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vandhe bhäratham
Art of Giving

Early Warning System on Flooding Conditions in Rivers

Lokesh BH

Founder-Chairman

Vandhe Bharatham

98452 92804

lokesh@vandhebharatham.org

The need for an early flood warning system

- Direct measurement of river velocity profile, level and discharge (Quantity).
- Early flood warning system gives indication very accurately on the approaching flood situation in a particular stretch of river.
- Such early warnings/alerts helps take preventive and corrective actions by the concerned dam/district authorities.
- Saves lives, livestock and assets.
- Reduces the aftermath effects like health and expenditure.
- Helps discharge water gradually in downstream location to evacuate existing water and accommodate rushing in water. This helps prevent excessive flooding in the flood plains, thus reducing damages.
- In a situation where there are dams in series, which tends to increase the level.
- Sudden releases from upstream dams can be avoided during heavy rainfall and monsoon season by careful planning using the available information.

Other Benefits

- Interstate water transfer accounting
- Water availability assessment and allocation planning for irrigational purpose

Scope of an early flood warning system

This work can be taken up in stages.

Stage 1 – Real time continuous monitoring of flow, discharge volume, velocity and level of water in river sending live data to a central station and dams/reservoir offices.

Installed in about 4 locations on the river, each separated from the other in travel time of the river flow, roughly 10 hours apart.

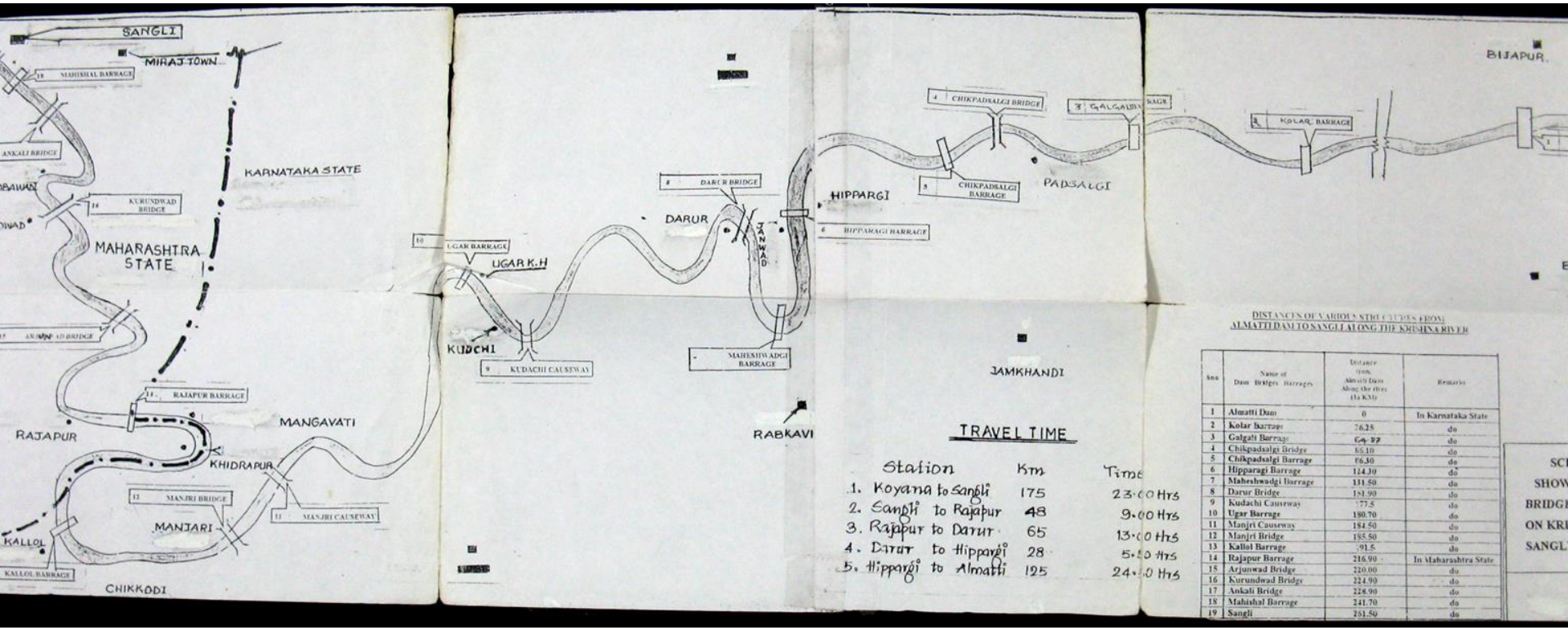
Real time monitoring of water level in dam/reservoirs and also additional level monitoring station on select locations on the river.

Stage 2 – Software's that take the discharge, velocity, level, in the catchments area to co-relate the flows from multiple locations and project the flows over the next 24 hours into the down stream reservoirs.

Level at various barrages and river flow relationship shall be established from the level monitoring and flow monitoring devices throughout the river, which provides information much earlier than the main stream flow changes.

Stage 3 – Automated control of dam/reservoir gates with a security and authorisation process and monitoring of gate openings.

Graphical representation of Krishna River, Various structures and the Water Travel Time

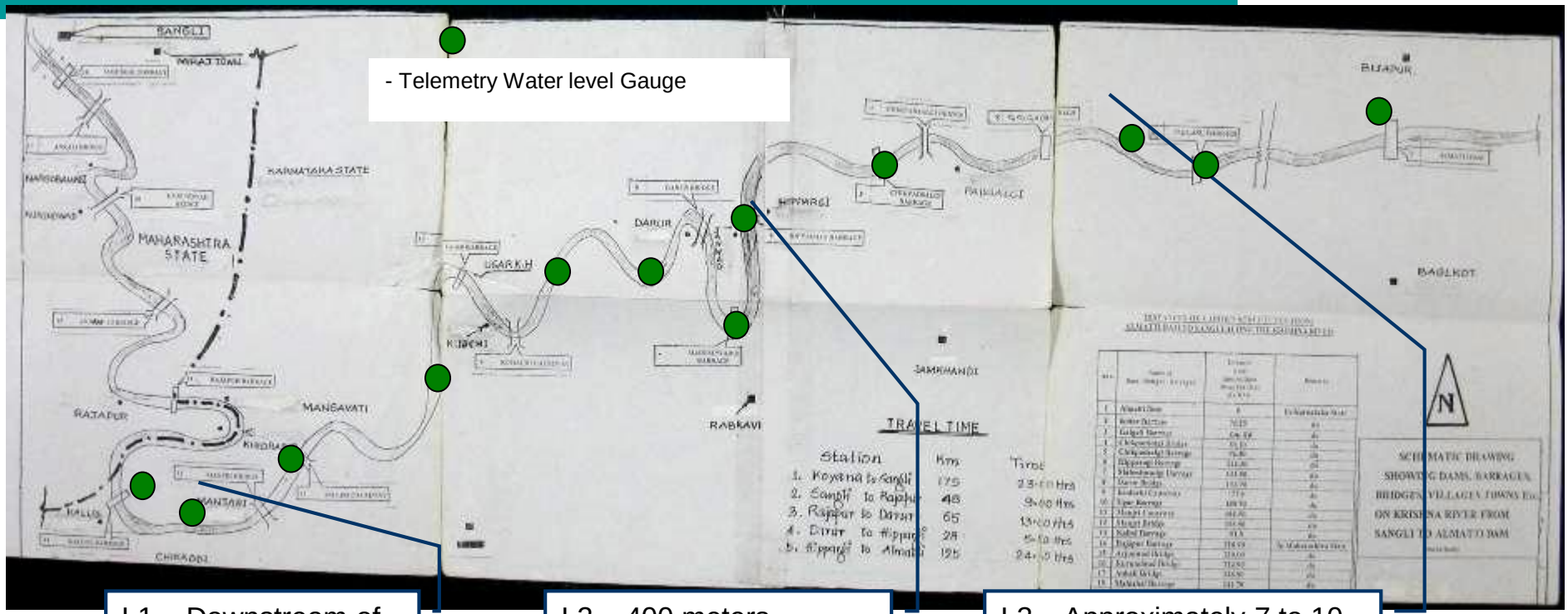


DISTANCES OF VARIOUS STRUCTURES FROM ALMATTI DAM TO SANGLI ALONG THE KRISHNA RIVER

Sno	Name of Dam Bridges Barrages	Distance from Almatti Dam Along the river (in KM)	Remarks
1	Almatti Dam	0	In Karnataka State
2	Kolar Barrage	76.25	do
3	Galgali Barrage	64.37	do
4	Chikpadsalgi Bridge	85.10	do
5	Chikpadsalgi Barrage	86.30	do
6	Hipparagi Barrage	114.30	do
7	Maheshwadgi Barrage	131.50	do
8	Darur Bridge	151.90	do
9	Kudachi Causeway	177.5	do
10	Ugar Barrage	180.70	do
11	Manjri Causeway	182.50	do
12	Manjri Bridge	185.50	do
13	Kallol Barrage	91.5	do
14	Rajapur Barrage	216.90	In Maharashtra State
15	Arjunwad Bridge	220.00	do
16	Kurundwad Bridge	224.90	do
17	Ankali Bridge	228.90	do
18	Mahishal Barrage	241.70	do
19	Sangli	251.50	do

Vandhe Bhäratham, # 637, 13th Cross, 5th Main, M.C. Layout, Vijayanagar, Bengaluru - 560 040 India
Mobile: +91 9845292804 | Tel : +91 80 23356750 | E-mail : info@vandhebharatham.org

How does the early flood warning system work – Model with an illustration



L1 – Downstream of Kallol. In Yadur.

L2 – 400 meters Upstream of Hipparagi.

L3 – Approximately 7 to 10 hours of flood water flow upstream of Almatti.

TRAVEL TIME downstream and DISTANCE upstream from control infrastructure like dam, reservoir, canals, etc., are considered to identify the location for real time flow monitoring system installation.

Correlation between the level, velocity and discharge with respect to time between L1, L2 and L3, will help identify the change in velocity, level variation and discharge variation reflecting at the downstream point. Additionally river water level inputs will help trigger much earlier monitoring and assessment of variations.

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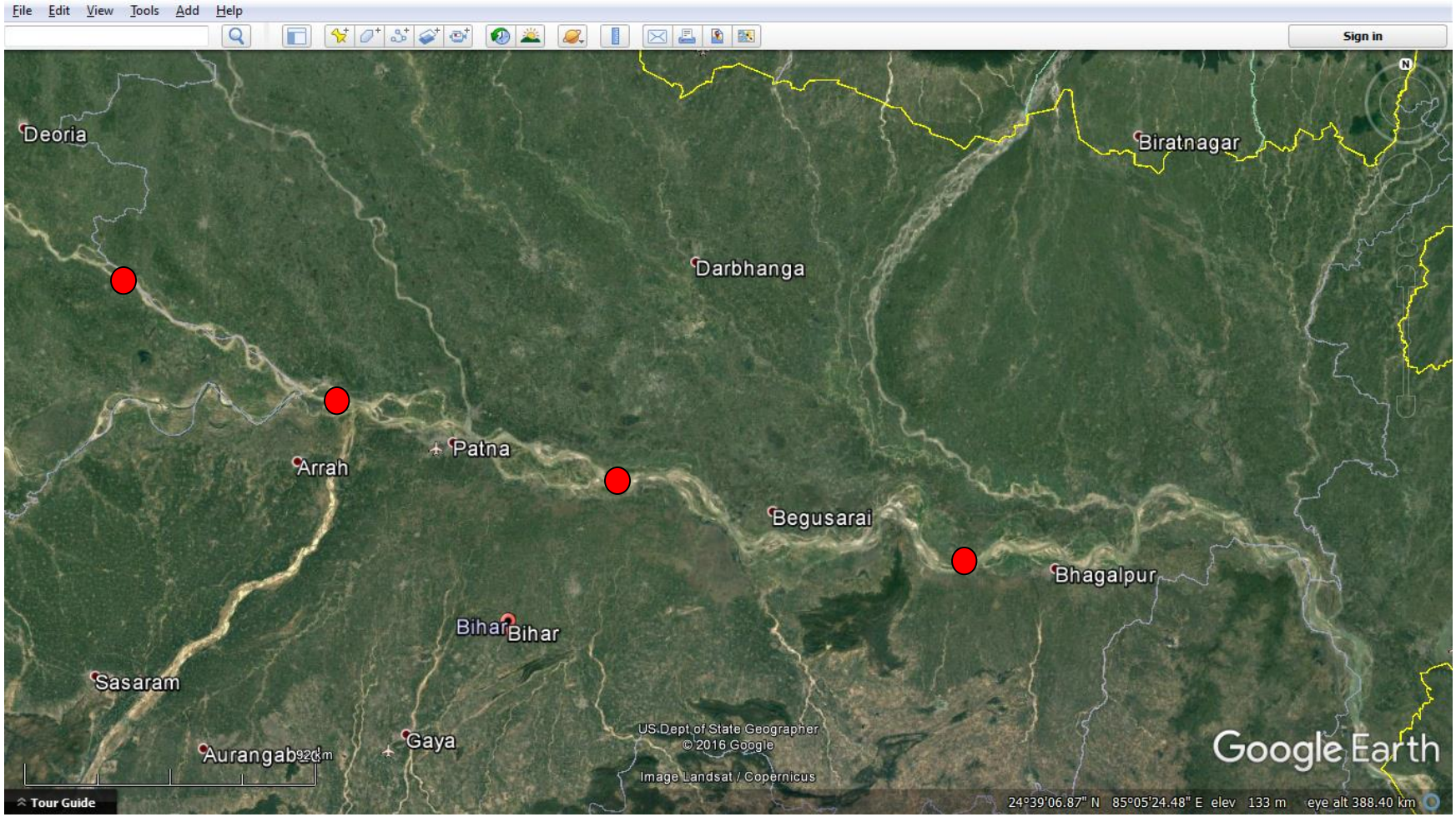

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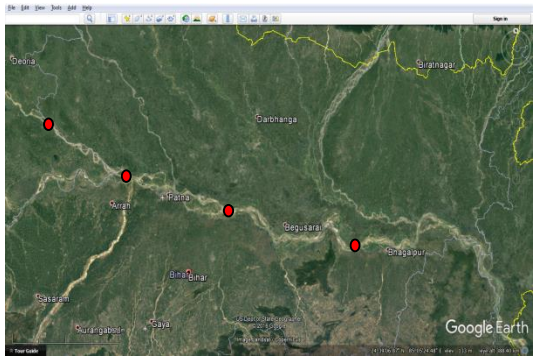


Each Red Dot (Flow meter location is spaced roughly to monitor the Travel Time of the river flow for every 10 to 15 hours.

1 location to 2nd – 10 hours travel time

2nd to 3rd – 10 Hours

3rd to 4th – 10 hours

The 4 Red Dots – Monitoring station for :

1. Velocity of the water in the river cross section.
2. Water Level in that chainage.
3. Q Volumetric Discharge in m3/s.
4. Variation in V, Q and H.

Each location will continuously monitor, record and transmit the various parameters to a central location or multiple locations.

The variation of different parameters occurring at the upstream point is correlated with the same parameter at the downstream point to assess the flooding possibility.

If variations in upstream location is found reflecting in the downstream location with respect to time, the watch will be finer over time.

Over next few hours intensive correlation will help ascertain impending flooding situation and alerts/warnings are issued as per the communication hierarchy.

Correlation between the level, velocity and discharge with respect to time between L1 , L2, L3 and L4, will help identify the change in velocity, level variation and discharge variation reflecting at the downstream point. Additionally river water level inputs will help trigger much earlier monitoring and assessment of variations.

What does the system consist of?

The system at each location consists of flow meters in a combination of transit time principle and surface velocity measurement principle which can measure rivers (main stream) of width up to 700 meters.

The sensors installed are in multi plane, cross path arrangement. The computing, control, communication and power equipments are also part of the system.

The underwater devices are the sensors and connectors.

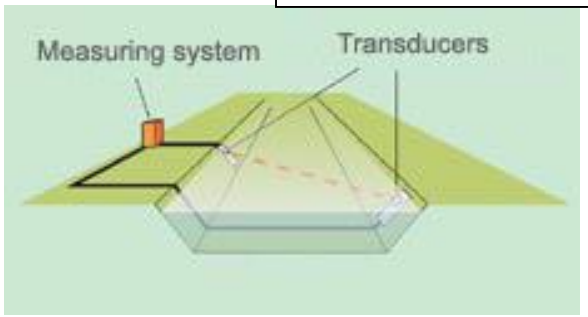
The cables connecting the sensors will cross over the river and the other devices will be housed on a concrete platform/house typically 15-20 feet above the river bank ground.

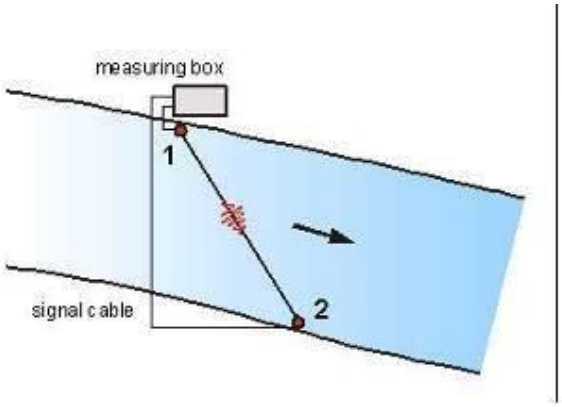
The Communication to the Central Monitoring Center will be Irridium/satellite communication.

The central monitoring station will have data reception facility, computers, software to correlate current, historic and communication of current information and alert facility.

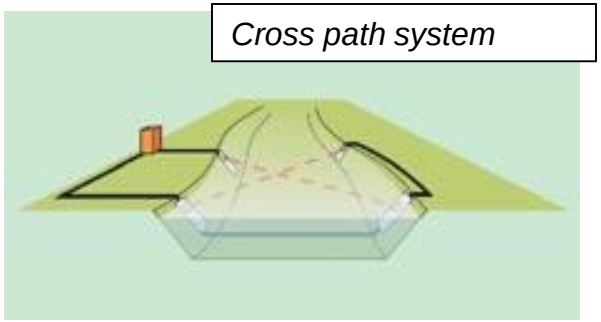
Various Configuration possibilities

Single path system

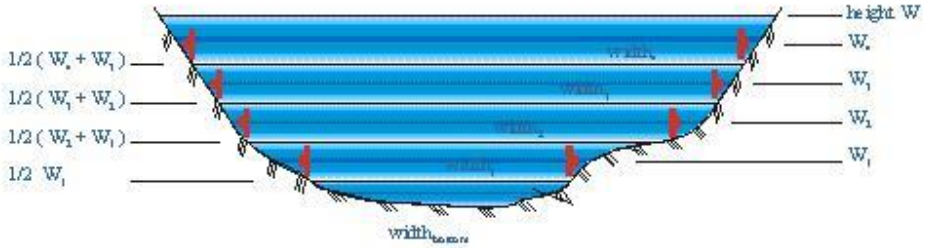




Cross path system



Mid Section Method (ISO 6416)



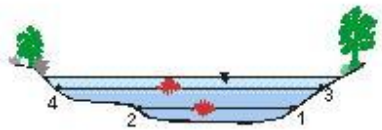
$Q_1 = v_1 \, 1/2 \, (W_0 - W_1) \, b_1$

$Q_2 = v_2 \, 1/2 \, (W_1 - W_i) \, b_2$

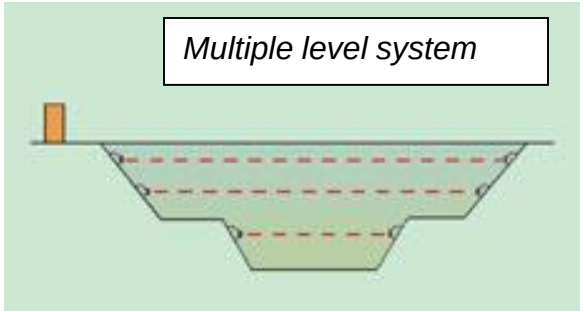
$Q_i = v_i \, 1/2 \, W_i \, b_i$

$Q_{surface} = v_0 \, [W - 1/2 \, (W_0 + W_1)] \, B_0$

$Q_{bottom} = 0.8 \, v_i \, 1/2 \, W_i \, B_{bottom}$



Multiple level system



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Existing methods to manage water

Rainfall – Runoff modeling – not typically in use anywhere in the state.

Numerical weather models

- Where is the data for numerical modeling?
- Based on estimates and not real time measurement of parameters
- Assessment of inflow into the reservoir with Levels in Dams/ Flumes / Weirs
- No relations with various reservoirs and not a coordinated system.

Shortcomings in the existing methods.

- Not continuous and does not accommodate changes on periodic basis.
- Not online and no correlation of data and analysis, hence analysis and communication is delayed and by then a lot of water would have flown away.
- Time consuming and is not direct and not reliable during emergency.
- Does not provide an electronic warning platform for setting thresholds around the targets which needs to be adhered through the control infrastructure.
- No Exception handling and control in real time.
- May not give accurate representation (resolution, spatial) of the entire catchment and the main stream discharge.
- Travel and administration cost are involved.
- Authorities involve in flood management require flow forecasts in upper reach and level forecast in few more locations for operational decision at shorter time interval.

Overview of the architecture

Measuring Site

- Send and
- Receive flow, velocity, level data
- On set time/event

Mobile phone users receive SMS and alerts

Central Monitoring Station

- Capture monitoring location details (cross section, chainage, flood plain details, etc)
- Capture measurement site data
- Capture information sharing details (who needs what data and when?)

- Correlate the data between locations.
- Analyse data and categorise the event in normal, emergency, etc and send alerts and corrections required.
- Reports

•Information
•Suggestion
•Alarms
•Alerts

Dam/Reservoir users can access data in real time along with alerts/alarms.

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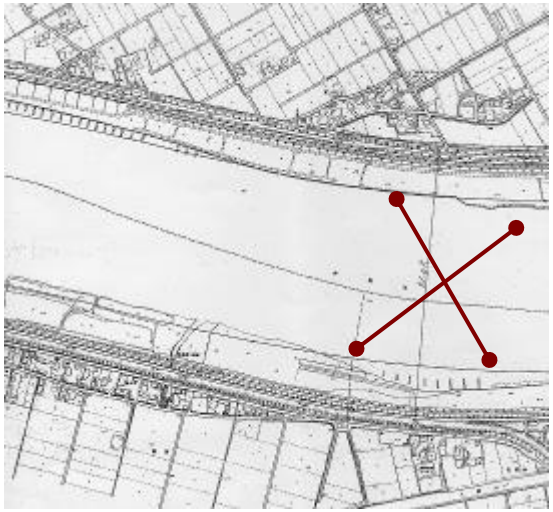
Sawara Flow Meter Installation

- Responder System / 3 Layers / Path Length 381 m



Main House

Responder

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Sawara Flow Meter Installation

- Transducer
- Installation

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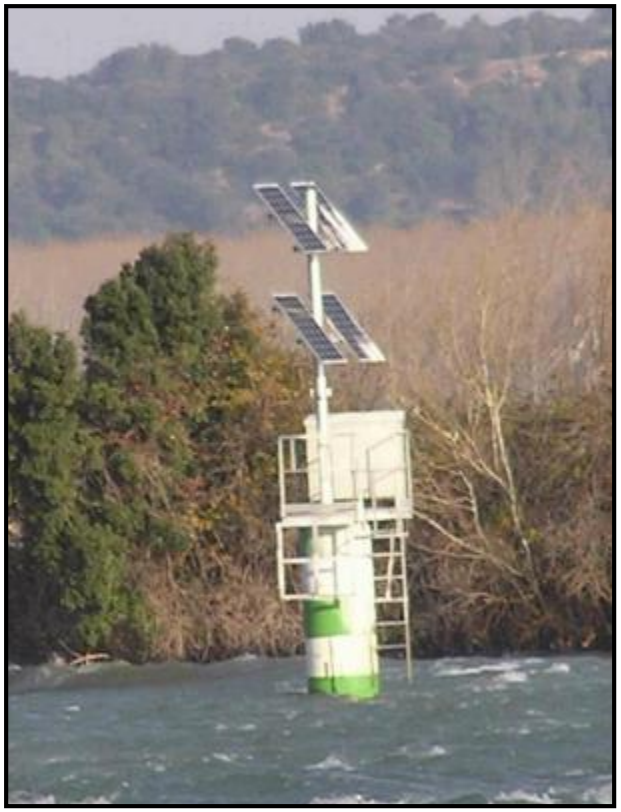
Strasbourg France - Installation

System Chusclan / Frankreich

Rhone

Responder



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Thank You

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