Chapter 5
Water Resources and Hydrology

5.1 General

Planning for water resources development in a basin requires careful assessment of the available water resources and reasonable needs of the basin in foreseeable future for various purposes such as drinking, irrigation, hydro-power, industries, navigation etc. Hydrological studies are carried out to assess the available quantity of water in a given basin. This chapter deals with the assessment of water balance in the Krishna basin upto the Nagarjunasagar dam site, in the basins lying enroute the link alignment, in the Pennar basin upto the Somasila dam site and simulation study of Nagarjunasagar reservoir.

5.2 Hydrological analysis

NWDA has prepared water balance study reports at Nagarjunasagar dam site on river Krishna, Somasila dam site on river Pennar and of the basins lying enroute the link alignment. The methodology adopted by NWDA for computing the water balance of a sub-basin is discussed in the following paragraphs:

5.2.1 Surface water availability

Observed flow data at the terminal G&D site and the rainfall observed at various raingauge stations in and around the catchment of a sub-basin are collected. To the observed flows, year-wise upstream utilisations are added to get virgin yields. Weighted rainfall for the catchment upto the G&D site and for the whole sub-basin is worked out. Using these virgin flows and weighted rainfall upto the G&D site, a rainfall - runoff relationship (linear/non-linear) is developed by statistical methods. Using the best fit equation and weighted rainfall for the entire sub-basin, monsoon yields are computed. To the monsoon yields, non-monsoon yields are added for arriving at annual gross yields for the entire sub-basin. The annual gross yields thus arrived at are arranged in descending order, from which 50% and 75% dependable annual gross yields are obtained.

The overall surface water available in a sub-basin is arrived at by summing up the yield (at 50% and 75% dependabilities separately),

regeneration and imports and by deducting the exports, if any, from the sub-basin.

5.2.2 Water requirement

The requirements of water at the ultimate stage for various uses viz. irrigation, domestic, industrial and hydro-power are worked out as follows:

Irrigation needs: The requirements for irrigation are worked out for all the existing, ongoing and proposed major, medium and minor projects in a sub-basin. For this purpose, all the projects planned/executed by the states as per their master plans are considered. The designed annual utilisation is considered for the existing and ongoing projects. The requirements for future projects are determined by adopting intensities of irrigation as 150%, 125% and 100% for major, medium and minor projects respectively. For assessing the crop water requirements by climatological approach, the potential evapotranspiration values for various stations as given in the IMD scientific report No.136 (1971) are adopted. In the case of a deficit basin, if the ultimate annual irrigation considering all the existing, ongoing and future major, medium and minor projects works out to less than 30% of the maximum culturable area of the sub-basin, the requirements are calculated by increasing the annual irrigation to 30% of the maximum culturable area of the sub-basin. In the case of a surplus basin, the annual irrigation at the ultimate stage is increased to 60% of the maximum culturable area. 50% of such increased annual irrigation is considered to be under future medium projects and the remaining 50% under future minor schemes.

Domestic needs: The requirement of water for domestic consumption by the rural and urban human population and for the livestock is estimated by projecting the rural, urban human population and the livestock of the catchment to 2025 AD using the available census data. Per capita per day water requirement of 70 litres, 200 litres and 50 litres is considered for the rural and urban human population and livestock population respectively as per the recommendations of the Ministry of Works and Housing in their manual “Water Supply and Treatment”. The requirement of 50% of the rural human population and of the entire livestock is considered to be met from groundwater and the requirement for the remaining 50% of rural human population and the entire urban human population is considered to be met from surface water. However,

in the water balance reports being revised now, the population projections are made to 2050 AD instead of 2025 AD.

Industrial needs: In the absence of relevant data to estimate precisely the industrial water needs, industrial requirement is taken to be equivalent to the total domestic requirement for human population and livestock. The entire industrial requirement is considered to be met from surface water.

Hydro-power needs: Requirement for the hydropower is taken to be the evaporation losses at the reservoirs with hydro-power production. Wherever the evaporation data of the projects is available, the same is made use of and wherever the data is not available, the same is worked out from the surface area of water in the reservoir, assuming suitable evaporation values.

5.2.3 Regeneration

The regeneration is considered as (a) 10% of the net utilisation for irrigation from all the existing, ongoing and future identified major and medium projects, and (b) 80% of the domestic and industrial uses to be met from the surface water.

5.2.4 Water balance

The total water requirement of a sub-basin, worked out on the methodology outlined above, is deducted from the overall surface water availability at 75% and 50% dependabilities to determine the water balances (surplus/deficit) at those dependabilities respectively.

5.3 Hydrological and water balance studies of the Krishna basin upto Nagarjunasagar dam site

The catchment area of the Krishna river from its source upto the Nagarjunasagar dam site includes the independent catchments of 8 upper sub-basins i.e., Upper Krishna, Middle Krishna, Ghataprabha, Malaprabha, Upper Bhima, Lower Bhima, Tungabhadra and Vedavathi and part of the Lower Krishna sub-basin upto Nagarjunasagar dam site. The catchment extends over an area of 220705 km^2 which works out to 85.2% of the total catchment area of the Krishna basin and lies in the states of Maharashtra (69425 km^2), Karnataka (113272 km^2) and Andhra Pradesh (38008 km^2). The hydrological studies in respect of all the

above sub-basins have been carried out by NWDA and the annual yield series of each sub-basin have been developed. The annual gross yield series of the catchment of Krishna basin upto Nagarjunasagar dam site for the period from 1951-52 to 1983-84 have been arrived at by summing up the annual yield series of the Lower Krishna sub-basin upto Nagarjunasagar dam site to the annual yield series of the 8 upstream sub-basins. From this series, the 75% and 50% dependable annual gross yields are determined to be 58423 Mm^3 and 67346 Mm^3 respectively.

The water balance has then been worked out by deducting the ultimate water requirements for various uses like irrigation, industrial, domestic and others from the overall availability duly considering the regeneration, import and export.

Surface water needs for irrigation have been assessed by considering the ultimate annual irrigation. The surface water requirement for irrigation from all the existing, ongoing and future major, medium and minor projects is given in Table 5.1.

Table 5.1
Surface water requirement for ultimate irrigation in the catchment of Krishna basin upto Nagarjunasagar dam site

State	Project category	Annual irrigation (ha)	Annual utilization (Mm^3)
Maharashtra	Existing	441320	3917
	Ongoing	646974	6007
	Proposed	507713	3219
	Additional area	209499	1260
	Sub-total	1805506	14403
Karnataka	Existing	1363649	12043
	Ongoing	946962	7032
	Proposed	497360	3921
	Additional area	153645	1155
	Sub-total	2961616	24151
Andhra Pradesh	Existing	331391	3335
	Ongoing	104398	845
	Proposed	19984	136
	Additional area	182616	1360
	Sub-total	638389	5676
Total	Existing	2136360	19295
	Ongoing	1698334	13884
	Proposed	1025057	7276
	Additional area	545760	3775
	Grand total	5405511	44230

The requirement of water for domestic consumption computed by projecting the rural and urban human population and the livestock to 2025 AD are given in Table 5.2. The domestic requirement to be met from surface water sources works out to 3348 Mm^3.

Table 5.2
Domestic water requirement in Krishna basin upto Nagarjunasagar dam site by 2025 AD

Category	Population ('000')	Daily needs per capita (litres)	Total Domestic Water requirement (Mm^3)	Domestic water Requirement to be met from surface water (Mm^3)
Rural	61605	70	1576	788
Urban	35077	200	2560	2560
Live stock	37144	50	677	-
Total			4813	3348

In the absence of relevant data on the industrial water needs, the industrial needs by 2025 AD have been assumed to be of the same order as that of domestic water requirement, which is 4813 Mm^3.

The regeneration from irrigation uses at 10% of net water utilisation from all the existing, ongoing and identified future major and medium projects is 2789 Mm^3. The regeneration at 80% of the domestic and industrial water uses to be met from surface water resources are 2681 Mm^3 and 3849 Mm^3 respectively.

The total evaporation losses of all the hydel projects have been taken as hydropower needs which is worked out to be 1154 Mm^3. Thus, the computation of surface water balance of the Krishna basin upto Nagarjunasagar dam site is given in Table 5.3.

Table 5.3
Surface water balance at Nagarjunasagar dam site

1	**Availability**		Units: Mm^3
	a) Gross annual yield		
	i) At 75% dependability		58423
	ii) At 50% dependability		67346
	b) Surface water import (+)		Nil
	c) Surface water export (-)		15722
	d) Overall availability		
	i) At 75% dependability		42701
	ii) At 50% dependability		51624
2	**Surface water requirement for**		
	i) Irrigation	44230	
	ii) Domestic	3348	
	iii) Industrial use	4813	
	iv) Hydro-power needs	1154	
	Sub-total	53545	53545
3	**Regeneration (+)**		
	i) Irrigation	2789	
	ii) Domestic	2681	
	iii) Industrial use	3849	
	Sub-total	9319	9319
4	**Surface water balance**		
	a) At 75% dependability		(-) 1525
	b) At 50% dependability		(+) 7398

The water balance at the Nagarjunasagar dam site shows a net deficit of 1525 Mm^3 at 75% dependability. Hence, the Nagarjunasagar - Somasila link depends on surplus Godavari flows drawn from Inchampalli reservoir through the Inchampalli - Nagarjunasagar link and the spills/releases from the Srisailam reservoir.

5.4 Hydrological and water balance studies of enroute basin

The Nagarjunasagar – Somasila project is envisaged to divert the surplus water that is made available at Krishna by the preceding links connecting Godavari and Krishna. The east flowing rivers south of Godavari is generally found to be deficit in nature. In view of this, the water from

enroute rivers is not proposed to be diverted. The link canal passes through the river basin namely (i) Gundlakamma and (ii) streams between Gundlakamma and Pennar before falling into Somasila dam of Pennar basin. The water balance status of Gundlakamma, stream between Gundlakamma and Pennar and Pennar basin upto Somasila dam are shown as Table 5.4 and 5.5 respectively.

Table 5.4
Surface water balance in Gundlakamma basin

1	**Availability**		Units: Mm^3
	a) Gross annual yield		
	i) At 75% dependability		449
	ii) At 50% dependability		758
	b) Surface water import (+)		1250
	c) Surface water export (-)		Nil
	d) Overall availability		
	i) At 75% dependability		1699
	ii) At 50% dependability		2008
2	**Surface water requirement for**		
	i) Irrigation	1476	
	ii) Domestic	48	
	iii) Industrial use	86	
	iv) Hydro-power needs	Nil	
	Sub-total	1610	1610
3	**Regeneration (+)**		
	i) Irrigation	125	
	ii) Domestic	38	
	iii) Industrial use	69	
	Sub-total	232	232
4	**Surface water balance**		
	a) At 75% dependability		(-) 321
	b) At 50% dependability		(+) 630

Table 5.5
Surface water balance in the basin area covered by the streams between Gundlakamma and Pennar

1	**Availability**		Units: Mm^3
	a) Gross annual yield		
	i) At 75% dependability		558
	ii) At 50% dependability		990
	b) Surface water import (+)		767
	c) Surface water export (-)		Nil
	d) Overall availability		
	i) At 75% dependability		1325
	ii) At 50% dependability		1757
2	**Surface water requirement for**		
	i) Irrigation	1425	
	ii) Domestic	82	
	iii) Industrial use	138	
	iv) Hydro-power needs	Nil	
	Sub-total	1645	1645
3	**Regeneration (+)**		
	i) Irrigation	88	
	ii) Domestic	66	
	iii) Industrial use	110	
	Sub-total	264	264
4	**Surface water balance**		
	a) At 75% dependability		(-) 56
	b) At 50% dependability		(+) 376

5.5 Hydrological and water balance studies of Pennar basin upto Somasila project

The Pennar basin has been divided into 4 sub-basins for the purpose of hydrological studies: (1) Upper Pennar (2) Middle Pennar, (3) Lower Pennar, and (4) Pennar delta. The catchment area of Pennar basin upto Somasila project includes catchments of the three upper sub-basins viz. Upper Pennar, Middle Pennar, Lower Pennar and part of Pennar delta sub-basin upto Somasila project.

The gross annual yields of the catchment of Pennar basin upto Somasila project for the period from 1901-02 to 1982-83 have been arrived at by adding the gross annual yields of the three upper sub-basins and of the part catchment of Pennar delta sub-basin upto Somasila project. By arranging the combined annual yield series in descending order, the 75% and 50% dependable annual gross yields of the catchment have been found to be 1894 Mm^3 and 3035 Mm^3 respectively.

The water balance has been then worked out deducting the ultimate water requirements for various uses like irrigation, industrial, domestic and other uses from the overall availability, duly considering the regeneration, import and export. The ultimate irrigation and surface water requirement in the Pennar basin upto Somasila project are presented in Table 5.6.

Table 5.6
Ultimate irrigation and surface water requirement in the Pennar basin upto Somasila project

Project category	**Annual irrigation (ha**			**Annual utilisation (Mm^3)**		
	In basin	**Import**	**Total**	**In basin**	**Import**	**Total**
Existing						
Andhra Pradesh	176036	138525	314561	1392	1379	2771
Karnataka	28842	-	28842	201	-	201
Ongoing						
Andhra Pradesh	51400	223904	275304	399	1615	2014
Karnataka	21414	-	21414	152	-	152
Proposed						
Andhra Pradesh	85435	-	85435	852	-	852
Karnataka	3112	37191	40303	33	394	427
Additional Area						
Andhra Pradesh	134473	-	134473	1291	-	1291
Karnataka	16647	-	16647	160	-	160
Total	517359	399620	916979	4480	3388	7868

The requirements of water for domestic use in the rural and urban areas and for livestock have been computed by projecting the rural and urban population and livestock to 2025 AD. The total domestic water needs are assessed to be 799 Mm^3. The domestic requirement proposed to be met

from surface water is works out to be 470 Mm^3. Details are given in Table 5.7.

Table 5.7
Domestic water requirement by 2025 AD in Pennar basin upto Somasila project

Category	Population ('000')	Daily needs per capita (litres)	Total Domestic Water requirement (Mm^3)	Domestic Water requirement to be met from surface water (Mm^3)
Rural	12186	70	311	156
Urban	4308	200	314	314
Live stock	9573	50	174	-
Total			799	470

80% of domestic water use to be met from surface water source is considered to be available as regeneration to the streams. The industrial requirement by 2025 AD has been assumed to be of the same order as that of domestic water requirement which is 799 Mm^3. It is proposed to be met from the surface water sources. 80% of this use is considered to be available as return flow to the streams.

The water balance computations at Somasila project site taking into account the availability, import, regeneration and water needs is given in Table 5.8.

Table 5.8
Surface water balance of Pennar basin at Somasila project

1	**Availability**		Units : Mm^3
	a) Gross annual yield		
	i) At 75% dependability		1894
	ii) At 50% dependability		3035
	b) Surface water import (+)		3813
	c) Surface water export (-)		1865(2776*)
	d) Overall availability		
	i) At 75% dependability		3842
	ii) At 50% dependability		4072
2	**Surface water requirement for**		
	i) Irrigation	7868	
	ii) Domestic	470	
	iii) Industrial use	799	
	iv) Hydro-power needs	Nil	
	Sub-total	9137	9137
3	**Regeneration (+)**		
	i) Irrigation	460	
	ii) Domestic	376	
	iii) Industrial use	639	
	Sub-total	1475	1475
4	**Surface water balance**		
	a) At 75% dependability		(-) 3820
	b) At 50% dependability		(+) 3590

***Note:** Export includes 911 Mm^3 of water to be exported to streams between Pennar and Palar via Telugu Ganga canal to be met from 50% dependable yields available at Somasila project.

5.6 Simulation studies of Nagarjunasagar reservoir

5.6.1 Inflows into Nagarjunasagar reservoir

As assessed in the respective water balance study, the Krishna basin upto Nagarjunasagar dam site is deficit by 1525 Mm^3. The Nagarjunasagar - Somasila link canal, being an integral part of the Mahanadi - Godavari - Krishna - Pennar –Cauvery - Vaigai - Gundar link essentially envisages to divert part of the surplus waters of Mahanadi and Godavari proposed to be brought to the Nagarjunasagar reservoir through the Inchampalli - Nagarjunasagar link. The inflows into the Nagarjunasagar reservoir considered for the purpose of simulation

studies of the reservoir for effecting the diversion through the Nagarjunasagar - Somasila link consist of the following.

1. Yield from the intermediate catchment between Srisailam and Nagarjunasagar
2. Spills and dam power house releases from Srisailam reservoir, and
3. The surplus Mahanadi and Godavari waters diverted into Nagarjunasagar reservoir from Inchampalli reservoir through the proposed Inchampalli - Nagarjunasagar link.

5.6.1.1 Yield from the intermediate catchment between Srisailam and Nagarjunasagar dam sites

The gross annual yield series of the catchment between Srisailam and Nagarjunasagar dams are presented in the preliminary water balance study at the Nagarjunasagar project site prepared by NWDA. The yearly gross yields from this series for the period from 1951-52 to 1980-81 have been considered for working out the net inflows into the Nagarjunasagar reservoir from the intermediate catchment. The yearly net inflows have been computed proportionately deducting the ultimate surface water requirement which are worked out corresponding to 75% dependable annual yield for this catchment from the annual yields and duly considering the regeneration, import and export.

Then, the monthly distribution of the net annual inflows into the Nagarjunasagar reservoir from the catchment between Srisailam and Nagarjunasagar is done based on the monthly inflow data at the Dindi project which is an existing medium project, in the same catchment.

5.6.1.2 Spills and power house releases from Srisailam reservoir

Srisailam dam is located upstream of Nagarjunasagar dam for which the simulation studies of Srisailam reservoir have been carried out considering the annual inflows into the reservoir and the demands to be met from this reservoir and these studies are dealt in detail in the feasibility report of Krishna (Srisailam) - Pennar link project prepared by NWDA.

The spills and power house releases thus obtained from the above simulation studies of Srisailam reservoir for Srisailam – Pennar link project are considered as inflows into the Nagarjunasagar reservoir.

5.6.1.3 Diversion to Nagarjunasagar reservoir through proposed Inchampalli - Nagarjunasagar link

The Godavari (Inchampalli) - Krishna (Nagarjunasagar) link canal, as proposed by NWDA envisaged to divert annually 16426 Mm^3 of surplus Mahanadi and Godavari waters to Nagarjunasagar dam. Out of this a quantity of 14090 Mm^3 of water will reach to Nagarjunasagar reservoir after meeting the enroute domestic demand of 110 Mm^3, irrigation demand of 1850 Mm^3 for Kakatiya Canal Stage II and Srisailam LBC, and transmission losses of 376 Mm^3.

The demands from Inchampalli reservoir comprise of the requirements of the Inchampalli left and Right Bank Canals, Inchampalli - Pulichintala link and Inchampalli - Nagarjunasagar link in addition to the evaporation losses from the reservoir.

The simulation of the Inchampalli reservoir is carried out considering the monthly inflows into the reservoir and monthly requirements to be met from the reservoir to assess the spill and power releases that is available for Polavaram – Vijayawada link project has been made use to this link also.

From the monthly diversions through the Inchampalli - Nagarjunasagar link as obtained from the simulation of Inchampalli reservoir, irrigation and domestic uses and transmission losses enroute this link canal are deducted to arrive at the net inflows into the Nagarjunasagar reservoir through the link.

5.6.1.4 Computation of gross inflows into the Nagarjunasagar reservoir

The monthly inflows into the Nagarjunasagar reservoir during each year for the period from 1951-52 to 1980-81 are arrived at by adding the respective net inflows from all the above three sources i.e. yield from the catchment between Srisailam and Nagarjunasagar, spills and power house releases from Srisailam and surplus Godavari water transferred from Inchampalli into Nagarjunasagar reservoir.

5.6.2 Demands from Nagarjunasagar reservoir

5.6.2.1 Demands of existing NSLBC and NSRBC

The Nagarjunasagar reservoir as planned by the Government of Andhra Pradesh is to meet the irrigation needs of the existing commands under Nagarjunasagar Left Bank Canal (NSLBC) and Nagarjunasagar Right Bank Canal (NSRBC) in addition to the power generation requirements of the main dam toe powerhouse. The designed annual utilisations for irrigation under NSLBC and NSRBC being met by the Nagarjunasagar reservoir at present are:

1. NSLBC 3979 Mm^3
2. NSRBC 3979 Mm^3

However, the above designed utilisation of NSLBC and NSRBC are proposed to be met partly from surplus Godavari waters diverted through the Inchampalli - Pulichintala link and partly from the Nagarjunasagar reservoir as per the break-up shown in Table 5.9.

Table 5.9
Break-up of the irrigation demands of NSLBC and NSRBC to be met by Inchampalli - Pulichintala link and Nagarjunasagar reservoir

Units: Mm^3

Sl. No.	Command	Total designed water requirement	Requirement to be met from	
			Inchampalli – Pulichintala link	Nagarjunasagar - reservoir
1	NSLBC	3979	1382	2597
2	NSRBC	3979	1623	2356

5.6.2.2 Demands of Nagarjunasagar - Somasila link

The Nagarjunasagar - Somasila link is envisaged to carry 9790 Mm^3 of water annually to meet the following demands, in addition a quantity of 2356 Mm^3 of water will be utilize to meet the requirement of existing NSRBC. Thus, the total transfer through Nagarjunasagar – Somasila link is 12146 Mm^3.

i) 124 Mm^3 towards the domestic and industrial water requirements of the areas enroute the link canal.

ii) 908 Mm^3 for irrigation of the proposed command area enroute the link in the basin area covered by streams between Gundlakamma and Pennar.

iii) 8426 Mm^3 by transfer to Pennar basin to meet the deficit in Pennar basin and further diversion from Pennar to other southern river basins.

iv) 332 Mm^3 of transmission losses enroute the link canal from Nagarjunasagar to Somasila.

The computation of all the above demands and their monthly distribution pattern are dealt in detail in Chapter on "Water and irrigation planning".

5.6.2.3 Arrangement for diversion of water from Nagarjunasagar - Somasila link canal – its integration with existing NSRBC

i. The Nagarjunasagar - Somasila link proposes to divert 9790 Mm^3 annually, in addition partially meeting irrigation requirement of existing NSRBC, to the tune of 2356 Mm^3 annually.

ii. The existing NSRBC is designed to carry its designed utilisation of 3979 Mm^3 annually. As per the proposed rescheduling of the demands of the existing command of NSRBC partly by the Inchampalli - Pulichintala link and partly from the Nagarjunasagar reservoir through the existing NSRBC, the existing NSRBC would be required to carry only 2356 Mm^3 annually to meet this part command requirement. The remaining capacity (1623 Mm^3 annually) of the NSRBC is proposed to be utilised for the diversion of the waters proposed through the Nagarjunasagar - Somasila link upto the tail end of NSRBC at RD 202.75 km.

iii) The Nagarjunasagar -Somasila link canal, which will be running adjacent to the existing NSRBC upto its tail end would carry only the remaining quantum of proposed diversion of 8167 Mm^3 (i.e. 9790 –1623 Mm^3) to effect economy in its construction costs.

iv) At the tail end of the NSRBC (i.e. at RD 202.75 km), the Nagarjunasagar -Somasila link canal would be widened to accommodate the additional waters of 1623 Mm^3 brought by the NSRBC, thereafter the single link canal carrying the full diversion of 9790 Mm^3 would run upto its tail into the Somasila reservoir at RD 393.02 km.

v) By such an integration of Nagarjunasagar - Somasila link with the existing NSRBC, the total diversion from Nagarjunasagar dam

through Nagarjunasagar – Somasila link would be 12146 Mm^3 consisting the demands of part command of NSRBC (2356 Mm^3) and demands of the Nagarjunasagar - Somasila link (9790 Mm^3).

The monthly distribution pattern of various annual demands of Nagarjunasagar - Somasila link includes NSRBC and NSLBC from the Nagarjunasagar reservoir.

5.6.2.4 Releases for power generation at Nagarjunasagar dam

The powerhouse at the toe of main dam has an installed capacity of 810 MW with seven units of 100 MW each, capable of reversible operation and one conventional unit of 110 MW. The water from this powerhouse after generation of power is being released at present into the river to flow to the Prakasam Barrage and beyond. There is a proposal to create a tail pool below the Nagarjunasagar dam by constructing a tail dam at 21.065 km downstream of the main dam to facilitate reversible operation of generating units of the said powerhouse. Hence, after creation of the tail pool, a greater part of the releases to the river from the powerhouse will be pumped back into the reservoir. Thus the dam powerhouse would be used only for peaking power generation. However, there is also a possibility to have a toe powerhouse at the tail dam for producing power from the releases for Krishna delta.

As per the "Report of the expert committee on utilisation of river waters in Krishna basin, AP., Vol. I", the total demand of Krishna delta from Prakasam Barrage is 5131 Mm^3 (181.20 TMC) of which the contribution of the intervening catchment between Nagarjunasagar and Prakasam Barrage is 2866 Mm^3 (101.20 TMC), leaving a gap of 2265 Mm^3 (80 TMC) to be provided by way of releases from Nagarjunasagar. The Government of Andhra Pradesh has also a proposal to provide this 2265 Mm^3 (80 TMC) of water from Godavari through the Polavaram Right Bank Canal. Thus when the Polavaram Right Bank Canal becomes operational, releases from the Nagarjunasagar reservoir may not be required for this purpose for the Krishna delta.

However considering the water balance study of Lower Krishna sub-basin prepared by NWDA, the yield from intermediate catchment between Nagarjunasagar and Prakasam Barrage, as worked out on pro-rata basis is only 1182 Mm^3 at 75% dependability. After deducting the requirement of 74 Mm^3 for the Varikuntapadu medium project, the

annual flow available for use at Prakasam barrage is only 1108 Mm^3. Also as per the feasibility report of Polavaram -Vijayawada link canal prepared by NWDA, a quantity of 3501 Mm^3 will be transferred to the Prakasam Barrage through this link canal, indicating that 1236 Mm^3 will be transferred in addition to the 2265 Mm^3 as proposed by the Andhra Pradesh State through the Polavaram RBC.

Thus, against the requirement of 5131 Mm^3 of the Krishna delta, 4609 Mm^3 (1108+3501) is only available through the above two sources, the gap being 522 Mm^3. Hence, as per the studies by NWDA, the Krishna delta would be requiring additional supplies of 522 Mm^3, which will have to be invariably provided by way of releases from the Nagarjunasagar reservoir.

Keeping the above scenario in view and to make up the short falls, if any, it is proposed to keep the annual releases from Nagarjunasagar to Krishna delta as maximum as possible without disturbing the other demands from the reservoir viz. NSLBC (2597 Mm^3), NSRBC (2356 Mm^3) and the proposed diversion through the Nagarjunasagar - Somasila link (9790 Mm^3). Under such circumstances, it is assessed by the simulation studies that a maximum of 944 Mm^3 could be released annually to the Krishna delta from Nagarjunasagar at more than 95% dependability. Firm power generation of 25 MW would be possible from the dam powerhouse by these releases from Nagarjunasagar to the Krishna delta.

5.6.3 Simulation studies

The simulation studies of the Nagarjunasagar reservoir were carried out for a period of 30 years from 1951-52 to 1980-81 considering the monthly inflows into the reservoir from various sources and the monthly demands to be met from the reservoir in the following order of priority.

i) Demands for irrigation of NSLBC part command
ii) Demands for irrigation of NSRBC part command
iii) Demands for firm power generation of 25 MW by the Dam Power House
iv) Demands of Nagarjunasagar – Somasila link for enroute domestic, industrial, irrigation uses and transfer to the Somasila reservoir.

Initial condition of reservoir storage at half full has been considered for the simulation. The reservoir evaporation losses have been duly considered.

5.6.3.1 Results of simulation

The results of simulation of Nagarjunasagar reservoir for the period of 30 years from 1951-52 to 1980-81 in terms of success rate are presented in Table 5.10. The success rate of each demand is computed by dividing the number of years in which the full demands are met by the total number of years of simulation i.e. 30 years.

Table 5.10
Results of simulation of Nagarjunasagar reservoir for the period from 1951-52 to 1980-81 (30 years)

Sl.No	Component	Full demand (Mm^3)	No. of years in which full demand is met	Success rate
1	NSLBC (Part command)	2597	24	80%
2	NSRBC (Part command)	2356	24	80%
3	Power generation (25 MW)	1039	26	86.7%
4	Nagarjunasagar–Somasila Link	9790	24	80%