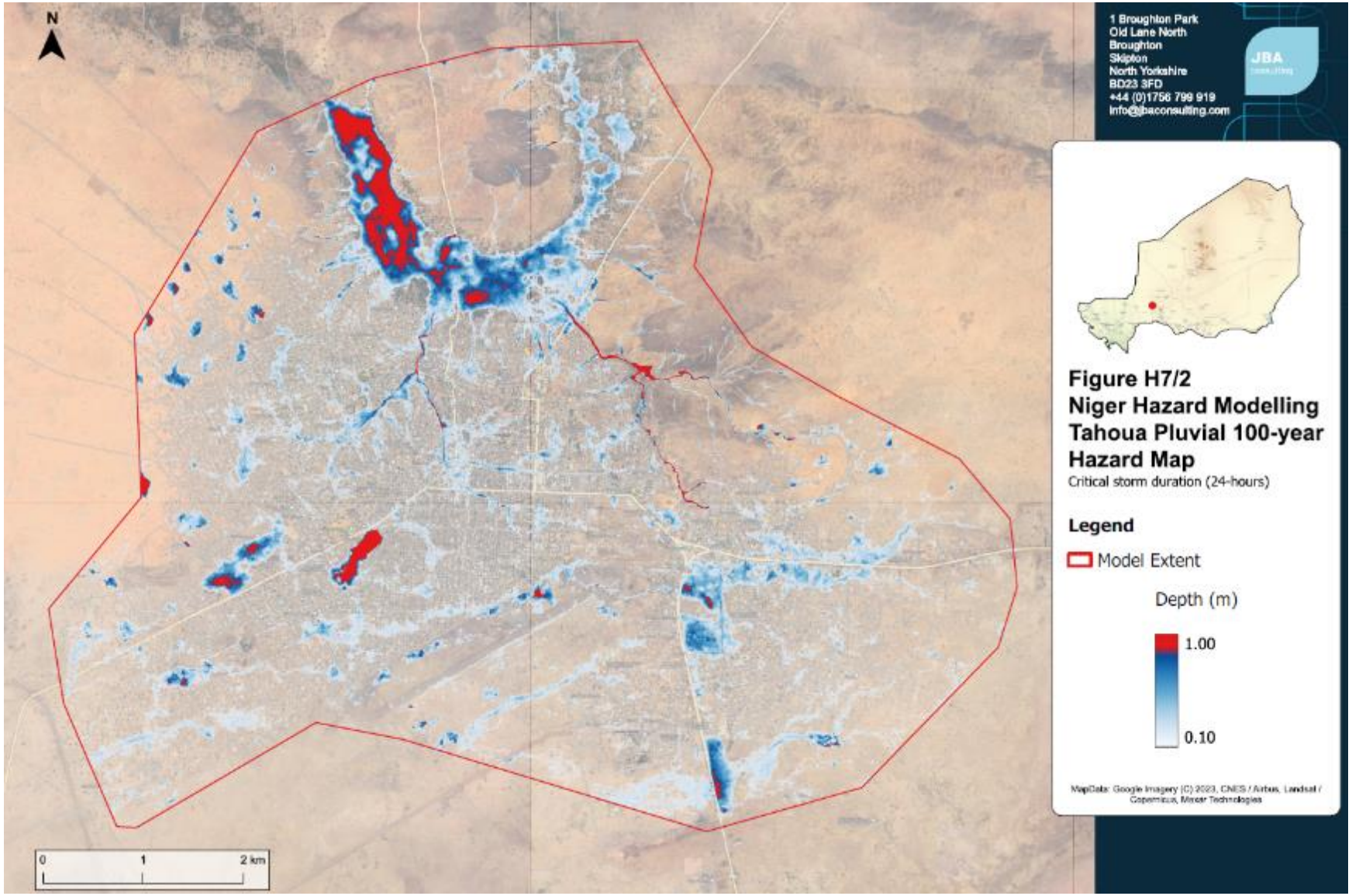
Flood forecast made and issued

Emergency responders alerted and decide on actions

At risk populations warned, actions taken

Reference points




N
1 Broughton Park
Old Lane North
Broughton
Skipton
North Yorkshire
BD23 3FD
+44 (0)1756 799 919
info@jbaconsulting.com
Figure H7/2
Niger Hazard Modelling
Tahoua Pluvial 100-year
Hazard Map
Critical storm duration (24-hours)
Legend
Model Extent
Depth (m)
1.00
0.10
0
1
2 km

Congo Stream -Freetown


Freetown, 2019

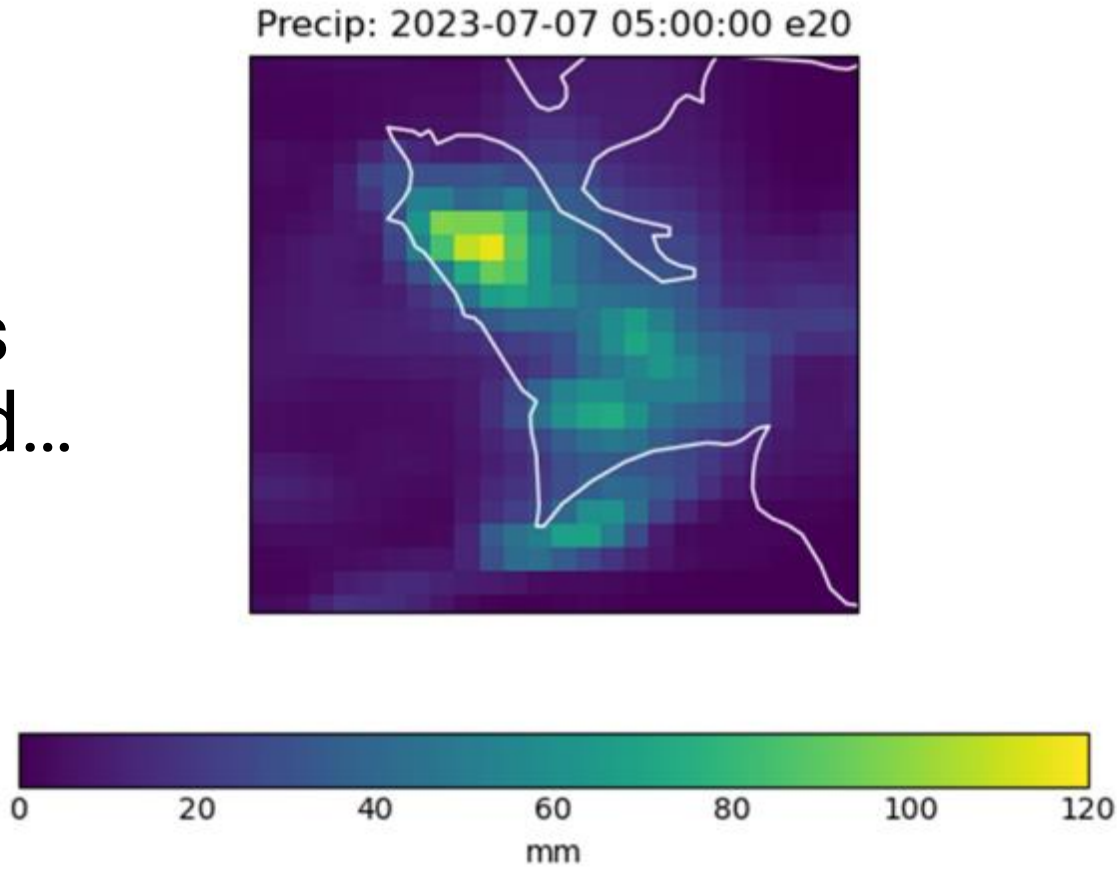

2015

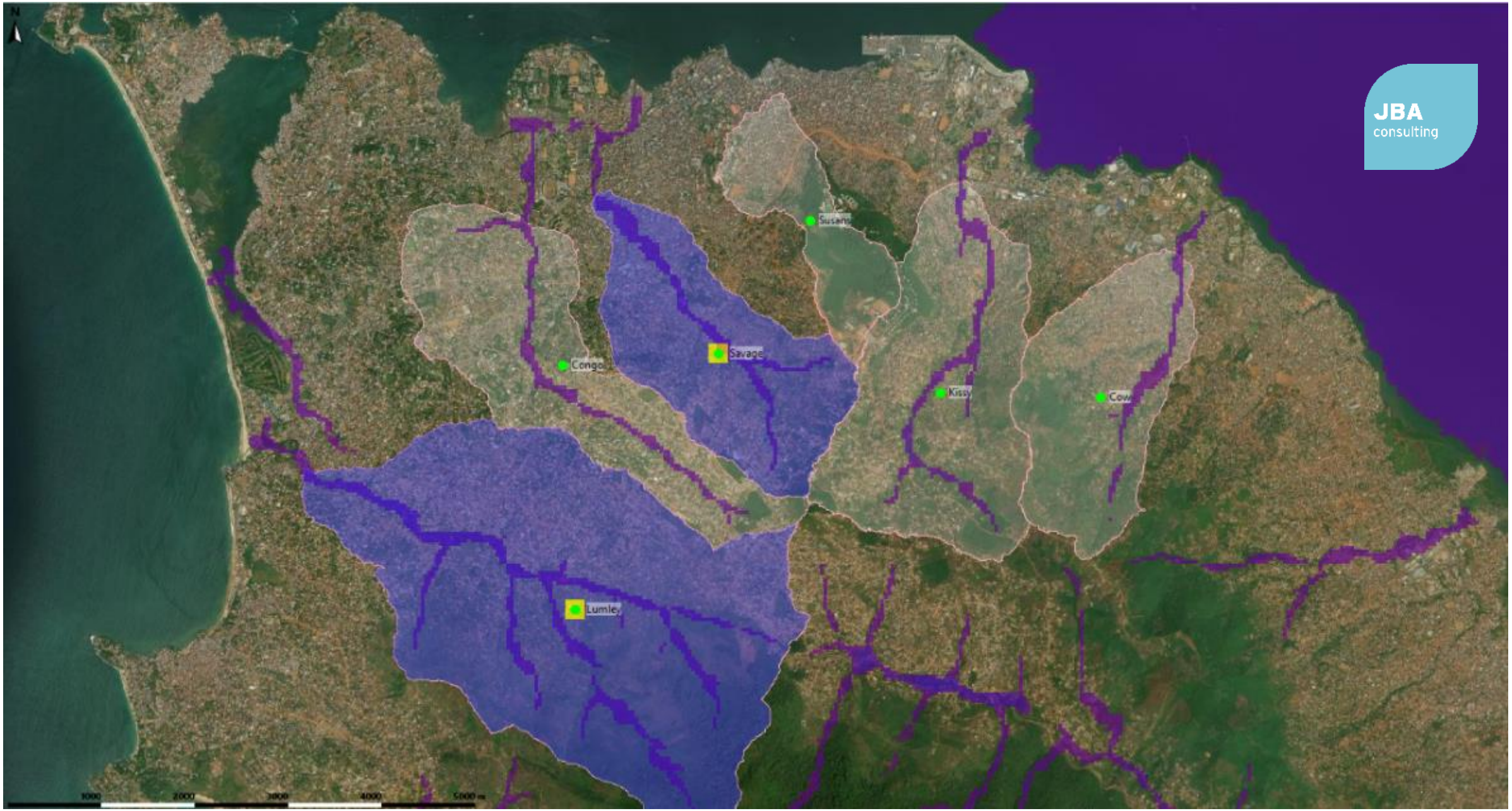

2017


2020

A solution…

Probabilistic, convective-permitting rainfall forecasts … effectively communicated…




N
JBA
consulting
Congo
Savage
Lumley
Kissy
Cow
1000
2000
3000
4000
5000 m

FLOOD GUIDANCE
Issued 0900 UTC 8 July 2023

There is a MEDIUM CHANCE of LOW-IMPACT FLOODING in the next three days.
AND
There is a LOW CHANCE of HIGH-IMPACT FLOODING in the next three days.

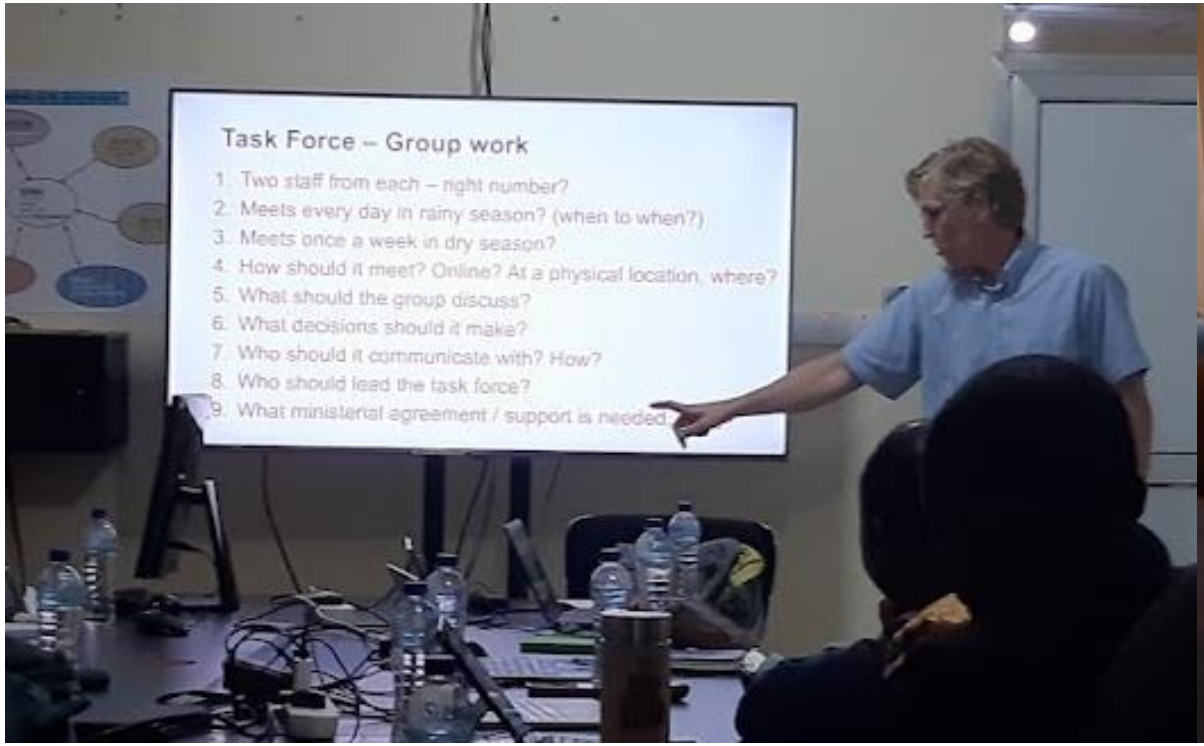
There is a MEDIUM CHANCE of LOW-IMPACT FLOODING in the next three days.
AND
There is a LOW CHANCE of HIGH-IMPACT FLOODING in the next three days.

- Some communities inaccessible due to flooded access routes or completely cut off.
- Flooding affecting properties and parts of individual or multiple communities.
- Disruption to travel and access routes could be flooded. Damage to transport network.
- Prolonged disruption to utilities and services.
- Water pollution may result in increased water borne disease.

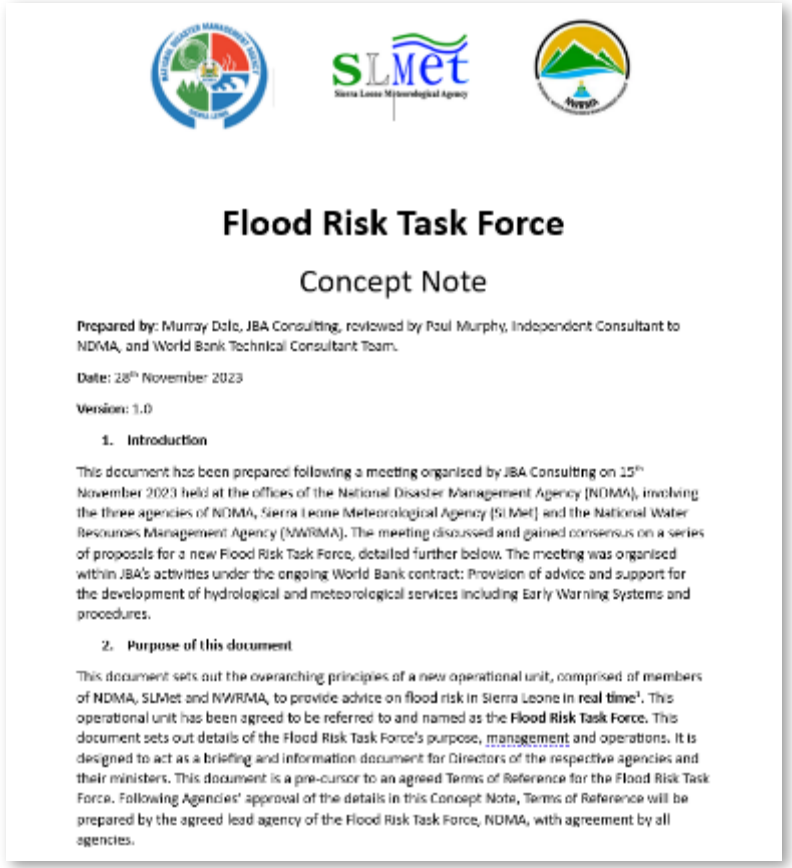
Low-impact flooding (Maps to Incident Level 1, Bronze):
- Individual risk for the more vulnerable or for those making decisions in unfamiliar situations (e.g. when flooded areas).
- Localised flooding affecting individual properties.
- Local damage to structures in poor condition.
- Local / short term disruption to travel.
- Localised / short term disruption to utilities and services.
- Water pollution may result in increased water borne disease.

	Low Impact Flooding	High Impact Flooding
High chance	• Increase level of NDMA preparedness for possible flooding. • Consider whether additional factors will affect flood impact (e.g. long period since last rain and increase channel blockage). • Communicate with professional partners of potential for flood in next three days. • Contact and liaise with SLMet on rainfall timing updates.	• Increase level of NDMA preparedness for possible high impact flooding. • Consider whether additional factors will affect flood impact (e.g. long period since last rain and increase channel blockage). • Communicate with professional partners of potential for flood in next three days. • Consider advising professional partners to take anticipatory actions such as channel blockage clearance if safe to do so, in partnership with NWRMA. • Issue more frequent flood advice reminders (**not flood warnings**) via radio, TV, social media. • Contact and liaise with SLMet on rainfall timing updates. • Contact and liaise with NWRMA regarding river levels in Freetown.
Medium Chance	• Raise NDMA preparedness level above normal level during rainy season. • Contact and liaise with SLMet on rainfall timing updates.	• Increase level of NDMA preparedness for possible flooding. • Consider whether additional factors will affect flood impact (e.g. long period since last rain and increase channel blockage). • Communicate with professional partners of potential for flood in next three days. • Issue flood advice reminders (**not flood warnings**) via radio, TV, social media. • Contact and liaise with SLMet on rainfall timing updates.
Low Chance	• Raise NDMA preparedness level above normal level during rainy season. • Contact and liaise with SLMet on rainfall timing updates.	• Raise NDMA preparedness level above normal level during rainy season. • Contact and liaise with SLMet on rainfall timing updates.
No flood guidance issued	• Maintain normal level of vigilance in rainy season and examine SL Met daily forecasts.	• Maintain normal level of vigilance in rainy season and examine SL Met daily forecasts.

Flood Risk Task Force



Flood Risk Task Force



Flood Risk Task Force

Concept Note

Prepared by: Murray Dale, JBA Consulting, reviewed by Paul Murphy, Independent Consultant to NDMA, and World Bank Technical Consultant Team.

Date: 28th November 2023

Version: 1.0

1. **Introduction**

This document has been prepared following a meeting organised by JBA Consulting on 15th November 2023 held at the offices of the National Disaster Management Agency (NDMA), involving the three agencies of NDMA, Sierra Leone Meteorological Agency (SLMet) and the National Water Resources Management Agency (NWRMA). The meeting discussed and gained consensus on a series of proposals for a new Flood Risk Task Force, detailed further below. The meeting was organised within JBA's activities under the ongoing World Bank contract: Provision of advice and support for the development of hydrological and meteorological services including Early Warning Systems and procedures.

2. **Purpose of this document**

This document sets out the overarching principles of a new operational unit, comprised of members of NDMA, SLMet and NWRMA, to provide advice on flood risk in Sierra Leone in **real time**[1]. This operational unit has been agreed to be referred to and named as the **Flood Risk Task Force.** This document sets out details of the Flood Risk Task Force's purpose, management and operations. It is designed to act as a briefing and information document for Directors of the respective agencies and their ministers. This document is a pre-cursor to an agreed Terms of Reference for the Flood Risk Task Force. Following Agencies' approval of the details in this Concept Note, Terms of Reference will be prepared by the agreed lead agency of the Flood Risk Task Force, NDMA, with agreement by all agencies.

National Water Resources Management Agency

Name: Junisa Patrick Bangali Esq.

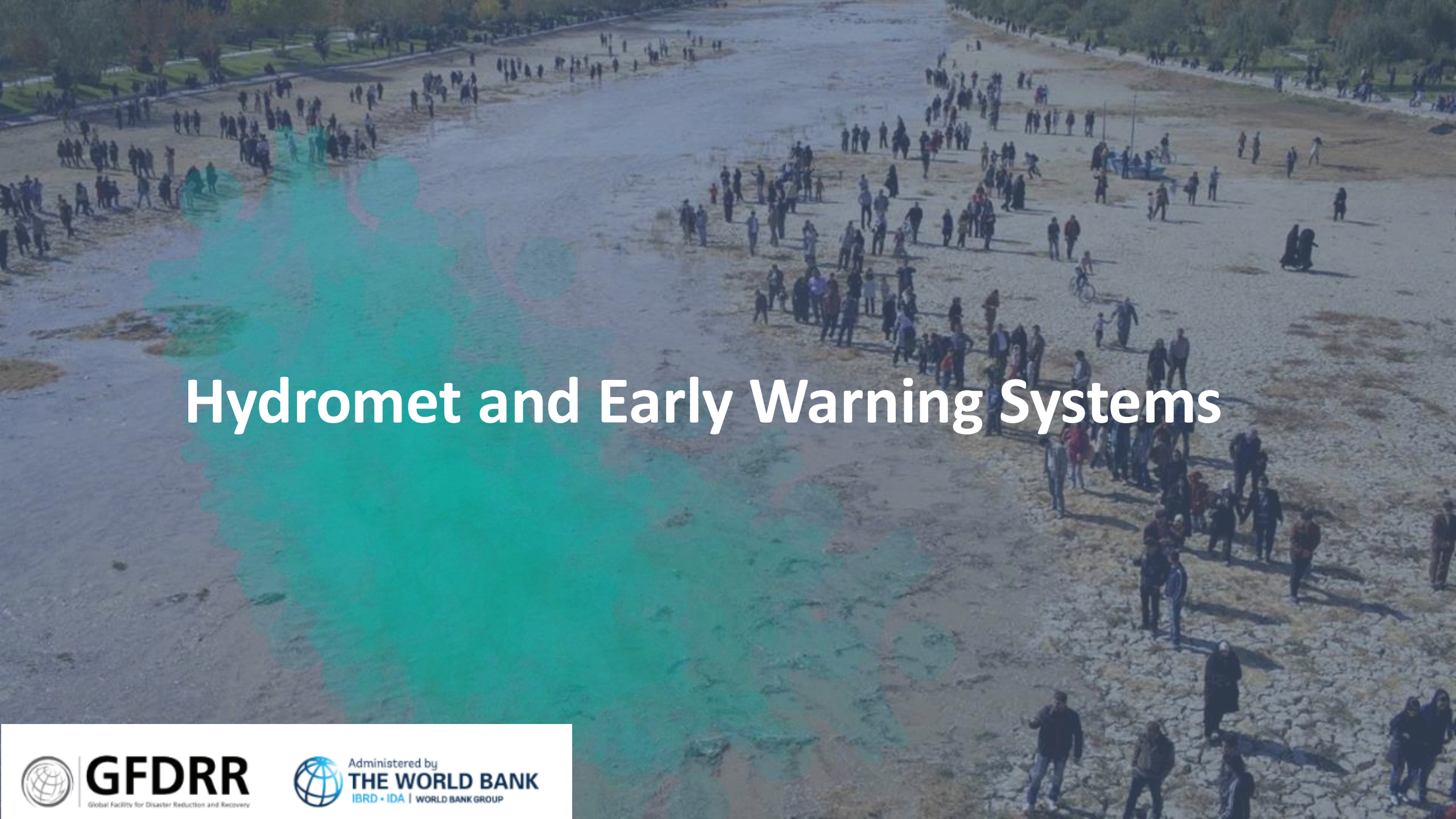
Designation: Director-General

Signed:

Date: 22-12-2023

Thomas Lebbie

- Director, Disaster Risk Reduction and Preparedness, National Disaster Management Agency, Sierra Leone
- Leader of the Sierra Leone Flood Risk Task Force, made up of the National Disaster Management Agency, Sierra Leone Meteorological Agency and National Water Resources Management Agency



Hydromet and Early Warning Systems

GFDRR
Global Facility for Disaster Reduction and Recovery

Administered by
THE WORLD BANK
IBRD • IDA | WORLD BANK GROUP

Challenges

The importance of Hydromet information and EWS is greater than ever and continue to grow

Public sector (NMHS and DRM) is still a backbone of the system but institutional capacity in most developing countries is inadequate due to low visibility and government underfunding

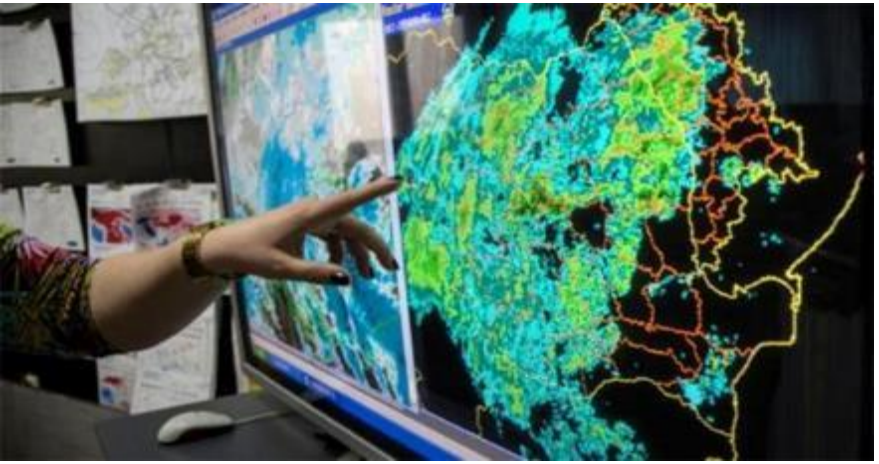
Significant obstacles exist for building public-private partnerships

Capacity Gap between developed and developing countries is not reducing

Consequences: losses of lives and "excessive" economic losses which could have been minimized or avoided

WORLD BANK GROUP

GFDRR is a focal point of Hydromet and EWS activities in the World Bank



- GFDRR Hydromet/EWS team was created in 2011 as a service center to provide analytical and implementation support to NMHS in developing countries and WB teams for preparation & implementation of programs strengthening Hydromet services and EWS
- GFDRR Hydromet/EWS Thematic Area is central in mainstreaming the hydromet agenda in the Bank's operations → **increasing the WB portfolio to USD1 billion (Portfolio review FY23)**
- The team leads WB Hydromet Community of Practice
- Three pillars of activities:
  - Support for Hydromet and EWS Investments
  - Analytical Support and Capacity Building
  - Partnership coordination

WORLD BANK GROUP

The approach for investments is constantly evolving….

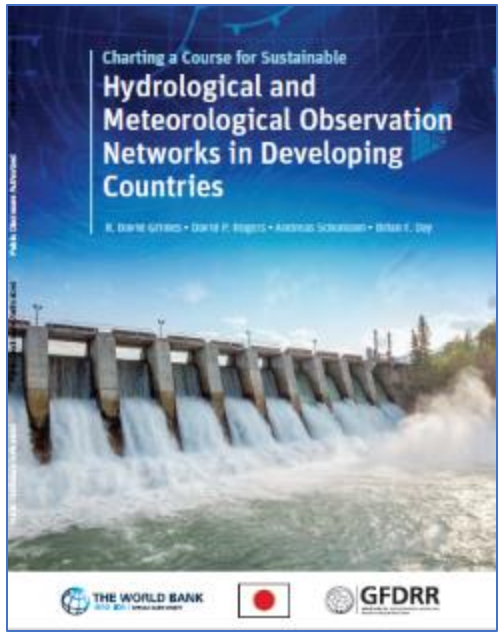
Conventional Approach (1995-2015)

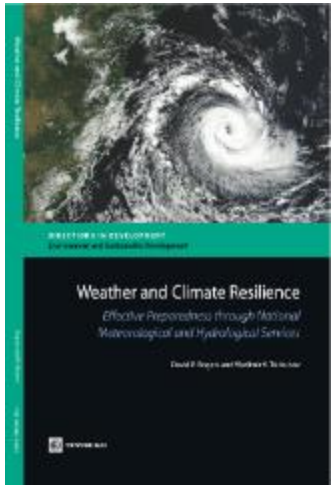
- Focus on the NMHS system
- Focusing on the public sector
- **Modernization of infrastructure**
  Institutional Strengthening
  Service Delivery

Emerging Approach

- **Focus on national Hydromet and EWS value chain** (including last mile and vulnerable communities)
- Public, Private and Academic Sectors as well as NGOs/CSOs
- **Service Delivery and EWS**
  Institutional Strengthening
  Fit-for-purpose affordable infrastructure
  Multi-Hazard Anticipatory and Inclusive EWS
- **Integration with sectoral solutions** (Agriculture, Water, Social Protection, Environment, etc.)

The highlights of analytical support





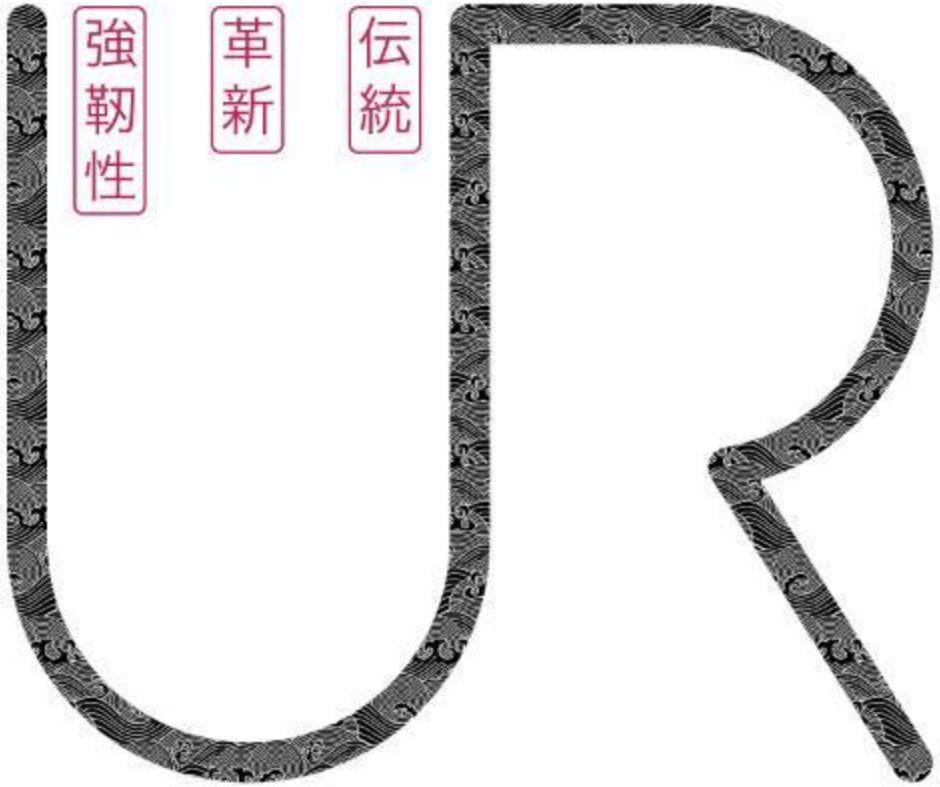
WORLD BANK GROUP

Partnerships are critical for Hydromet/EWS

- **GFDRR is the World Bank focal point for cooperation with partners on Hydromet and EWS programs**
- **Main partners:**
  - USAID, Japan, EU, Austria…
  - WMO, UNDRR, IFRC, GCF…
  - Leading NMHSs (UK Met Office, NOAA, Geosphere…)
  - Global and regional centers (ECMWF, RIMES…)
  - Private and academic institutions (HMEI)
- **Main programs:**
  - CREWS
  - Alliance for Hydromet Development
  - Systematic Observations Financing Facility (SOFF)
  - Global Weather Enterprise Forum
  - EWS4All

Q&A

1. What solutions have audience members found can be effective?
2. How should the technology and communication challenges be moved forward?
3. Other questions?



TRADITION • INNOVATION • RESILIENCE

Thank you !

Additional slides – for supporting questions

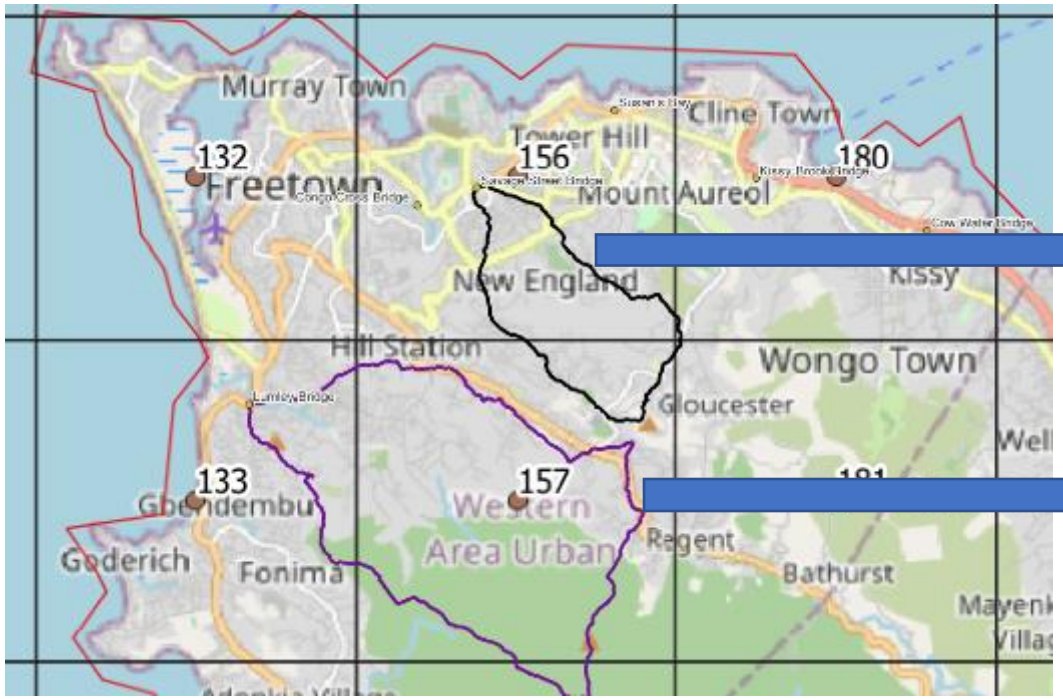
Chance		
High		
Medium		
Low		
	Low	High

Impact

Overall Flood Risk

High	
Medium	
Low	

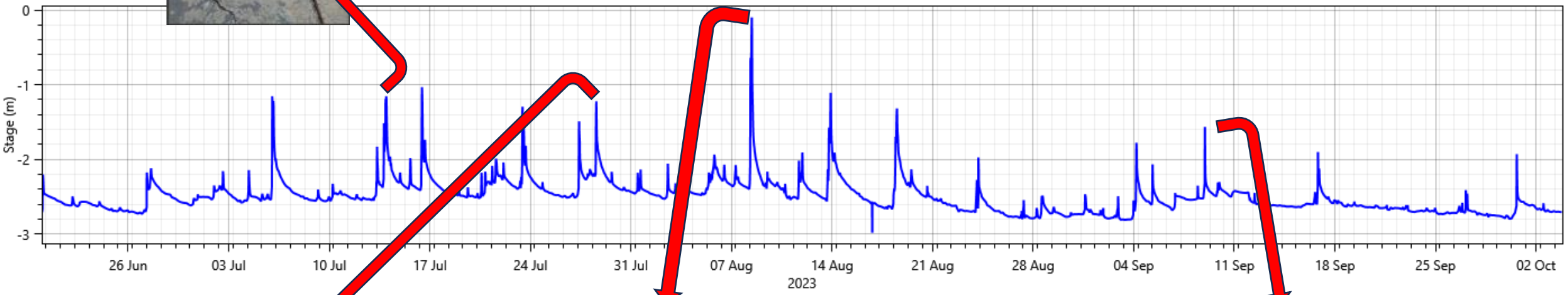
River level measuring



Congo Valley River

Lumley Creek

NWRMA Lumley gauge data



Images kindly supplied by Thomas Lebbie, NDMA and Ishmail Kamara, NWRMA

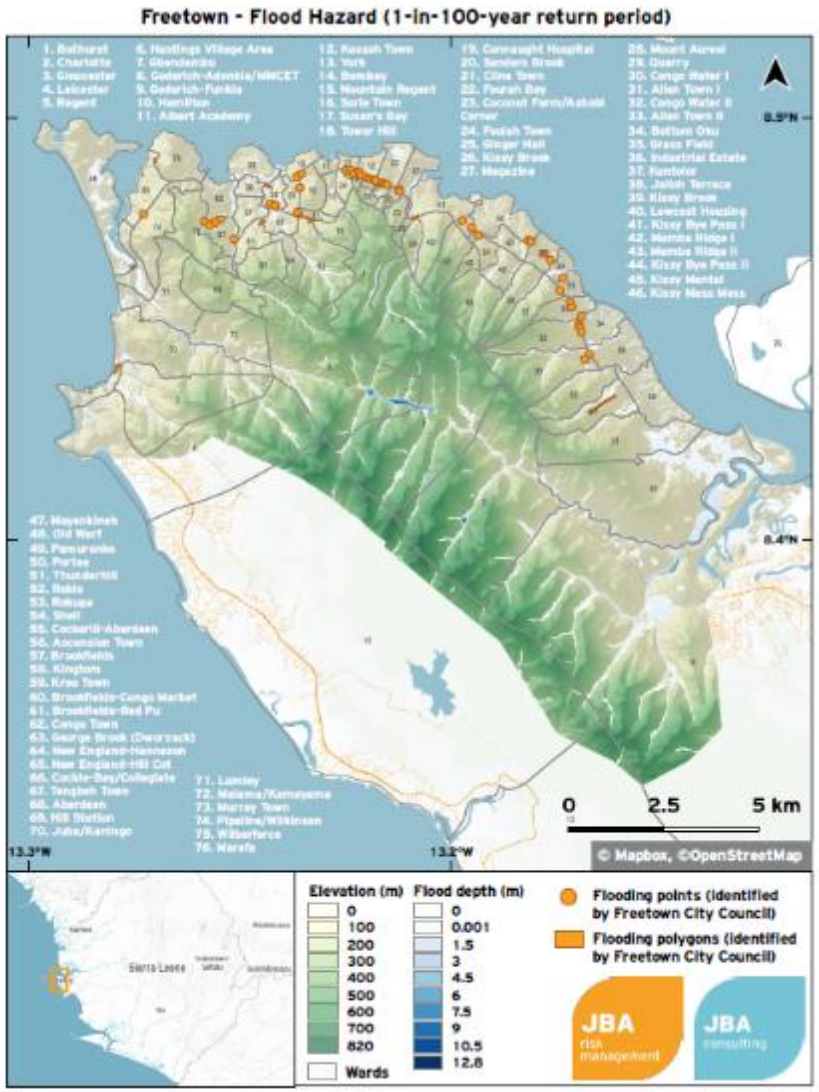
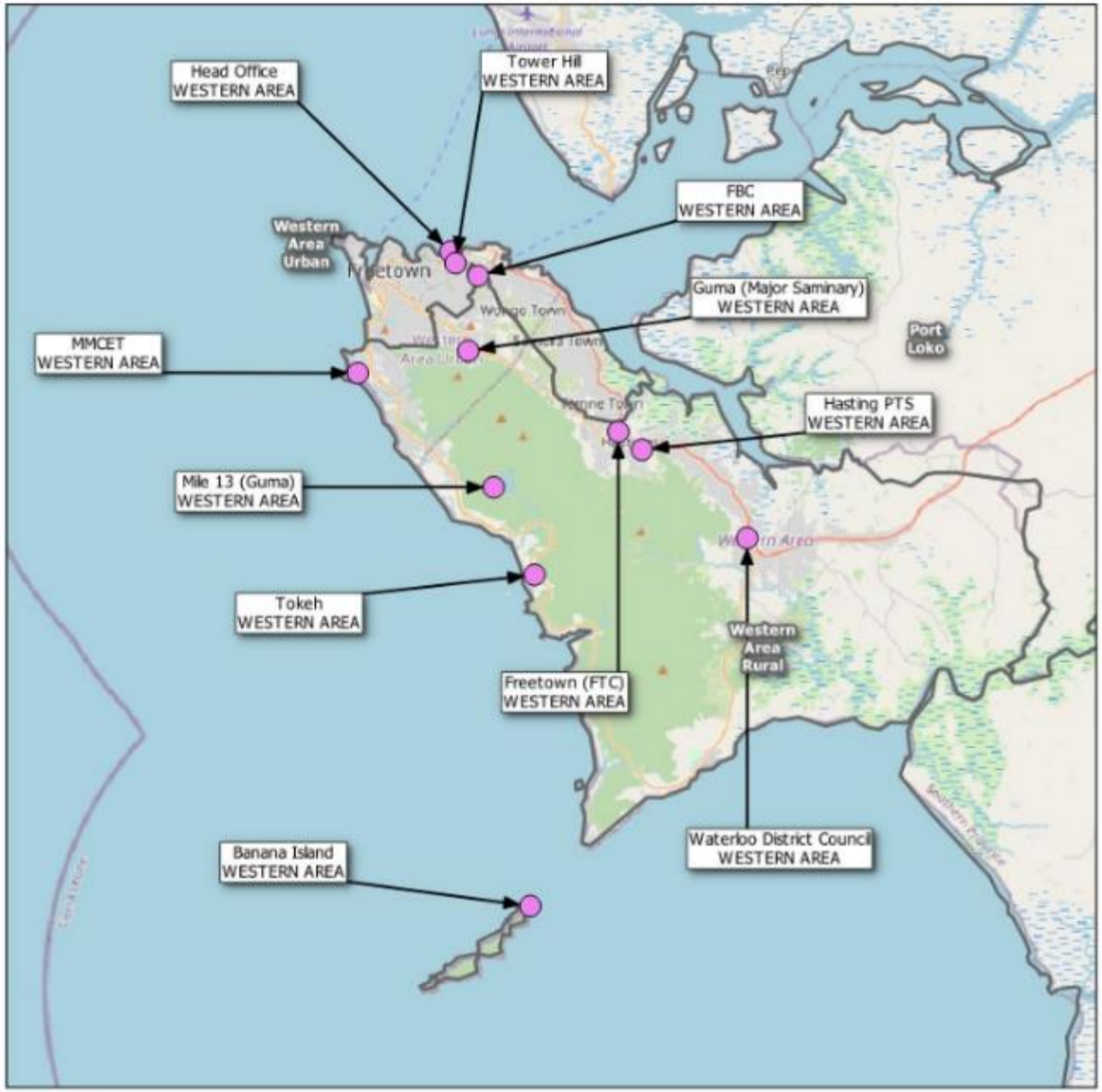


Figure 1: Comparison of JBA's 30m resolution river flood map for Sierra Leone for the 1 in 1,500-year return period (left) against the upscaled river flood map for the 1 in 1,500-year return period using the 1m DEM (right).

Rain gauge maintenance is important

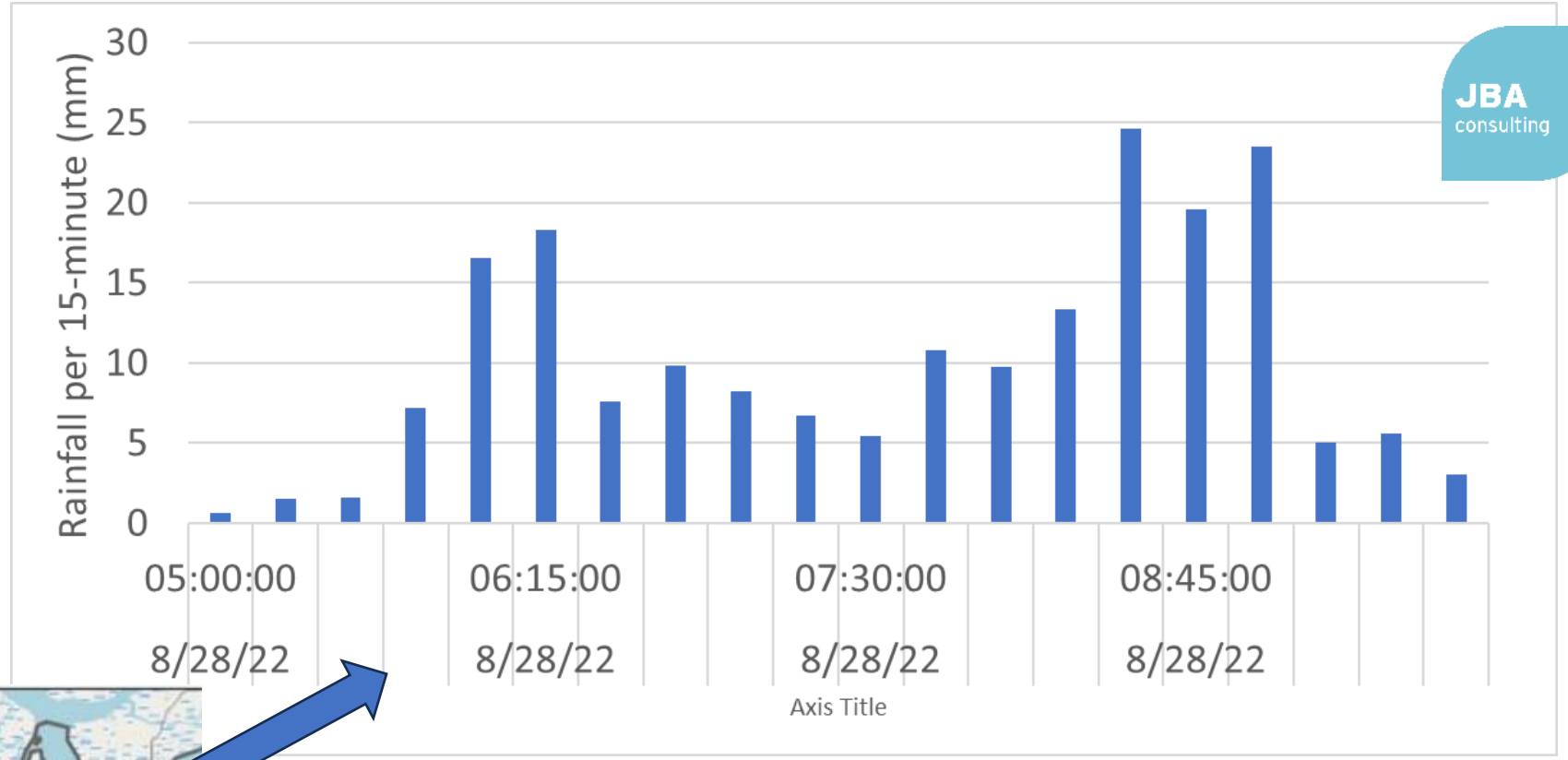


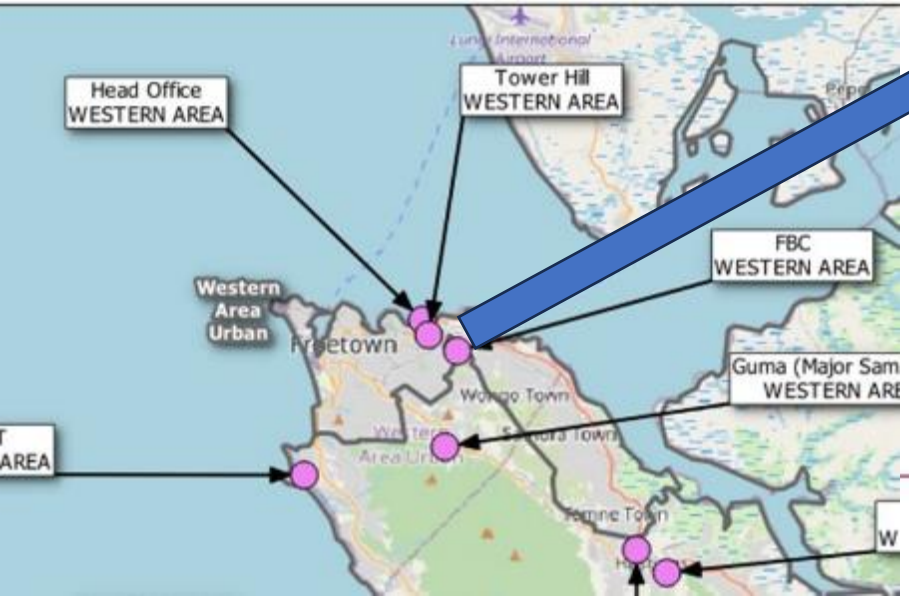
Rainfall Stations by district

- EAST KAILAHUN- KENEMA
- EAST KONO
- NORTH BOMBALI- TONKOLILI
- NORTH KERENA- FALABA-KABALA
- NORTH- KAMBIA
- PORTO LOKO
- SOUTH PUJEHUN
- SOUTH- BO
- SOUTH- MOYAMBA - BONTHE
- WESTERN AREA

JBA consulting

SLMet rainfall data
15-minute data are important!

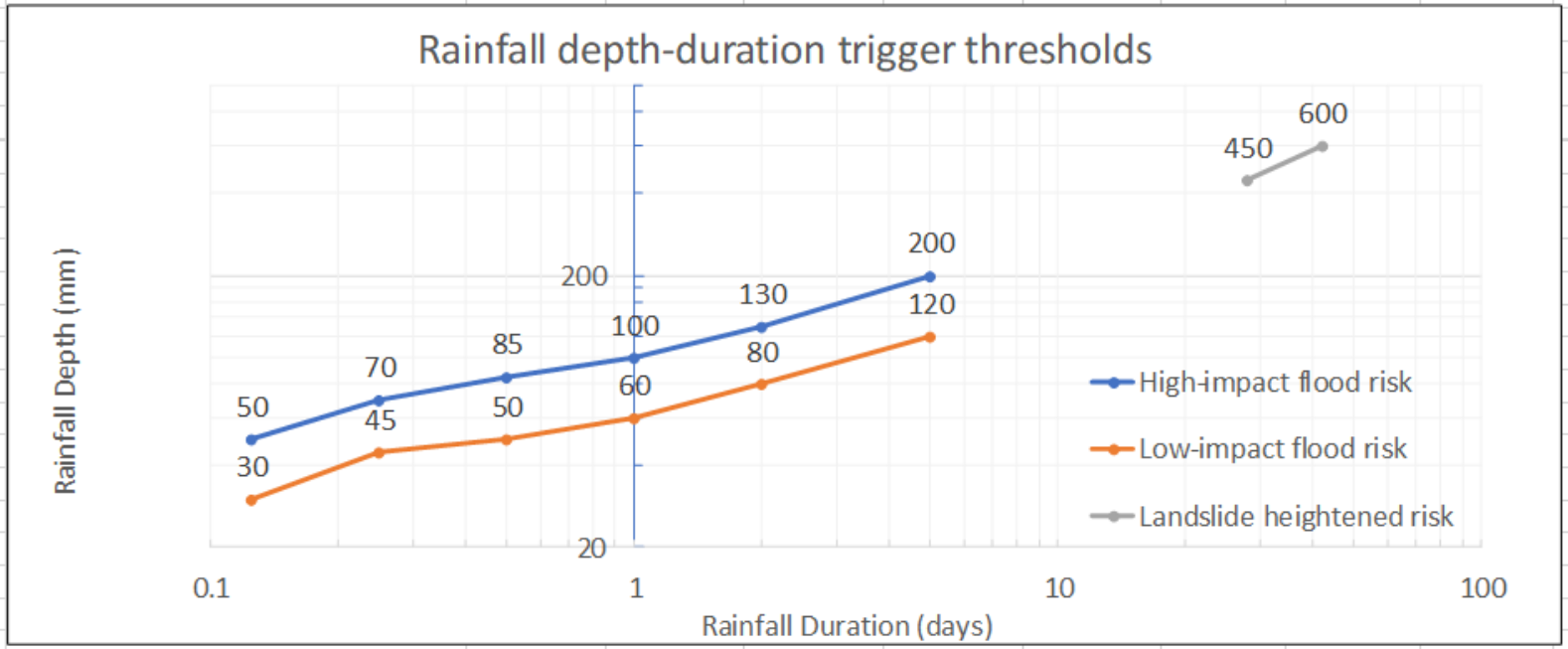


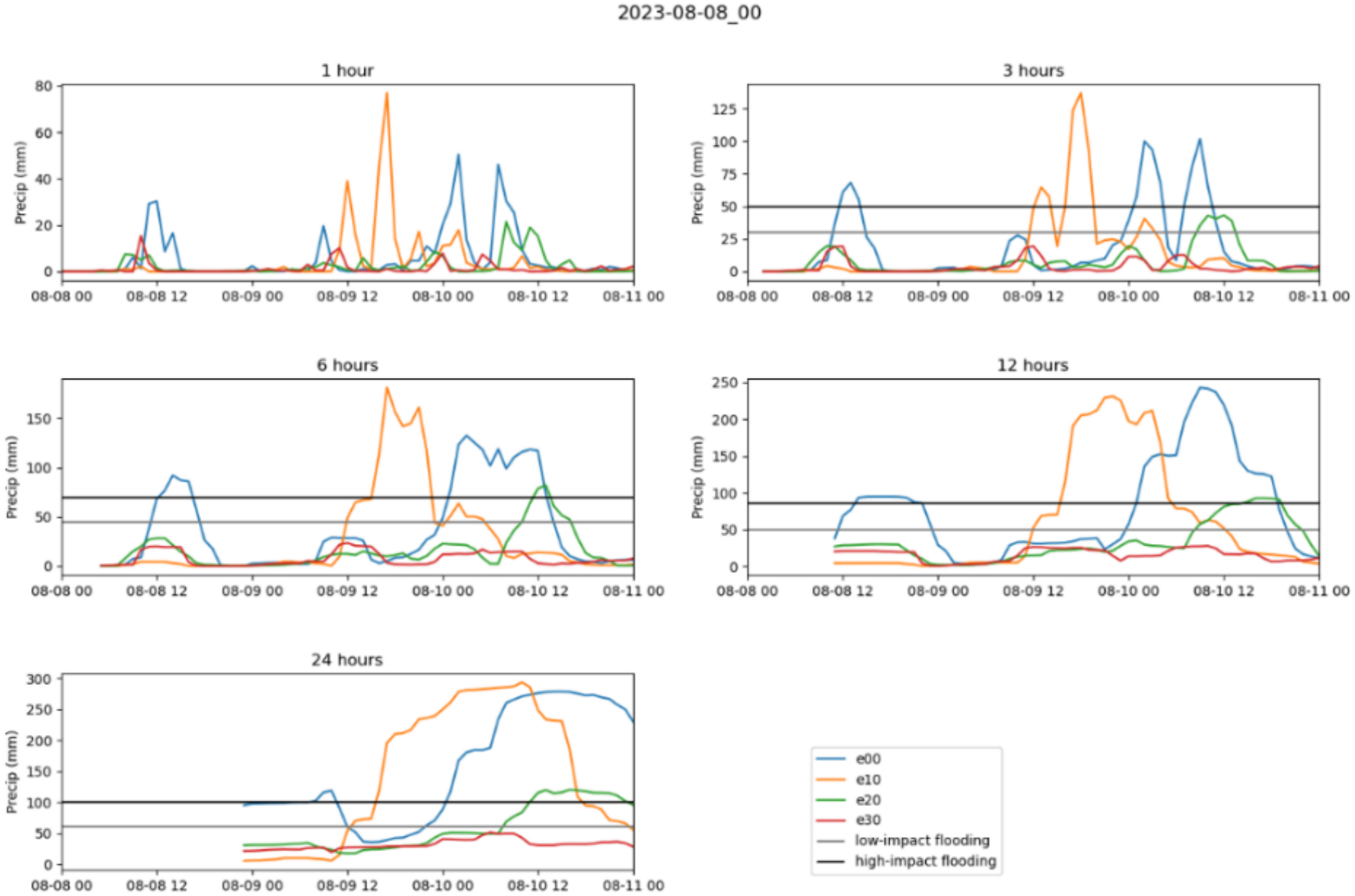


174mm in 3 hours!

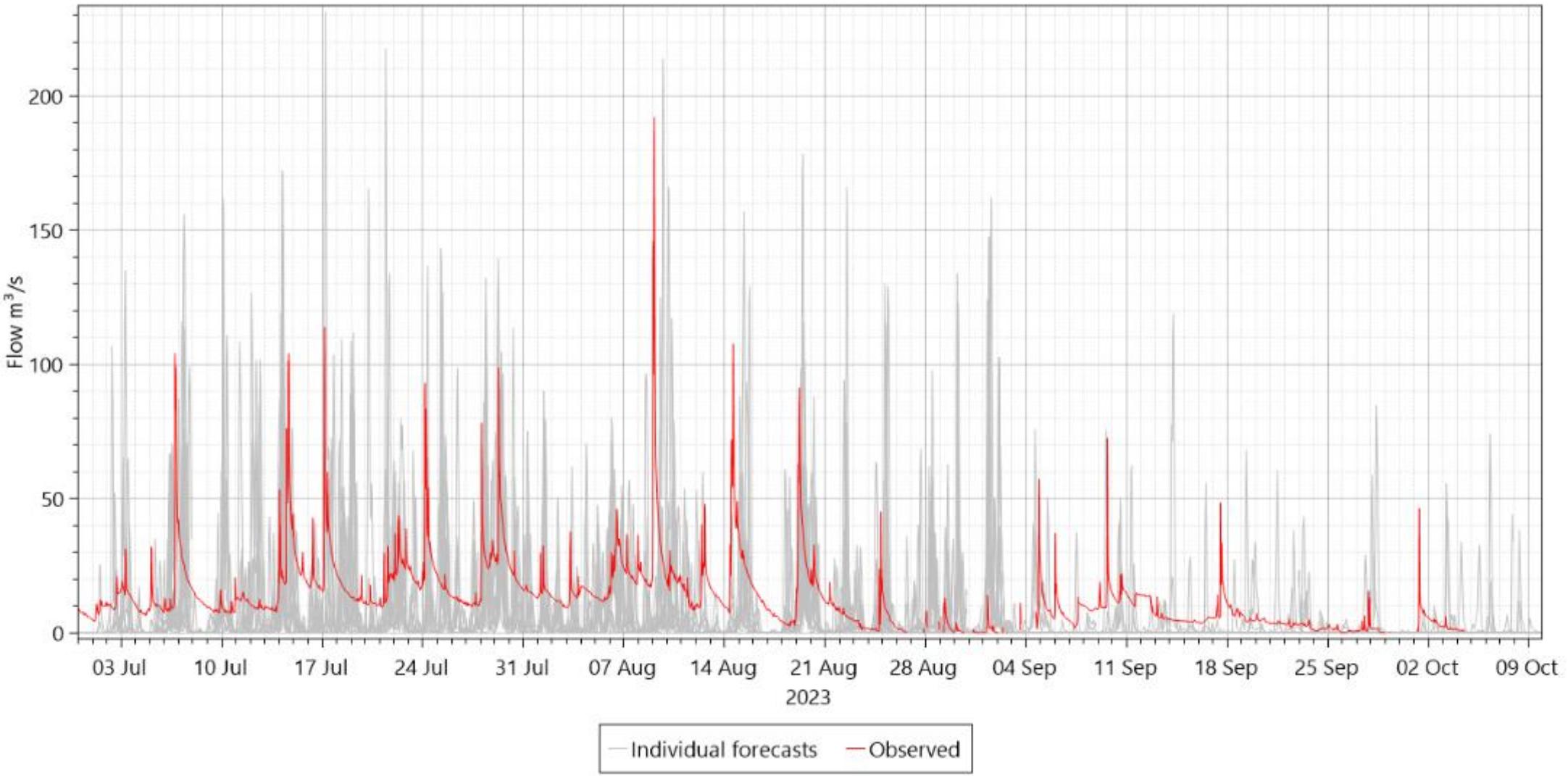
How much rain in how long causes flooding? Rainfall trigger thresholds

	Flood risk						Landslide risk	
Rainfall duration	**3-hours**	**6-hours**	**12-hours**	**24-hours**	**48-hours**	**5-days**	**4-weeks**	**6-weeks**
High-impact flooding expected	50mm	70mm	85mm	100mm	130mm	200mm		
Low-impact flooding expected	30mm	45mm	50mm	60mm	80mm	120mm		
Elevated risk of landslide							450mm	600mm





JBA consulting


200
150
100
50
0
Flow m³/s
03 Jul
10 Jul
17 Jul
24 Jul
31 Jul
07 Aug
14 Aug
21 Aug
28 Aug
04 Sep
11 Sep
18 Sep
25 Sep
02 Oct
09 Oct
2023
Individual forecasts
Observed

Conclusions of trial (JBA)

- Some skill shown in the model forecasts
- Generally, all eight major events forecast, but some timing errors (being investigated)
- Quite high number of ‘false alarms’
- JBA’s 2.2km rainfall forecast system uses 12km GEFS model data – using 9km ECMWF data might improve forecasts
- JBA has set up a FEWS system that could be run operationally with improved rainfall forecasts

Recording impacts

Date of Occurance	Community/Town/Village	Type of Incident	Cause of Incident	Dwelling Houses	Facility	School
28/04/2021	Regent	Windstorm	Wind	0	Regent Rural community School	1
10/09/2021	Pogodon,Cuttinbana,Hamilton	Flooding	Damaged Guma Pipe	2	None	0
10/09/2021	Congo Bridge community	Flooding	Rain	3	None	0
11/06/2021	Wilberforce barrack	Windstorm	Wind	0	ices Primary Sc	5
10/09/2021	9 Bass Street/Brookfields	Windstorm	Wind	0	School	1
15/09/2021	George Brook Road	Mudslide	Rain	1	None	0
15/09/2021	Thomson Bay	Flooding	Blocked Drinage	0	None	0
15/09/2021	Pademba Road PWD Junction	Flooding	Blocked Drinage	0	None	0

	A	B	C	D	E	F	G	V	W	X
1		Incident ID	Reporte	Date of Occuranc	Responsible Dirctorat	Region	District	Business Owners	Number of Household	Populatio Size
3	26	210428WSWR005	Open Source	28/04/2021	R & R	Western Area	Western rura	0	0	236
4	95	210910FFWR001	Volunteer	10/09/2021	R & R	Western Area	Western rura	0	5	27
5	96	210910FFWU002	Open Source	10/09/2021	R & R	Western Area	Western Urban	0	4	37
6	##	211106WSWU056	Open Source	11/06/2021	R & R	Western Area	Western Urban	0	0	400
7	##	210910WSWU055	Volunteer	10/09/2021	R & R	Western Area	Western Urban	0	0	70
8	##	210915LSWU001	Volunteer	15/09/2021	R & R	Western Area	Western Urban	0	3	15
9	##	210915FFWU003	Open Source	15/09/2021	R & R	Western Area	Western Urban	0	0	0
10	##	210915WU004	Volunteer	15/09/2021	R & R	Western Area	Western Urban	0	0	0
11	##	220505WSWR071	Open Source	05/05/2022	R & R	Western Area	Western Rura	0	0	
12	##	220505WSWR072	Open Source	05/05/2022	R & R	Western Area	Western Rura	0	0	
13	##	220416FRWR047	Open Source	16/04/2022	R & R	Western Area	Western Rura	0	1	
14	##	220828FLWO007	DSCOORD	28/08/2022	RR	Western Area	Western Urba	0	1439	5
15	##	220828FLWO008	DSCOORD	28/08/2022	RR	Western Area	Western Urba	0	18	
16	##	220828FLWO009	DSCOORD	28/08/2022	RR	Western Area	Western Urba	0	129	
17	##	220828FLWO010	DSCOORD	28/08/2022	RR	Western Area	Western Urban	0	12	
18	##	220828FLWO011	DSCOORD	28/08/2022	RR	Western Area	Western Urban	0	4	

N/A	Lumley	8.4521	13.27252		Heavy Downpour of Rain	5	None	0	0	0	0	0											
N/A	Lumley Regent Road,Jarret Drive	8.45435	13.2687	Flooding	Heavy Downpour of Rain	2	None	0	0	0	0	0	0	0									
	Lumley Amadu			Flooding																			

Possible future developments, beyond assignment

Meteorological forecasts:
Trial ECMWF global model to drive JBA system
Trial use of more ensemble members
Rainfall-runoff forecast system:
Calibrate Lumley data and trial the FEWS system in real time
Operational & capacity building:
Flooding Task Force meet daily through rainy season 2024 and beyond
Flooding Task Force run / use the FEWS system for Freetown
Flood warning:
Community awareness, vigilance through volunteer WhatsApp group
Involvement of FCC, Red Cross, NGOs etc. +++