

**Dams in Telangana State**

**An Incredible Challenge Confronted in effectively managing the  
Probable Maximum flood**

**Neelam Sanjeev Reddy Sagar Dam (NSRSP) Location**

**- A Case Study.**

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## 1. INTRODUCTION:

### 1.1 DAMS IN TELANGANA STATE:

- Irrigation projects in the state of Telangana are listed under two heads namely Godavari Basin and Krishna Basin.

### 1.2 Projects under Godavari Basin

SNo.	Name of the Project	Storage (TMC)	Primary usage
<b>Major Irrigation</b>			
1	Nizam Sagar	58.000	Irrigation
2	Singur	29.910	Power, Drinking Water
3	Alisagar & Guthpa LIS	4.900	Irrigation
4	Indiramma Flood flow canal from SRSP	19.979	Irrigation
5	Kinnerasani	8.139	Irrigation
6	SRSP-II	22.999	Irrigation
7	Sripada Yellampally Barrage	60.360	Irrigation
8	Dr. B. R. Ambedkar Pranahitha Project	160.000	Irrigation
9	PV Narsimharao Kantanapally (Thupakulagudem)	100.000	Irrigation, Power
10	JCRGLIS	60.000	Irrigation
11	Choutapally Hanumanthu Reddy LIS	1.050	Irrigation
12	Kaleshwaram LIS	4.500	Irrigation
13	Lendi	2.430	Irrigation
14	Sita Rama Lift Irrigation Scheme	16.50	Irrigation, Power
15	Bhaktha Ramadasu Lift Irrigation Scheme	5.5	Irrigation
16	Lower Penganga Project	5.119	Irrigation
<b>Medium Irrigation</b>			
17	Suddavagu	2.230	Irrigation
18	Gollavagu	0.830	Irrigation
19	Ralivagu	0.620	Irrigation
20	Mathadivagu	0.905	Irrigation
21	Peddavagu – Ada	8.599	Irrigation

22	Peddavagu – Neelawai	1.727	Irrigation
23	Peddavagu – Jagannadapur	1.074	Irrigation
24	Gundallavagu	0.244	Irrigation
25	Modikuntavagu	3.267	Irrigation
26	Pallemvagu	2.177	Irrigation

### 1.3 Projects under Krishna Basin

S No.	Name of the Project	Storage (TMC)	Primary usage
<b>Major Irrigation</b>			
1	Modernization of Nagarjuna Sagar Project	105.70	Irrigation
2	Rajiv (Bhima) Lift Irrigation Scheme	20.00	Irrigation
3	AMRP (SLBC)	30.00	Irrigation
4	Mahathma Gandhi(Kalwakurthy) LIS	52.00	Irrigation
5	Jawahar (NettamPadu ) LIS	22.00	Irrigation
6	Palamuru Ranga Reddy LIS	90.00	Irrigation
7	Dindi LIS	30.00	Irrigation
<b>Medium Irrigation</b>			
8	Koilsagar	3.90	Irrigation
9	Musi	9.40	Irrigation

## **2. NEELAM SANJEEV REDDY SAGAR DAM (Srisailam Dam):**

- In the state of Telangana, River Krishna is one of the major Inter state river on which projects/dams were constructed for Irrigation and Hydro Power Generation.
- Neelam Sanjeev Reddy Sagar Dam(NSRSP), also known as Srisailam Dam as it is near the Srisailam Temple town is constructed on Krishna River.
- It has the tallest spillway in the whole state and second in the country.
- It is located completely in the Tiger Reserve forest of the Nallamala Hills. Hence it was primarily designed for Hydro Electric Power generation project.
- Nalgonda district is listed as one of the drought prone areas of the state. Thus Later on Tunneling was carried on for the canals, water was driven out of the forest area and then used for irrigation purpose. Without disturbing the Tiger Reserve Forest.

### **The Srisailam Dam is designed for:**

- A thousand year return flood of 20.20 lakh cusecs
- For a discharge of 11.1 lakh cusecs at FRL +885 ft
- For a discharge of 13.2 lakh cusecs at MWL 892 ft including the power draft,

While the flood received peaked to **25.40 Lakh Cusecs**, on 2nd October from 6.00 pm onwards and continued at this level of inflow for more than 10 hours.

### **2.1 CHALLENGE:**

- During Investigation, it was found that the foundation rocks at the location identified for the dam, the underneath geology and earth were not suitable for taking the stresses from the dam.
- The dam is proposed at such a location where the maximum stresses has been carried onto the existing hillocks.
- At first Nagarjunsagar Dam (NSP) was constructed then Srisailam Dam was constructed. NSP is located downstream of the Srisailam Dam.
- It was constructed in such a way that the height of backwaters of NSP is greater than the Tail Water Level of the Srisailam. So stilling basin of Srisailam was greater than the Tail water Level of the Dam.

## 2.2 The October 2009 flood:- Limitations for release of flood water

- The October 2009 flood has more than 100 years return period.
- The maximum discharge released from Srisaillam was 7.36 lakh cuses on 15th October 1998, whereas flood inflow was 25.4 lakh cusecs on 3rd October, 2009.
- The flood resulted in building up of water at the Srisaillam dam to a level of +896.5 ft. which is above maximum water level (MWL) of +892 ft.
- No guidelines on operating gates beyond this and more storage would submerge more areas upstream due to back waters.
- Beyond MWL there is a problem in emptying of the Tungabhadra River water into Krishna.
- In downstream when discharge is more, there is an issue of submergence of power utilities on left and right banks.
- It faced the challenge but withstood due to good workmanship and the design of the dam. It reached Factory of Safety but still stood safe and functioning well.

## 3. RAINFALL AND WATER ALLOCATION:

- Most of the catchment area of Krishna River in erst while Andhra Pradesh is a drought prone area.
- The mean annual rainfall in the catchment area ranges between 635mm and 1016mm and it is mainly from South-West monsoon.
- In the normal dependable year, the State has to receive about 550 TMC of water from upper States, out of its total allocation of 800 TMC of water in addition a return inflow of 11 TMC.

### 3.1 PROJECTS ON KRISHNA RIVER:

The State has constructed Nagarjuna Sagar, Srisaillam, Jurala and Prakasam Barrage to harness the waters of Krishna river.

### 3.2 DROUGHT SITUATION:

Both Krishna and Godavari basins were undergoing through severe shortage of water due to less rainfall till September 2009.



Fig.1

### 3.3 FLOOD SITUATION:

Overnight, the situation turned from drought plan to flood management due to unprecedented rainfall in the catchment area and very short lead time as the cloud burst occurred very near to the project rather than in the western ghats.

The Srisailem Dam is primarily built for generating hydel power and is not designed for managing huge floods.

Hence, the only way left is to moderate the floods by discharging flood water.

However, free discharge of the entire flow is not possible because of limitations at the Srisailem Dam itself as discussed earlier and also limitations at the Nagarjuna Sagar Project (NSP) below and the Prakasam Barrage (PB) near Vijayawada.

**3.4 Probable maximum flood** is a theoretical concept likely to happen once in 10000 years. PMF is the flood that may be expected from the most severe combination of critical and hydrologic conditions that are reasonably possible in a particular drainage. The Probable Maximum Flood (PMF) for Srisailem reservoir is estimated as 26.08 lakh cusecs. Thus the flood inflows received on 2nd October night touched almost the PMF assessed.

**3.5 Nagarjuna Sagar Dam** which is designed:

- For 15.9 lakh cusecs discharge at MWL
- 13.83 lakh cusec at FRL has received a flood inflow of 14.66 lakh cusecs

Fig.2



**3.6 The Prakasam Barrage** which is designed

- For 11.9 lakh cusecs has received 11.10 lakh cusecs
- The Sunkesula Barrage and Jurala Dam also received maximum inflows.

Fig.3



Thus, all irrigation systems in Krishna Basin were at the maximum capacity for the first time in history.



#### **4. RAINFALL FORECAST:**

##### **4.1 IMD FORECAST:** Daily weather report given

- 29.09.09: indicated rain or thunderstorms are likely to occur at many places over Telangana, and a few places in interior Karnataka and Rayalaseema during the next 48 hours.
- 30.09.09: indicated isolated heavy to very heavy rain like to occur in coastal area, Telangana and isolated heavy rain is likely over Rayalaseema during next 48 hours.

However the quantum of rainfall received was beyond forecast and imagination.

##### **4.2 CWC FORECAST :**

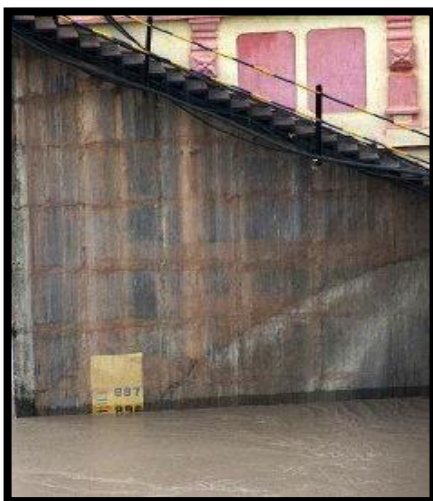
- 29.09.09: forecast levels were not alarming and well below the warning level.
- 30.09.09: The first advisory indicating the level to touch +310 at Mantralayam which is about 300 km upstream of Srisaïlam dam site was issued.(*fig.1*)
- 1.10.2009: from CWC unit office at Kurnool mentioning that the historical flood level of +315.8M is likely to touch by midnight.

##### **4.3 REAL TIME MONITORING OF FLOOD AND MODELLING:**

The hourly increase in water levels is obtained from the dam sites to arrive at inflows as most of the river gauges are damaged or were overflowing. The **spatial and temporal movement of water** is almost accurately assessed and this has helped in decision making for flood moderation and evacuation of people.

- The water level in the reservoir on 30.9.2009 at 6 AM was +884.40 feet.
- However keeping in view the flows observed at Jurala Dam(215 Km upstream of Srisaïlam Dam) and in Tungabhadra river (Kurnool) and ongoing rainfall, the spillway gates were operated from 7 PM on 30.9.2009 with a discharge of 1,15,114 cusec and further gradually increased to 5,34,650 cusec by 6 AM on 1.10.2009 by operating gates stage by stage.
- Keeping in view of the increasing trend of flood on 1.10.2009 morning, 10 gates were further raised to their total height with a total discharge of 8,99,046 cusec (including power draft). Further the 11<sup>th</sup> gate (Gate No 12) was also operated at 9 PM on 1.10.09 and total discharge of 9, 66,052 cusec (including power draft) allowed.
- The reservoir level was depleted to +880.6 feet by 11 PM on 1.10.2009 from +884.90 feet at 7 PM on 30.9.2009, due to release in advance of higher discharge than inflows.

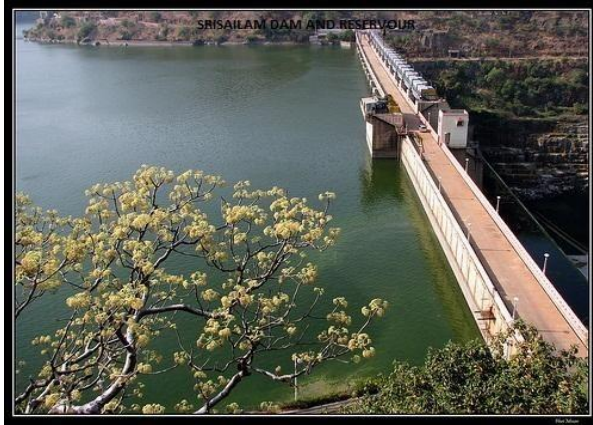
- At MWL, the discharge from dam is 13.2 lakh cusec which is far below the peak inflow and it is the reason for built up of reservoir upto +896.50 feet, though all the gates were opened. By 9 PM on 1.10.2009 a discharge of 4,50,000 cusec was observed at Kurnool gauge (Tungabhadra) and 11 out of 12 gates were already opened at Srisailam.
- Thereafter, the unprecedented high inflows started increasing the reservoir level and touched the FRL at 5 PM on 2.10.2009. The inflows in reservoir on 2<sup>nd</sup> October evening onwards were about 25.50 lakh cusec, which had resulted in impounding of flood water above FRL and up to MWL and also beyond up to + 896.50 feet on 3.10.2009 at 12.00 noon.
- At 11:30 am on October 3, **vibrations were observed at the levels of the road deck and hoist bridge** when the upstream water levels were in the order of +896.00 feet and above. After studying the situation, Gate No 1 and other gates were lifted further by 6 feet i.e., 55 feet above sill level and facilitated the discharge to the tune of 14.5 lakh cusec and observed the conditions.
- After observing for one hour it was noticed that the water level in the reservoir did not rise and the water level at the bottom of T-Beam was reduced by 2 feet and that the vibrations in the civil structure and gate ropes were minimum.
- The ropes of Gate No 4 on right side were in snapped position and it was decided not to further operate this gate. Engineers succeeded in opening the 12<sup>th</sup> gate of the dam (i.e., Gate No 1) at 1 pm on October 3 (after 20 years) allowing 14.8 lakh cusec outflow from the dam.



*Fig.4 Max Water level at Srisailam*



*Fig.5 Inundated Power house at Srisailam dam*



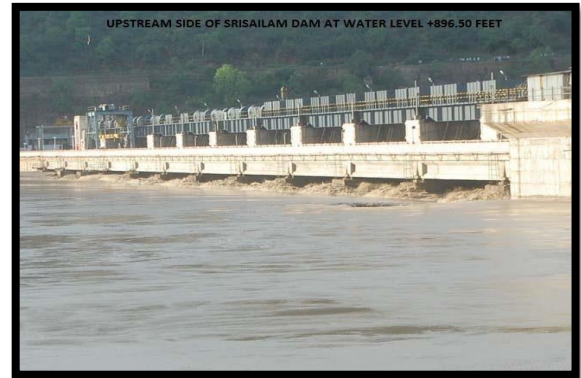
*Fig.6 Srisailem dam and reservoir*



*Fig.7 Downstream view of Srisailem dam*



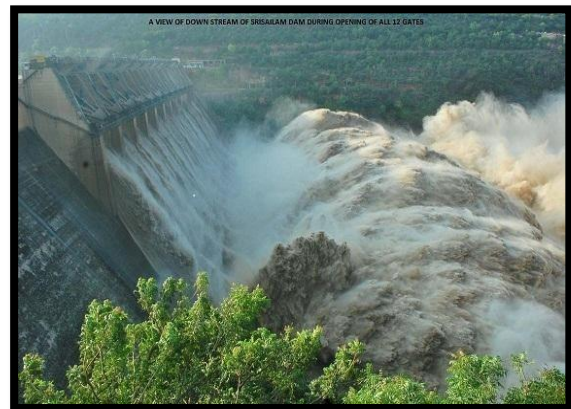
*Fig.8 An ariel view of the Srisailem dam with +896.50 feet at water level*



*Fig.9 Upstream side of Srisailem dam heavy inflows*



*Fig.10 Maximum outflow through spillway at Srisailem dam*



*Fig.11 A view of downstream of Srisailem dam during opening of all 12 gates*

### SRISAILAM

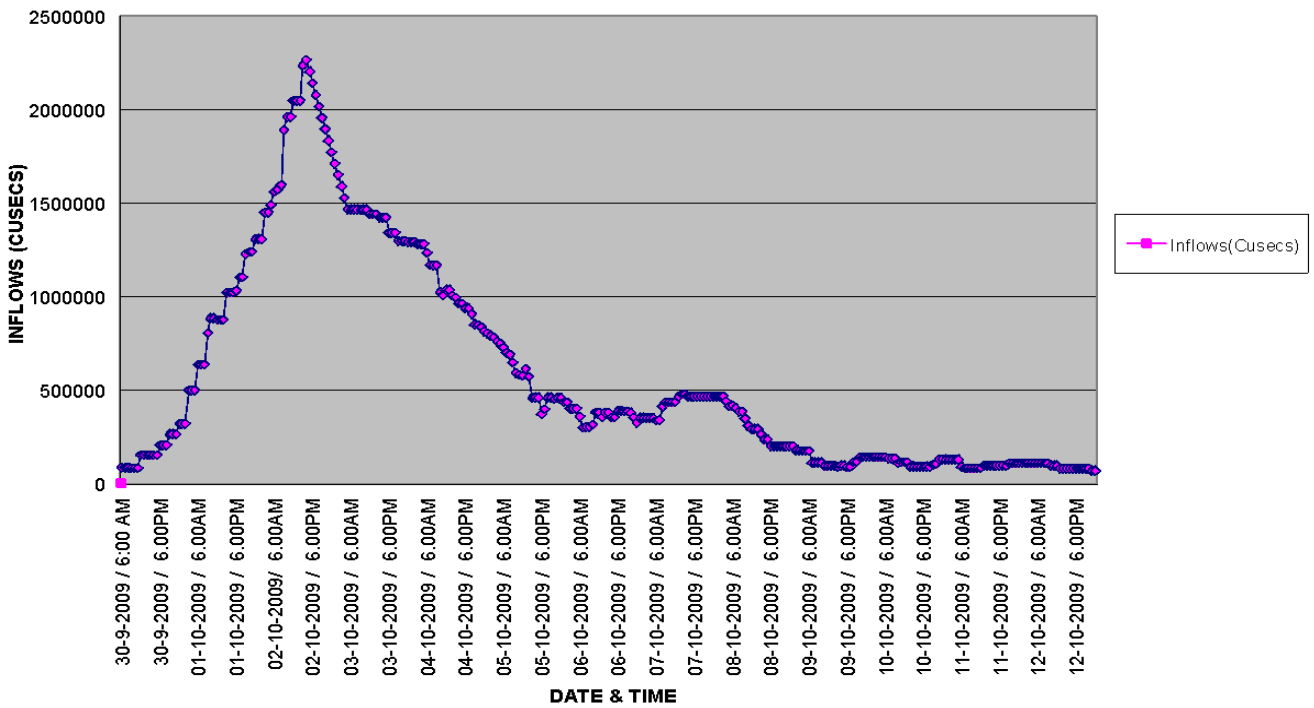


Fig.12 Map showing Inflows at Srisaillam dam between September 30 to October 12, 2009

### SRISAILAM

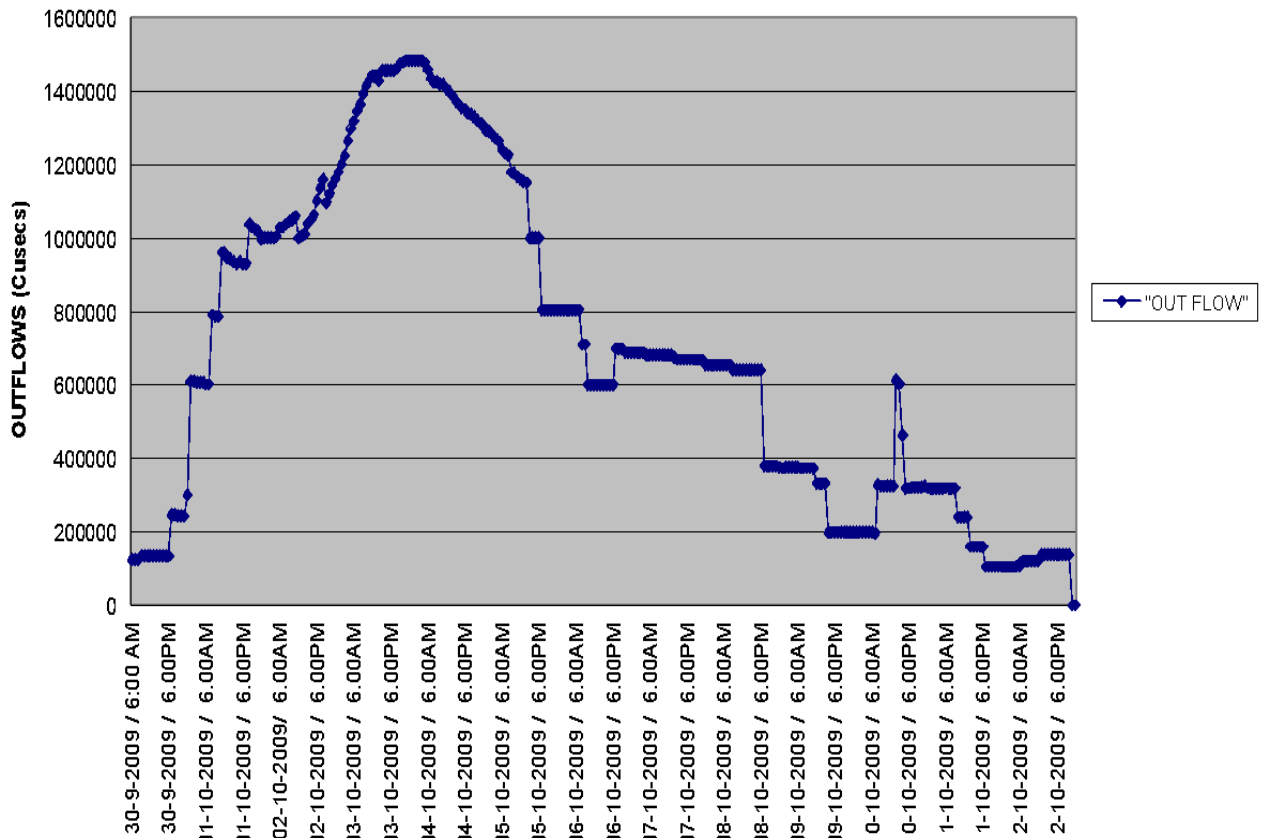


Fig.13 Map showing Outflows at Srisaillam dam between September 30 to October 12, 2009

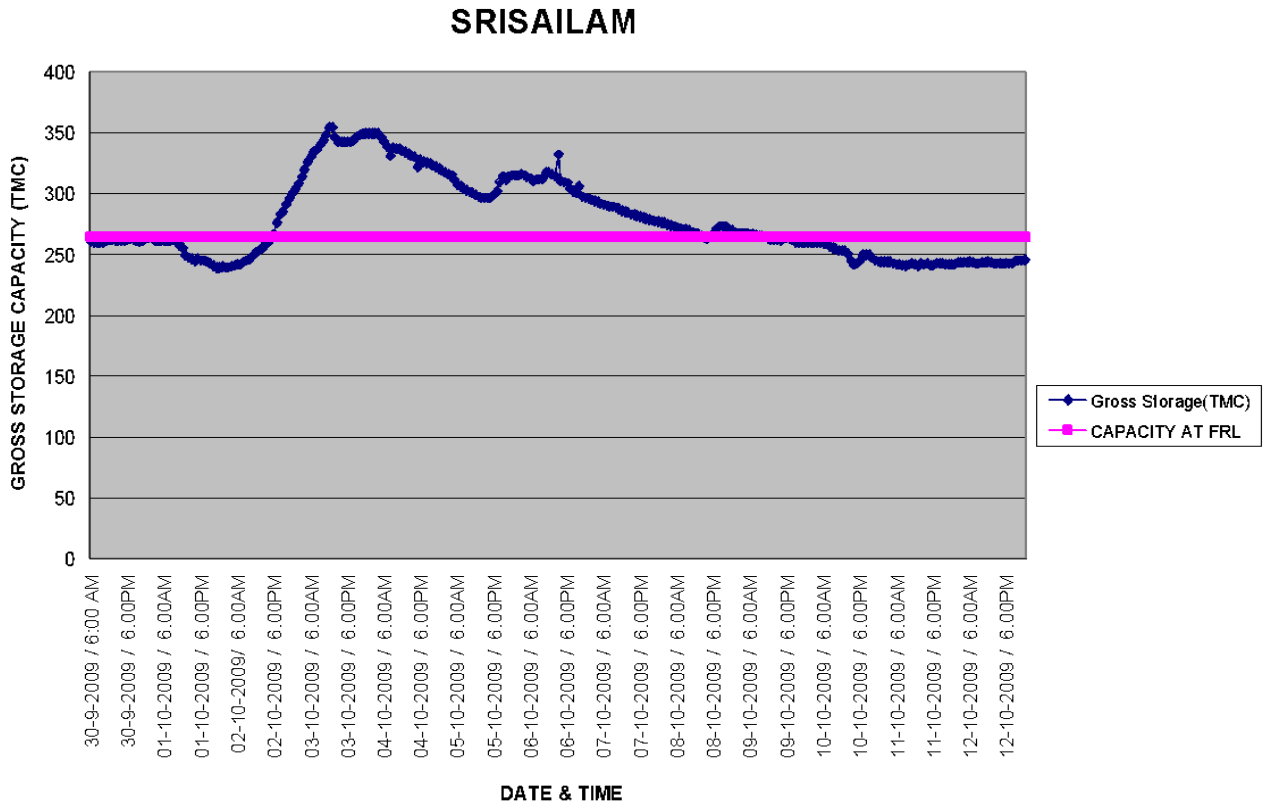


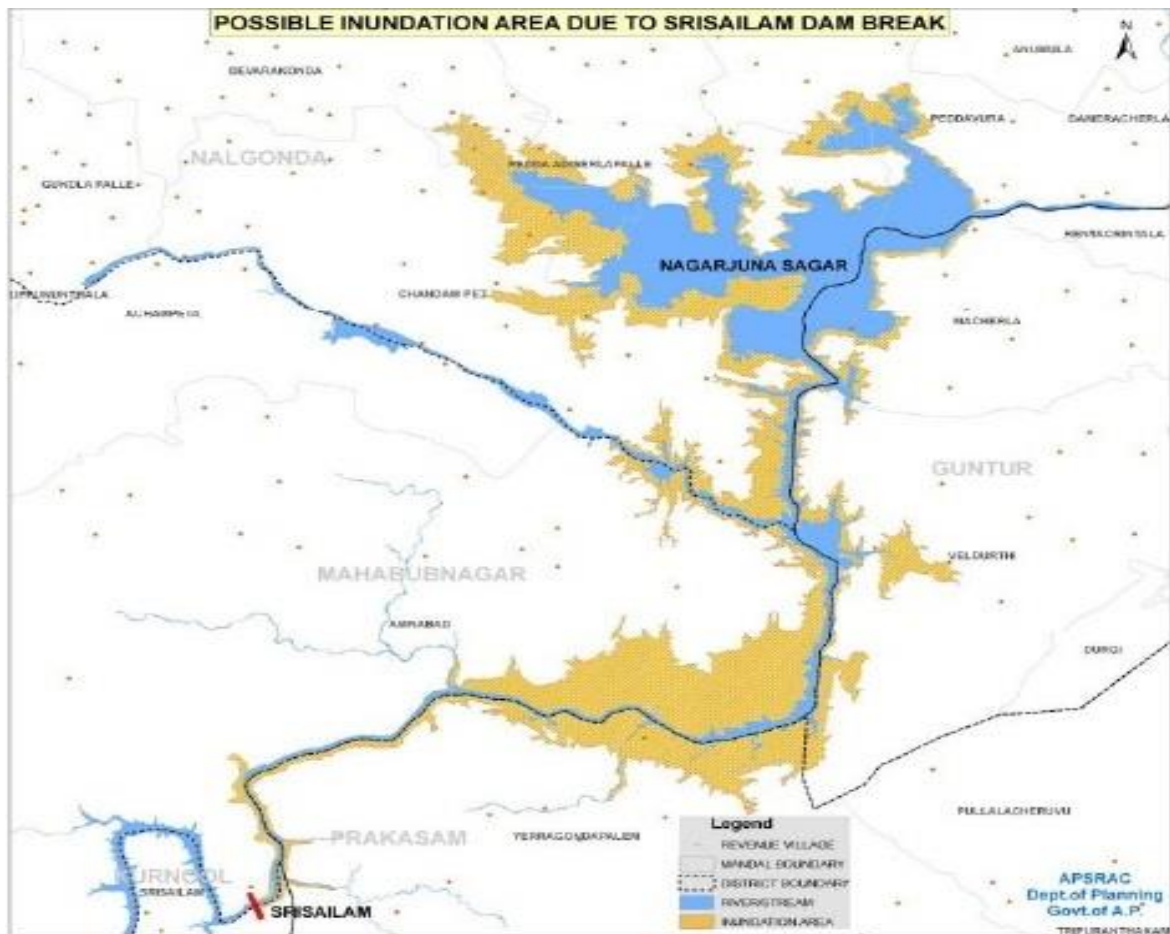
Fig.14 Map showing gross capacity at Srisaillam dam between September 30 to October 12, 2009



## 5. REFERENCE TO COURSE MATERIAL:

With reference to the Advance Hydrology Course Module **Week 1& 2:**

- **Dam break analysis, A case study on dam Break Analysis** lesson shows the importance of development possible inundation maps due to dam break and a critical additional factor affecting the flood management i.e the irrigation systems maintenance and also dam safety aspects of large dams.
- **Dam failure concepts and Modelling** lesson aided a lot in understanding the real time modelling of the floods at Srisaillam Dam.



*Fig.15 Possible Inundation Map of Srisaillam Dam break*

## **6. SUMMARY:**

In brief, this write up has covered under different sub headings

- What are the different dams of Telangana State
- Introduction about Srisaïlam Dam
- Challenge in the dam's location and design
- The Rainfall, water allocation, forecast conditions in the state
- The October 2009 floods
- Real time flood monitoring and modelling using Gate Operation of the Reservoir for disposing off the PMF
- The Maps showing the Inflows, Outflows and Capacity of the reservoir
- Photographs of the Dam at the time of flood monitoring
- References to the lessons of the course.

## **7. CONCLUSION:**

The October 2009 floods can be cited as an excellent example of perfectly coordinated efforts and consultative decision making on such complex technical matters. The entire quantum of water was safely routed to the sea without causing much impact on the civilization existing enroute.

The time to time modelling studies for dam sites and hourly monitoring of the flood levels and taking decisions on flood discharge from the dams at flood control room and excellent regulation of the inflows and out flows at Srisaïlam, Nagarjuna Sagar and Prakasam barrage to enable the projects work in tandem as a flood control measure, saved the state from major catastrophe.