MASTER PLAN MODULES INFRASTRUCTURE MODULE

Solid Waste Management, Water Supply and Sanitation

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1. BACKGROUND

1.1 Introduction and Relevance

The pilgrimage to Sabarimala has now turned into a fascinating phenomenon with its special geographical, ritualistic and economic characteristics reinforced year after year with the visit of millions of pilgrims of all faiths from all parts of the country and abroad. The essence of the pilgrimage is spelt out by the dress codes and mannerisms of the pilgrims. All pilgrims, old and young, rich and poor drape black *mundu* or loin cloth and / or other black dresses and most of them prefer to trek to the holy destination while the most arduous ones prefer trekking bare footed right from homes. They resort to a simple way of life ever since the start of their penance or *vratha* and chant the holy manthra "Swamiye Saranam Ayyappa" throughout the journey. They address each other as Swamy and see the God in each other as enlightened by the word "Thatvamasi" displayed atop the Gopuram of Sanctum Sanctorum.

The only desire of the pilgrims is few seconds of *darshan* of their beloved God. The pilgrims survive on bare necessities of life such as water to drink and bathe, toilet facilities, simple food to reduce their appetite and the bare minimum space to stretch out. As the type of developments at the destination exemplifies, the pilgrimage has over the years, undergone a transition in tune with changing times. As the number of pilgrims started increasing and as the consumption patterns started changing, the demand for basic services has increased and their impact on available resources has become colossal and sometimes irreversible. Usage of resources and resultant wastes has already left manifold impacts on the pristine forest environment and the rivers and streams which originate and run through it.

Sabarimala has surpassed all accepted definitions of a *forest temple* and the pilgrimage has become almost the centre stage of regional economy through its income multiplier effects. All types of forces are at play here in the arena of service provision, control and monitoring. Various agencies and groups offer varied types of services for the pilgrims and multiple types of monitoring mechanisms are at work here. However, provision of basic services to the pilgrims and prevention and control of negative externalities due to the wastes generated have not till date reached any acceptable level due to incompetent enforcement of existing rules and laws.

Despite the much hyped about controls and monitoring at various levels by various bodies/ agencies, ultimately, the pilgrims do not get water to drink or bathe at Sabarimala and lacks sufficient toilet facilities, water in River Pampa is highly polluted, poorly treated sewage and waste water still reaches the River and the streams and solid waste is seen strewn around, harboring fly menace and diseases which could apparently be referred to as a recurring *environmental trauma*. However, it is to be understood that the nature and its resources have a carrying capacity and forcing it to cope up with the increasing demands and resultant wastes would even lead to its breakdown finally ending up with repercussions on the pilgrimage itself. It is necessary to understand and provide for the minimum necessities of the pilgrims. Equally important is the need to preserve the sylvan settings of the temple from the impacts due to the wastes generated so as to sustain the pilgrimage itself.

1.1 Aims and Objectives

The study is aimed at understanding the demand - supply gaps of critical infrastructure and waste management services such as water supply, sanitation and management of solid waste and to devise efficient strategies for better provision of these services.

Objectives of the study are:

a) To study the present level of provision of water supply and sanitation services in terms of quantity and quality of such services provided.

b) To identify the changes in demand over the years and supply deficiency at Sabarimala and in the identified Base Camps

c) To identify the possibility to provide essential pilgrim facilities across the region to reduce their dependence / overloading at the final destination

d) To suggest strategies to ensure basic water and sanitation services to the pilgrims and the staff and at the same time protect, restore and upgrade the environmental components, which have over the years suffered due to indiscriminate exploitation.

1.2 Methodology

The methodology followed for the study on water and sanitation sub sector is as follows:

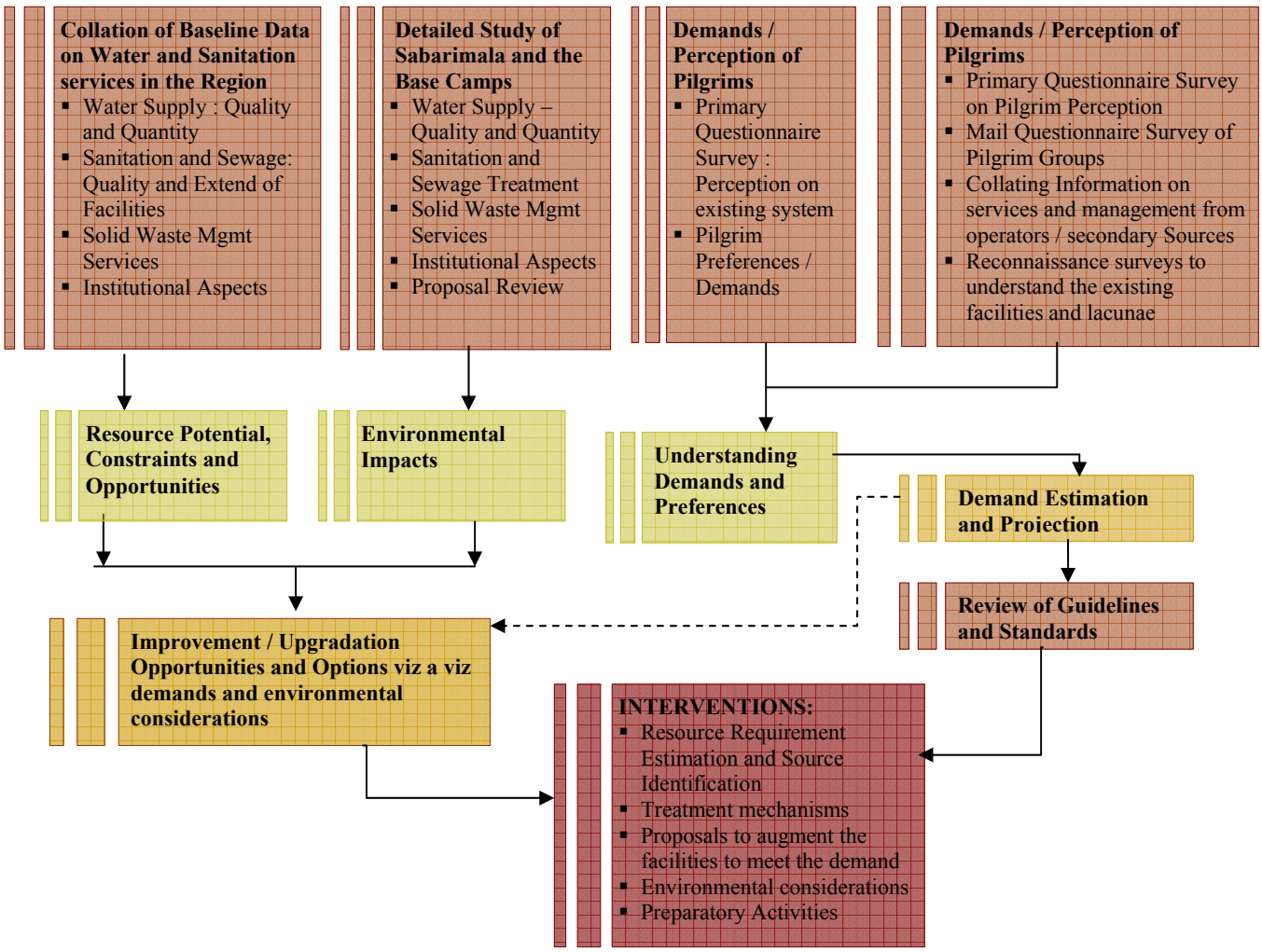

Figure 1: Methodology Adopted for the Study

Annexure 1 presents the details of the Primary Surveys and Terms of Reference(s) (ToRs) that were prepared to undertake these studies.

1.3 Scope of the Study

The study covers the existing situation of water and sanitation service provision at Sabarimala and the base camps, demand supply gaps in the provision of these services, impact of existing indiscriminate use on the environmental components and suggests mechanisms to provide better facilities to the pilgrims within the carrying capacity of the area in concern. The report outlines the requirements over the years and discusses the way forward in terms of additional actions and scrutiny required while realising the proposals mentioned therein. It also discusses the broad resource outlay required in terms of capital cost and land requirement for such interventions mainly around Sabarimala as it is required to initiate the procedures to transfer the land for the said use from the forest surrounds. However, detailed design of each intervention suggested does not fall under the purview of the Master Plan. It is suggested that required discussions with various agencies be carried out by respective implementing agencies to adopt suitable designs and formats as required prior to implementation and additional studies be conducted as warranted and permissions and / or modifications be obtained as per prevailing laws / rules from various Statal and Central agencies during the further stages of development, and such procedures and detailing do not form part of this consultancy service.

1.4 Structure of the Report

This chapter namely, Chapter 1 of the report gives a brief overview of the importance of this sub-module on Water and Sanitation and the Aims and Objectives, Methodology and Scope of the study undertaken to prepare the module. Following chapters throw light on the actual study undertaken, results of the study and the formulated strategies to achieve the set aim and objectives by year 2015 and policies / guidelines for the year 2050.

Chapter 2 presents the types of solid waste generated by the pilgrims and their impacts on the environment, its extent and severity in each area as identified during the study. It also discusses the proposals suggested to manage the solid waste in the manner best suited to the environment.

Chapter 3 discusses the existing scenario of water availability, its supply and demand characteristics and the suggested proposals.

Chapter 4 discusses the existing scenario of Sanitation facilities, their supply and demand characteristics and the suggested proposals.

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Chapter 5 compiles the proposed interventions and strategies to ensure provision of essential services for the pilgrims in the region and to ensure minimisation of impacts on the regional environment due to pilgrimage.

2. SOLID WASTE MANAGEMENT

2.1 Current Practices of Solid Waste Management

This Chapter reviews and analyses the current solid waste management practices at Sabarimala, Pampa, Trek routes, Base camps and Transit camps. The information on the current practices was collected through field inventories and reconnaissance surveys in addition to discussions with key stake holders namely, Travancore Devaswom Board (TDB), District Administrations, Kerala Forest Department (KFD), Eco-Development Committees (EDC), and Local bodies. Component wise information on existing solid waste management systems comprising collection, storage, transportation, processing and disposal has been collected. No reliable data is available on quantity of waste arising and its characteristics to enable development and planning of SWM operations. The information on practices of storage, collection and disposal were gathered during the quantity assessment surveys. The secondary and primary data are collated and analyzed to identify the gaps and deficiencies of the prevailing practices. Annexure 1 presents the details of the Primary Surveys and Terms of Reference(s) (ToRs) that were drafted for the Sub-consultants and study teams to undertake these studies.

This section reviews the current SWM scenario at the following locations:

- Sannidhanam, including temple premises and its vicinity;
- Pampa, including Ganapathy temple premises, Thriveni parking area and riverbanks;
- Trekking routes, including the traditional route from Pampa to Sannidhanam via Neelimala, and Appachimedu, trek route from Pampa to Sannidhanam via Swami Ayyappan road, trek route to Pampa / Sannidhanam via Erumely and Uppupara;
- Base and transit camps at Nilakkal, Sathram, Vandiperiyar, Erumely, Chalakkayam, Vadasserikkara and others.

The impact of pilgrimage in other key areas covered in the region is also briefly discussed here. They include Chengannur, Pathanamthitta, Changanassery and Punalur Municipalities.

2.1.1 Solid Waste Management system in Pampa Sannidhanam and Nilakkal

TDB is primarily responsible for the collection, transportation and disposal of waste. Proper SWM being one of the key environmental safeguards; Sabarimala Sanitation Society (SSS) was formed under the Chairmanship of Pathanamthitta District Collector to support TDB. Now SSS is vested with the responsibility of collection and transportation of waste during the pilgrim season, while disposal of waste is carried out by TDB. The infrastructure available for SWM operations are provided in Table 1.

Table 1 : SWM Vehicles, Equipments and Infrastructure

Description	*Nilakkal**	*Pampa, Trek route and Sannidhanam*
Litter and Storage bins	Nil	200 large metallic bins, 50 lt pole mounted bins
Transportation	One tractor with trailer	Four tractors ,one tiller
Processing	No processing	Pilot composting facility at Pampa
Disposal	Open dumping	Incinerators at Pampa and Sannidhanam
Manpower		550 workers -10 supervisors

Source: Travancore Devaswom Board and District Admn. Pathanamthitta
Note: Facilities in Nilakkal are being augmented by TDB based on the immediate interventions suggested by Ecosmart[1]

[1] *refer: Report on Immediate Interventions for the ensuing pilgrim season: 2005-06*

TDB operates the incinerators at Pampa and Sannidhanam during the peak pilgrim season to burn the waste reaching the disposal yard. A private operator is engaged for the operation. During the lean season, TDB engages workers for collection, but do not operate disposal facilities. The collected waste is openly thrown inside the forest area. The solid waste collection during the lean season is not regular. As part of the immediate interventions proposed for 2005-06 season in the Outline Master Plan for Sabarimala (2005) TDB has procured pole mounted litter bins, tractor dumper containers and plastic shredder.

The prevailing situation and the level of activities are briefly presented in the subsequent sections

2.1.1.1 Quantity and Characteristics of Waste generated

TDB, KFD and SSS clearly indicated that actual waste generated has not been quantified. Moreover, there was a lack of information on composition of waste except the data reported by few studies that have been conducted in the past.

A study conducted by Balasubramanian[2] on quantification of plastics and other wastes in the dung piles of elephants along the trekking routes leading to Sabarimala, indicated that 82.1 percent samples of litter had plastics and the remaining 17.9 percent contained other degradable materials. The plastics were found more in the surrounding areas of Sannidhanam and Pampa (63.40 percent) followed by areas proximate to water sources and thavalams (28.1 percent). During the study, it was observed that the carry bags formed 61percent of the total, followed by polythene bags (23percent). Re-usable plastic materials were only to the tune of 3percent among the plastic litter.

Table 2 : Percentages of Plastic in the Waste Stream

Type of Plastic waste	*Percentage*
Carry bags	61 percent
Polythene bags	23 percent
Other Plastics	13 percent
Recyclable plastics	3 percent

Source: Balasubramanium M. (1999) Baseline Survey and Ecological Impact assessment in Poongavanam at Sabarimala, KFD

Another study conducted by Rajan Gurukkal and Raju S[3] indicates that a large quantity of non-degradable waste is left around within the forest area by the end of the pilgrim season. Tabulated below is the quantity of non-degradable waste materials, which were found within an area of 20 sq. km. within the study period.

Table 3 : Non-Degradable Wastes

Places of Sample	*Plastic*		*Tetra pack/ Silver Foil*		*Polythene*		*Metal*	
	Carry Bags	*Bottles*	*Soft Drink Cases*	*Snack Cases*	*Hard type*	*Sacks*	*Bottle lids*	*Tin*
Valiyanavattom	13	5	14	11	3	7	26	3
Cheriyanavattom	11	9	12	21	5	9	123	8

[2] Balasubramanian M.(1999), ***Base line Survey and Ecological Impact Assessment in Poomkavanam at Sabarimala,*** India Eco-development Project Periyar Tiger Reserve, Kerala

[3] Rajan Gurukkal and Raju S (2001), **Enclave Management Study,** India Eco-development Project, Project Tiger, Kottayam

Places of Sample	*Plastic*		*Tetra pack/ Silver Foil*		*Polythene*		*Metal*	
	Carry Bags	*Bottles*	*Soft Drink Cases*	*Snack Cases*	*Hard type*	*Sacks*	*Bottle lids*	*Tin*
Pampa River Bank	6	2	19	2	2	2	26	4
Thriveni	8	4	17	3	2	1	14	6
Swami Ayyappan Road	4	3	13	14	1	0	27	1
Bhasmakulam	36	15	24	32	7	27	872	13

Source: Enclave Management Study (Rajan Gurukkal andRaju, 2001)

A rough estimate based on extrapolation of the figures in the above table indicates that the quantity of non-degradable waste arising within a radius of 7 sqkm around the temple would be around 7 tons/day during peak season. This would work out to about 20percent (by weight) of the daily waste arising during peak season.

The discussions held with the officials of TDB and GoK on solid waste generated at Sannidhanam, Pampa and trek routes, indicate that during the recent years, PET bottles formed the major fraction of the plastic waste arising in terms of volume while organic waste formed the major component in terms of weight. Additionally, other types of solid waste arising include pre-season construction waste and pre- season maintenance and post-season demolition waste.

Table 4 summarises the current waste generation trends and mode of primary disposal observed based on site reconnaissance conducted by Ecosmart at Sannidhanam, Pampa, Nilakkal and other trek routes.

Table 4 : Source, Composition and Mode of Primary Disposal of Solid Waste

Source	*Composition*	*Percentage Composition*	*Mode of Primary disposal*
Trekking routes, parking area, pilgrim resting places and open spaces	Pet bottles, plastic carry bags, bottles, tetra packs, cloth, paper, fruit peelings, food waste, flower waste	30 percent	Open throwing on land and in Pampa River. Depositing in bins
Hotels, restaurants, trade waste	Food waste, vegetable/fruit peelings, paper, plastics, ash, wood	40 percent	Open throwing. Depositing in bin/bag at source/public bin
Lodgings	Food waste, plastic carry bags, pet bottle, paper, glass bottles	18 percent	Open throwing., Depositing in bin/bag at source/public bin
Institutions	Paper, plastics	5 percent	Open throwing, Depositing in bins
Construction waste	Debris, wooden pieces	5percent	Open throwing
Others	Clinical waste, hazardous and animal droppings	2percent	Open throwing

Source: Reconnaissance study conducted by Ecosmart of Sabarimala, Pampa, Nilakkal, track routes, 2004

The solid waste generation varies considerably during the peak-and lean pilgrim season. The peak period of solid waste generation is during the Mandalapooja and second half of

Makaravilakku. During lean season, the solid waste generation is found maximum in the month of April (Vishu season). During off-peak season, the quantum of solid waste generation is less, mainly from institutions and offices and a few hotels and restaurants.

2.1.1.2 Segregation and Storage of Waste at Source

Segregation and storage of solid waste is generally absent though some hotels have crude ways of storing the waste. Majority of shops resort to open throwing of waste, which they find the most convenient way as the backyard is forest! Large heaps of waste is found in and around accommodation centres and dormitories.

Litterbins provided on the trekking routes and in Nadapanthals is typically open metallic type. These bins are of approximately 200 to 250 litres capacity and are placed on ground. These bins are located at a distance of 200 to 500 meter intervals on the trekking route. However, only a few bins were noticed in the remaining areas. Litterbins being large, direct transfer of waste to collection vehicle or shoulder bag are not possible.

Secondary storage bins provided at Pampa and Sannidhanam are typically large metal type drums, and are placed close to the hotels and restaurants along the pilgrim routes, as there is no other space or separate service bays and/or roads for placing them. Some of the large hotels deposit their waste in the storage drums, which are scraped down and loaded manually to collection vehicles. Overflow from the bins was observed in many of the locations. No facilities for storing the waste at source were found at Nilakkal during the last season. Immediately after the peak season gets over, the authorities managing the solid waste during the season remove the storage facilities. In the absence of such facilities, during lean and off-peak pilgrim season, the pilgrims visiting these areas resort to open throwing of waste

2.1.1.3 Collection and Transportation

Daily collection, transportation and disposal are done only during the peak season from mid-November to mid-January, until the end of Makaravilakku season. The collected wastes from the litter and storage bins are manually transferred to the tractor-trailers at Sannidhanam and Pampa for transportation to incinerator premises for burning.

The traditional trekking route between Pampa and Sannidhanam is steep with intermittent steps and therefore it is difficult to organise collection vehicles to traverse this path for collection. The workers engaged for sweeping and collection of waste from the trekking routes clean the pathways; empty the bins and dump the contents in the forest. Thus, the waste ultimately reaching the disposal site is only around 40 percent of the generated waste.

The fleet of vehicles operated during last season are two tractors and one tiller at Sannidhanam, two tractors at Pampa and one at Nilakkal.

2.1.1.4 Treatment and Disposal

The waste collected from Sannidhanam and Pampa is burnt in the incinerators located at Sannidhanam and Pampa (at Cheriyanavattom). The manually loaded incinerators have a rated capacity of 350 kg/hr and use diesel as a fuel. Around 75 percent of the total waste reaching the incinerator yard consists mainly of wet organic, plastic and other mixed inorganic waste. No efforts are being made to segregate recyclables or to treat the

biodegradable materials separately. Since manual loading is a cumbersome process, it results in backlog in feeding the incinerator, and hence results in piling of waste at the incinerator yards during the peak days of the pilgrim season. In addition, loading the incinerator with large quantity of PET bottles and incinerating glass pieces/particles result in clogging of gratings leading to operational difficulties and optimal performance. Moreover, since the mixed waste has low calorific value, fuel consumption is high; leading to higher operation and maintenance costs.

Crude dumping is the mode of disposal of the waste collected at Nilakkal. Heaping and burning of plastic waste was also observed.

No separate disposal facility is available for disposal of hospital waste at Pampa and Sannidhanam.

During the last season (2005-06), segregation of plastics (pet bottles and recyclable plastics) was done and pilot scale composting of organic waste was initiated based on the guidelines provided by Ecosmart[4].

2.1.1.5 Management and Operation

As stated earlier, SSS under the chairmanship of District collector, Pathanamthitta is responsible for collection and transportation during the peak pilgrim season at Sabarimala, Pampa, trekking routes and Nilakkal. Revenue Divisional Officer (RDO) of Adoor is the Member Secretary of SSS. Two Tahasildars are deputed during the pilgrim season to oversee the SWM operations. The workers for peak season are recruited on daily wage. They are mainly from the neighbouring State of Tamil Nadu. Ayyappa Seva Sangham (ASS) assists SSS in recruiting the SWM workers for the season.

Pampa, Sannidhanam and the trekking routes (traditional pathway and Swamy Ayyapan Road) are divided into sectors for SWM operation. Each segment is under the control of a supervisor overseeing the work of a group of workers. Workers collect and transfer the waste from the bins to the tractor container and are also responsible for sweeping and picking up the waste on ground and depositing in the bins. Hotels and commercial establishments are directed to deposit the waste at disposal site. In addition, direct collection is also seen done from certain establishments.

Forest department had initiated a drive after the last season for clearing Sabarimala of the backlog. EDCs were organised to collect and dispose off the solid waste spewed around Pampa, Trek routes and Sannidhanam. During the pervious two drives, 12.67 tonnes and 12 tonnes of solid waste was collected and burned off.

2.1.1.6 Awareness and Participation of NGOs in SWM

Lack of awareness is evident from the way in which pilgrims and other user group especially the traders and vendors behave while visiting the area during the pilgrim season. Open throwing and dumping of waste in rivers/rivulets and in forest area and burning of waste is resorted by the pilgrims. The involvement of NGOs, private entrepreneurs, and recyclers is not observed for SWM. TDB/SSS finds it difficult to manage the situation to the required level in spite of best efforts, as there is lack of a

meaningful partnership and co-ordination. Additionally, areas of awareness creation and recycling potential of large quantity of solid waste are not being addressed properly.

2.1.2 Erumely –Pampa Trek route

There are nine major transit camps along Erumely route with Viri, hotels, toilets facilities provided by EDCs organised by the KFD. The EDCs are formed to conserve the bio-diversity of Periyar Tiger Reserve (PTR) and are responsible for providing basic facilities for pilgrims and for ensuring cleanliness along this traditional pilgrim route falling in the PTR area including the Uppupara transit camp.

About 10 lakhs pilgrims trekked from Erumely to Pampa during the 2004-05 season. During Mandalakalam the pilgrim traffic is less (say 5-10 thousand /day) but during Makaravilakku starting from 1st January to 13th January about 60,000 pilgrims trek every day. Based on discussion with KFD and EDC and secondary information the quantity of waste arising along the route is around 300 to 350 tons during the season. Out of this, the generation at Valiyanavattom alone will be to the tune of 80 tons.

Each individual shop owner is responsible for collection and disposal of the waste from their premises. Waste are collected (both bio degradable along with non bio degradable) and are buried/burned. No facility like litter bins are available and waste is thrown open along the entire stretch. Valiyanavattom is found to have huge heap of waste during the peak days with no provision to dispose.

2.1.3 Erumely and Vandiperiyar Panchayats

Erumely Panchayat has a resident population of around 60000 as per 2001 census spread over an area of 119.3 sq.km. The Erumely town centre accounts for major activities during the pilgrim season as the Sastha temple and Vavar Mosque are in the town area. The Local body / Panchayat is responsible for SWM operation

During off season, the generation is about 8 tons/day, around 4 tons reaching the common collection places. The average pilgrim flow during the season is to the tune of 24000 and the peak flow is 65,000. The generation of waste would be 4 tons on average and would go up to 10 tons during Makaravilakku season. The Panchayat is not equipped to cope up with such a situation and waste generated is being disposed in a haphazard manner along the open spaces and rivers. During the recent years, solid waste collection at Erumely has improved significantly due to the activities of “Visudhi Sena”. But onsite facilities for storage, waste transport, segregation, processing and safe disposal are lacking. The incinerator under operation from the year 2000 has a capacity of 3 tons. Panchayat proposes to procure land for composting the organic fraction of waste.

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Vandiperiyar Panchayat has a resident population of 45,660 as per 1991 census. Currently only a small percentage of pilgrims especially those from some parts of Tamil Nadu opt this route .On developing Sathram as a Base Camp , the pilgrim flow is likely to increase .Based on the studies conducted in 2004-05 season, the expected average pilgrim arrival along this route is 7500/day with a peak flow of 30000. The waste generation due to this would be around 1.5 tons/day with a peak of around 4.5 tons during Makaravilakku. No organised

[4] IL&FS Ecosmart Ltd (August 2005), ***Report on Immediate Interventions for the Ensuing Pilgrim Season***

waste collection system is introduced in the Panchayat. A project for installing an incinerator to dispose the waste is under consideration by the Panchayat.

2.1.4 Sathram and Uppupara

Currently the pilgrim arrival through this camp is marginal as there are no facilities here and pilgrims prefer taking the vehicular route from Vandiperiyar to Uppupara. Restricting the transportation of pilgrims along the Vallakkadavu – Uppupara route will divert pilgrims through Sathram and average flow expected is 7500. Sathram has to be equipped to manage about 1.00 ton daily. Currently there is no facility provided at Sathram.

Pilgrims reach Uppupara by road from Vandiperiyar and by walk from Sathram. Current average is around 7500 and peak around 30000. EDCs are managing Uppupara by providing essential services. No facility for regular collection exists. Infrequent collection of waste is observable and it is mostly burned or disposed to the interiors. Almost 50,000-65000 people assemble for Makaravilakku day to view Jyothi. They start assembling 3-4 days in advance and results in large quantity of waste generation.

2.1.5 Other Local Body Areas

Punalur, Pathanamthitta, Changanassery and Chengannur Municipalities serve as transit camps during the season. The prevailing SWM scenario in these towns is presented in the following table **(Table 5).** It is observed that the system is not upgraded in compliance with Rules[5] and regulations and environmental safe guards. Open storage and manual multiple handling is still practiced with final disposal through open dumping. The issues are severe during the season when quantities increase manifold.

Table 5 : Salient Features of SWM in Municipalities serving as Transit Camps

Name of Municipality	*Area (in sq.km)*	*Population*	*Generation (in tons)*	*Secondary Storage*	*Transportation*	*Land(in ha)*	*Disposal*
Punalur	34.6	47226	10	Open collection	Trucks and tractors	Not available	Open dumping and Bio-gas
Pathanamthitta	12.40	37802	10	Open collection	Trucks and tractors	Not available	Open dumping and vermin composting
Chengannur	12.41	25391	7	Open collection	Lorry	3 .00	Open dumping
Changanassery	13.5	51960	15	Open collection	Trucks	1.25	Open dumping and vermin composting

Source: Clean Kerala Mission

2.1.6 Key Issues and Conclusions

Difficulty to cope up with large fluctuating influx of pilgrims during the peak pilgrim days is one of the major constraints observed in SWM. The crucial issue seems to be the open throwing of waste all along the pilgrim routes and in Pampa River and rivulets. This is mainly due to the lack of awareness among pilgrims and other user groups. Adding to this are the

(2005-06), GoK

[5] Municipal Solid Wastes (Management and Handling) Rules of the MoEF

inadequacies in infrastructure, trained manpower and the operational difficulties during peak pilgrim season.

Even though the situation is manageable during the lean season, the scenario is bad in the absence of a regular service. Absence of pre- season and post-season operations create backlog, which in the latter case leads to rotten dumps of garbage and plastics all over Pampa and Sabarimala. Wild animals in forest get exposed to this situation; wind spreads the plastics, and the river pollution cause concern not only to pilgrims, but also to tribal settlements downstream of Pampa. The environmental impacts of the current SWM practices are indicated in Table 6.

The municipalities, though have a regular system of SWM the same is not in compliance with current Rules and regulations and the crucial issue is the absence of long term secured landfill site and facilities for processing the organic fraction. Two municipalities (Pathanamthitta and Punalur) are yet to procure landfill sites. Secondary storages are predominantly open ground level space, while transportation is done in ordinary trucks and tractors. Municipalities are yet to assess the quantities of waste arriving and seasonal variations due to pilgrimage. No long term plans are developed, except some measures to initiate treatment with the support of Clean Kerala Mission of the GoK.

Table 6 : Impact of Current Practices of SWM

Environmental attributes	***Impacting activities/stresses***	***Type of impact***
Land	Irregular collection	Littering and improper land use
	Improper storage	Soil contamination
	Composting practices	Possibility of soil conditioning
	Open dumping	Inefficient use of land and pollution
Air quality	Irregular collection	Emission of methane, hydrogen sulphide
	Poor segregation	Foul odour due to putrefaction
	Improper storage	Emission of methane, hydrogen sulphide
	Poor fleet operation	Emission of particulate matter
	Open dumping	Foul odour due to improper practices
	Incineration/ Burning of waste	Emission of green house gases
Water quality	Irregular collection	Contamination due to clogging of drains
	Improper storage	Contamination due to leachate discharge
	Inadequate sweeping	Clogging of drains
	Composting practices	Leachate discharge due to poor management
	Maintenance of plant	Leachate discharge due to poor capture
	Open dumping	Contamination due to discharge and seepage
		Seepage of leachate to groundwater
		River pollution
Aesthetics	Irregular collection	Eye sore due to littering
	Improper storage	Unhygienic places
	Inadequate sweeping	Eye sore due to littering
	Poor fleet operation	Dust, littering and spillage of leachate
	Composting practices	Foul odour
	Maintenance of plant	Foul odour
	Open dumping	Unhygienic dump yard, foul odour

Environmental attributes	*Impacting activities/stresses*	*Type of impact*
Health	Irregular collection Improper storage Inadequate sweeping Poor fleet operation Composting practices Open dumping	Nuisance of flies and vectors Spread of worms and flies Spread of vectors due to clogging of drains Dust and smoke Occupational diseases Respiratory/allergic diseases due to burning Contamination of water Contamination to wild animals
Accidents	Improper storage Composting practices Open dumping	Fire accidents Wounds due to improper handling Animal menace Gas accumulation and explosion

Source: Analysis

Summarized below are the issues and deficiencies that were observed by Ecosmart during site surveys conducted for SWM at Pampa, Sannidhanam, Nilakkal, trekking routes, and at the proposed Base and Transit Camps.

- Absence of segregation and storage at source;
- Inadequate provision of litter and secondary storage facility;
- Improper design of bins;
- Manual handling and loading of waste;
- Non-tipping containers and difficulties in using traditional type of tractors in limited access space;
- Space constraints in locating secondary container stations and service routes away from pilgrim movement /activity corridors;
- Steep gradient and inaccessibility of vehicles in trekking routes;
- Space constraints at disposal site for unloading and final sorting of recyclables, compostable and combustible fractions;
- No treatment of organic compostable fractions;
- No tie up with recyclers for dealing with recyclable fractions;
- Burning of mixed waste of low calorific value leading to high OandM cost;
- No mechanical loading device for the incinerator;
- No pre-season and post season cleaning;
- Absence of regular collection during lean season days;
- Back log in collection of waste and treatment of collected solid waste;
- Open burning and dumping along the routes and within forest area;
- Absence of SWM facilities at Nilakkal, Sathram and other transit camps
- Deficient institutional arrangements and lack of properly trained personnel to manage the collected solid waste effectively;
- Mixing of infectious clinical/hospital waste with non-infectious solid waste;
- Lack of health and hygiene awareness among pilgrims and user groups;
- The major agencies involved in the SWM are SSS, TDB, KFD and the local bodies (Vadasserikkara, Erumely, Vandiperiyar, and Ranni-Perunad). Lack of co-ordination among these organisation is one of the areas of concern; and
- Inadequacy of regulatory measures and enforcement.

2.2 Assessment of Quantity and Character of Waste Generated

An accurate assessment of the quantity and characteristics of the solid waste generated is a crucial data required to formulate the Solid Waste Management plans. Rational decisions on present and future system requirements are possible only if reliable data on composition and quantity of solid waste are available. The method and capacity of storage, the type of collection vehicle, the optimum size of crew and the frequency of collection depends mainly on the volume and the density of wastes. The treatment and disposal method may be dependent on the type of material recycled, organic content of waste, which could be composted and recyclable material which could be separated. There is no authentic data with TDB on the quantity and quality of waste generated, collected, transported during the season from Sannidhanam, Pampa, Trek routes and Nilakkal. Local bodies and EDCs involved in SWM operations in other areas also do have no data on quantity and quality of waste arising in the area under their jurisdiction. Considering the above aspects, source-wise surveys were carried out for assessing the quantity and characteristics of waste generated at the core areas viz; Sabarimala, Pampa , traditional trek route from Pampa to Sannidhanam, Swami Ayyapan and Chandranandan Roads and Nilakkal.

Based on the site reconnaissance conducted by the Ecosmart at the above-mentioned locations, the major sources of the waste generation include hotels, shops, accommodation centers, nadapanthals, trekking routes. The sources identified are listed in Annexure 2.

2.2.1 Sampling Techniques and Sampling Methodology

Sampling points and methodology is primarily influenced by the techniques adopted for quantification of solid waste. Depending on the size of the area and resources available there are varieties of techniques for estimating the quantity of waste generated by a community. Few of the important techniques are:

- Modelling Techniques that apply generic waste generation rates and other community features for predicting waste quantities;
- Physical Sampling Techniques that use statistical methods to predict total waste stream quantity and composition by analyzing small volumes;
- Direct Measurement Techniques through pilot studies to collect the type and volume of waste generated by the community; and
- Indirect Method through assessment and summing up of the quantities of waste (i) collected and transported; (ii) the backlog in collection and transportation; (iii) the waste separated for recycling; and (iv)the quantity disposed at source.

To assess the quantity direct measurement techniques were used in this survey as it gives more reliable results and provide information on source wise generation. The waste generated is computed on the basis of the measured per unit generation from the sources. The survey was conducted at Nilakkal, Pampa, Cheriyanavattom, Trek routes from Pampa to Sannidhanam and Sannidhanam. For this purpose representative samples are identified from the inventory of the sources of generation. The sampling surveys were carried out from 6th to 8th, and from 11th to 14th of January 2006 to cover the week days, the week ends and the peak days.

To assess the physical characteristics of the MSW, on site physical analysis were carried out. Physical analysis is carried out for samples from representative collection points and from

disposal sites at Nilakkal, Cheriyanavattom and Sannidhanam. Details of these surveys and the results of the same are discussed in the subsequent sections of this chapter.

2.2.2 Quantity of Waste Generated

The total generation during the 2005-06 seasons works out to 2,978 tons at the four areas covered under the study. Week day, weekend and peak day generation show large variation since it is dependant on pilgrim arrivals and their activities. The quantities generated at the four areas are given in Table 7. The daily generation computed is average, and there are variations as pilgrim arrivals vary considerably during the season. The total generation is worked out for 48 week days, 12 weekends and 6 peak days. The number of days has been arrived on the basis of pilgrim flow pattern presented in the pilgrim count, pilgrim perception and related studies carried out.

Out of the four areas, Sannidhanam accounts for 42 percent and Pampa, 28 percent of the total waste. This is an indication of the current level of activities at these two locations.

Table 7 : Quantity of Waste Generated

Location	*Quantity generated/day in tons*			*Total generation in tons*				*Percentage to total*
	Week days	*Week ends*	*Peak days*	*Week day*	*Week end*	*Peak*	*Season*	
Nilakkal	5.54	11	16	266	132	96	494	17
Pampa	10	16	25	480	192	150	822	28
Trek route	5	6	12	240	72	72	384	13
Sannidhanam	16	25	35	768	300	210	1278	42
Total	36.54	58	88	1754	696	528	2978	100

Source: Survey and Analysis

2.2.3 Physical Composition

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Samples taken from the three locations as stated earlier are analyzed and the results are tabulated in the **Table 8**. As presented here the major fraction is bio-degradable. The plastics are as high as 10percent by weight which by volume will be one of the major fractions.

Table 8 : Physical Composition of Waste Generated

Constituent	*Percentage to weight*			
	Nilakkal	*Pampa*	*Sannidhanam*	*Average*
Food waste, fruit waste (easily biodegradable)	74	58	63	60.50
Plastic	7	8	12	10.00
Paper, paper plates, cups Cloths	12	16	17	16.50
Donkey droppings , cow dung, leaves	3	15	5	10.00
Other items	4	3	3	3.00
Total	100	100	100	100

Source: Field survey and analysis

As presented in **Table 9** the organic fraction during the season is to the tune of around 1800 tons, while plastic and paper accounts for 300 and 490 tons respectively. During the survey it

was observed that large volume of pet bottles form the bulk of the plastic waste. During the survey it was observed that the pet bottles transported to the two disposal sites at Pampa and Sannidhanam amounted to 12000 numbers /day (0. 2 tons) approximately.

Table 9 : Major Constituents of Waste

Location	*Quantity in tons*	*Major Constituents, in tons*		
		Organic-food waste	*Plastic, pet bottles*	*Paper, cups, plates*
Nilakkal	494	296.4	49.4	81.51
Pampa	1062	637.2	106.2	175.23
Sannidhanam	1422	853.2	142.2	234.63
Total	2978	1787	298	491

Source: Analysis

2.2.4 Future Trends in Waste Generation

In general context the waste generation is dependant on the growth in population and the change in living standards. The trend in waste generation in Sabarimala would mainly be dependant on the pilgrim arrivals and the change in trading and commercial activities. The pilgrim arrival varies considerably during the season and hence the variation in waste generation. This scenario is likely to change as peak pilgrim flows would be controlled based on optimum levels for satisfactory *darshan* and effective management. Secondly the current activities at Pampa would considerably get shifted to Nilakkal, while the duration of stay at Sannidhanam would also be reduced along with the measures to restrict trading activities. Considering these aspects the projected waste arising at three locations has been worked in the Table 10.

Table 10 : Quantity to be Collected and Processed

Location	*Quantity day in tons*					
	Week days	*Weekends*	*Peak days*	*Current Daily average*	*Projected total*	*Projected daily average*
Nilakkal	7	11	16	7.5	1500	22.5
Pampa	13	20	33	16.5	600	9.0
Sannidhanam	18	27	39	21.5	900	13.5

Source: Analysis

2.2.5 Interpretations and Inferences

The waste generation is influenced by the social and cultural habits in general. In addition to this, the generation in and around Sabarimala will be influenced by rituals and customs followed by the pilgrims. Since Sabarimala pilgrimage is unique, there is no other study to compare the results. However considering the urban standards of waste arising, the generation is on higher side. One reason could be the increasing trading and commercial activities which are normally not required to the tune as seen now.

The fraction of plastics is almost at par with the generation in cities, which will be of great concern in the environmentally fragile area of Pampa enroute and Sannidhanam. Around 83 percent of the generation is at Pampa, Sannidhanam and trekking route and indicates the

concentration of activities there. Decongestion of Pampa and Sannidhanam, and developing the base camp at Nilakkal as envisaged by the Master Plan assumes great importance in this context.

Based on the constituents in the waste generated, the qualities for separation of recyclables, treatment and incineration can be assessed and incorporated in future SWM Plans. Recyclable fraction is considerably high and plastic along with paper and other waste of similar nature, will be to the tune of 300 tons during a season while about 1800 tons of organic fraction is available for composting / bio-stabilisation. Large amount of plastics is an indication of extensive use of carry bags, pet bottles and plastic packages. It indicates that banning of plastic is not effective and strict enforcement should form an integral part of environmental safeguard.

As already stated, the waste generation is high and attributes to intense commercial activities which have to be curtailed as otherwise it could be at the cost of the fragile environment

The current capacity of Incinerators is 700 kg/hr and assuming 24 hour operation the maximum possible disposal is 17 tons/day working out to 1100 ton during the season. The generation during the season is around 2500 at Pampa and Sannidhanam. Hence the backlog in disposal is around 1400 tons.

2.3 Solid Waste Management Guidelines

The strategies and key considerations leading to the formulation of guidelines for the short term and long term Management of SWM in the core and peripheral areas are discussed in the first section. The second section in this chapter provides an outline of Plan for SWM for the planning periods as indicated below.

Short Term Plan	2007-2010
Medium Term Plan	2011 -2015
Long term Plan	2016- 2050

2.3.1 Strategies and Key considerations

- Bio-degradable, non bio-degradable and bio-medical wastes should never be mixed at source of generation, but separately stored. Insist on separate storage facility for all premises. It should form a part of the conditions under which the premises are leased out for seasonal activities. The local bodies can legally enforce the same to all temporary and permanent premises.
- Waste should never be allowed to reach the ground at primary and secondary stages of SWM. Storage at source should be such that the bins /containers can be manually lifted and emptied to secondary storage facility or collection vehicle
- Multiple handling of waste and its exposure during collection, transport and disposal should be minimal.
- Abolish all open collection points and provide container facility
- Abolish manual loading by scarping from ground
- Covered secondary collection containers should be used for transportation
- Resource recovery to be carried out as near to the source as possible
- Separation of recyclables should be encouraged at source level. The shops and hotels should collect back empty pet bottles, aluminium containers etc.

- A secondary sorting and separation of recyclables should be done prior to disposal/processing
- At transit and base camps, on site composting should be done to stabilize the organic fraction. Nilakkal, Pampa and Sannidhanam should have composting facility at the existing/ proposed location.
- Environmentally safe landfill or incineration is to be a part of the long-term disposal strategy. The landfill/incineration has to be restricted to waste that cannot be otherwise recycled, treated or recovered. **No landfill for secured disposal of rejects is proposed in forest area**. The landfill/incineration has to be restricted to waste that cannot be otherwise recycled, treated or recovered. No landfill for secured disposal of rejects is proposed in forest areas. For the local bodies landfill for secured disposal of reject after treatment can be done at non-forest areas within their administrative limits. Incineration as an option should be considered only where landfill is not feasible and waste arising is seasonal only.
- The success and sustainability of SWM would depend on building meaningful and effective partnership with stake holders, community, NGOs and private entrepreneurs
- Define the roles and responsibilities of various stakeholders and putting in place an operating framework
- All possible support of NGOs should be tapped at Sabarimala area. NGOs will be more effective in awareness creation programmes and 'watch and ward programmes' which are crucial in the entire area under study.
- EDC should be involved in the operation to the extent possible and trained EDC units should be developed in similar line as Kudumbasree in urban areas.
- Private entrepreneurship should be tapped in transportation , operating, composting units
- Recyclers should be involved in collection of recyclable fraction / transiting away the collected recyclables
- The management and operation should be handled by trained and professional team
- The core staff of TDB should be trained in effective management.
- During season the newly recruited staff /workers should also receive training
- Waste minimization efforts have to be built in the overall SWM program. This will be crucial especially at Sabarimala region and measures should be taken to minimize the commercial activities by limiting to the essential food and drinking water facilities. Plastic banning should be strictly enforced and squads should be formed to cover the entire area to monitor the same.
- Awareness creation has to a regular and continued programme. Creation of awareness amongst pilgrims and different stakeholders to meet the demands for a cleaner environment requires a continued effort. This activity should be taken up involving the participation of some leading NGOs and Community organizations. Materials required for the IEC campaign like manuals and other media communication should be developed through professional agencies. Measures should be taken to spread the message especially among pilgrims from other states using print media, Television and thorough NGOs, Guru swamis and temples/ agencies organizing pilgrimage)

The Outline of Master Plan prepared in 2004 and the Stage II, Phase 1 report on Immediate Interventions for 2005-06 have detailed out the proposed immediate requirements.

As stated in the foregoing section, Erumely, Vandiperiyar Vadasserikkara Panchayats and Chengannur, Pathanamthitta, Changanassery and Punalur Municipalities have to develop Detailed Project Report for an integrated SWM operation taking into account of the issues

during pilgrim season. As these local bodies lack expertise to develop projects and have financial constraints, they have to be supported by Clean Kerala Mission. A time bound programme may be considered for the local bodies so as to have an environmentally acceptable SWM operation during the short term plan period, i.e. 2007-10.

2.3.2 Targets and Interventions

In line with the strategies the targets for short, medium and long term is worked out and presented in **Table 11**. The percentages adopted are achievable levels and should be pursued for sustainable SWM. This exercise is done only for the key areas viz; Pampa, Sannidhanam and Nilakkal. The matrix is done for a total waste generation of 3000 tons during the season (2978 tons is the surveyed figure) and taking that this generation will be affected only by waste reduction policies. Along with increased level of segregation at source the quantity which can be treated and recycled also increases reducing the load on disposal.

Table 11 : Targets for Waste Management at Pampa, Sannidhanam and Nilakkal.

Component	*2007-10*		*2011-2015*		*2016-2050*	
	Percentage	*Quantity in tons*	*Percentage*	*Quantity in tons*	*Percentage*	*Quantity in tons*
Collection	90	2700	100	2940	100	2650
Segregation and storage at source	50	1350	90	2646	100	2650
Treatment of organic waste	30	810	40	1176	50	1325
Separation of recyclables	5	270	10	290	15	390
Waste minimisation	2	60	10	290	20	530
Disposal/ Incineration	-	1560		1184	-	405

Source: Analysis

To achieve the targets short, medium and long term interventions are proposed and presented below.

A. Nilakkal

Short Term
Procure Equipment and vehicles to meet the immediate requirements as per Stage II study. Initiate segregated storage at source Develop the Compost yard and composting of organic fraction Prepare DPR to meet the proposed base camp requirements as per the projected requirements , land use proposals and guide lines in Master Plan
Medium term
Upgrade SWM programme as per DPR
Long term
Review the scenario with respect to requirements, new technologies and upgrade

B. Pampa, Trek Routes and Sannidhanam

Short Term
Initiate source segregated source storage and ensure 100 percent coverage in two years Procure equipment and vehicles to meet the immediate requirements as per Stage II study.

Collect and treat the waste generated at Valiyanavattom Develop separate access road to Cheriyanavattom plant from Pampa and service roads and container collection bays. Develop Service roads segregating from pilgrim movement area at Sannidhanam for operating SWM vehicles Operate Shredder for pet bottle crushing Develop the Compost yard and compost organic fraction
Medium term
Prepare DPR for upgrading the SWM programme as per land use proposals and guide lines in Master Plan Implement DPR
Long term
Review the scenario with respect to requirements, new technologies and upgrade

C. Erumely –Valiyanavattom Route, Uppupara, Sathram
Short Term
Initiate Source segregated source storage Provide storage and litter bins at suitable intervals Abolish open burning of mixed waste, set up local composting units for stabilising organic waste. Collect and transport plastic waste to intermediate camps provided with shredder for shredding and transportation. Collect and treat the waste generated at Valiyanavattom and process at Cheriyanavattom plant
Medium term
Prepare DPR for upgrading the SWM programme as per land use proposals and guide lines in Master Plan Implement DPR
Long term
Review the scenario with respect to requirements, new technologies and upgrade

D. Municipalities and Panchayats
Short Term
Initiate Source segregated source storage Develop House to house collection system in the Municipal areas Abolish open collection of waste and provide secondary storage and litter bins at suitable intervals Develop DPR incorporating the pilgrim season requirements Upgrade landfill with controlled tipping /develop Sanitary landfill at own sites Set up decentralised /centralised treatment units
Medium term
Procure/develop site for landfill and for processing as per DPR and implementation of DPR
Long term
Review the scenario with respect to requirements, new technologies and upgrade

The immediate interventions for Upgrading SWM Services at Sabarimala, Pampa and Nilakkal are further elaborated in Table 12.

Table 12 : Short Term Interventions : Component wise break up

SWM Component	*Short Term 2007-2010*
Segregation and Storage at source	Initiate the provision of storage and cover 100percent premises bins for bio-degradable and non-biodegradable waste at all sources, including hotels, restaurants, fruit stalls, shops, lodges, and dormitories
Provision of litter bins along trekking routes, common places, base and transit camps, parking area	Provide litterbins at closer intervals. Introduce bins of size and design which can be handled by collection crew
Secondary collection Points	Locate secondary collection – closed Tractor trailer/tiller trailer – at suitable area away from pilgrim routes Trailers will be provided at parking areas, Bus terminals, close to hotels/shops and lodging facilities at Pampa and Sannidhanam Create temporary bays for storing waste at different 4 to 5 locations along Swami Ayyappan road
Primary collection	Direct collection by two men crew from hotels /shops either in tiller or manual hauling to nearest secondary collection point Provide a two men crew for transferring the waste in litterbins. The same crew to clear the waste thrown on the ground along the segment /beat allotted to them, either by sweeping or by hand picking
Secondary collection and transport	Use of tractors with tipping arrangements, covered containers Develop Separate access to processing site
Recycling	Tie up with recyclers for recycling of PET Bottles, removal of crushed PET bottles and other recyclables
Processing	Composting of highly degradable waste in pits Incinerate other wastes Provide mechanical loading system to the incinerators located at Pampa and Sannidhanam Develop a deep landfill for hazardous and clinical waste.
NGO participation	Involve NGOs like Ayyappa Seva Sangham, SAPP-EDC to participate in SWM management, awareness creation, and enforcement
Training	Train workers and supervisors to effectively manage the SWM
Awareness creation	Prepare pamphlets in Tamil, Telugu, Malayalam, Hindi and English and circulate through Ayyappa Seva Sangham in all States before the pilgrim season Tie up with TV channels in Kerala and other Southern States to convey awareness message throughout the pilgrim season Awareness programme for hotel, shop and other establishments at Pampa, Sannidhanam and those along the routes Use print media to brief the Do's and Don'ts prior to start of the pilgrim season
Waste minimization	Provide more kiosks with water cooler and drinking water outlets to phase out use of pet bottle water Replace plastic materials by eco-friendly substitutes, like paper cups and plates, cloth and jute bags, etc.
Legal and enforcement aspects	Incorporate a list of banned items, which should not be used/sold by traders/vendors in the lease areas. A clause should be built in the lease

SWM Component	*Short Term 2007-2010*
	agreement. Suspend license of those who violate the conditions. Enforce relevant clauses of Waste Management and Handling Rules, Kerala State Pollution Control Board and MoEF rules and regulations
Institutional Aspects	Develop a suitable management structure to bring all the agencies responsible for implementing SWM under one umbrella. Define function wise responsibility for each of these agencies

Points to be noted:

- No waste bin should be left open after the season considering the wildlife.
- No waste should be seen strewn around after the season. The one-day waste collection drive should be made mandatory after every pilgrim season.
- Clear-cut guidelines should be ensured for hotels and shops regarding the manner to store and deal with the solid waste generated from their premises
- Awareness, Watch and Ward for pilgrims and shop keepers
- Till such time, the donkeys / mules are phased out, special squad for collection of donkey / mule excreta from areas of pilgrim activity need to be enforced. Specially marked / coloured sacks may be provided to waste collectors and / or donkey operators to collect these. The excreta may be used as manure. Incentives to those who collect and deposit this waste at pre-fixed area may be thought of. This may be also used instead of cow-dung in composting unit. Special equipments like blunt broom and spatula may be provided to the mule waste collectors as the mule excreta is usually seen spread on the ground due to trampling.
- It should be remembered that, as is done with many tourist areas in eco-sensitive zones, it may not be possible to ask the visitors to carry the waste considering the holy Irumudi which the pilgrims would be carrying. In addition, the crowd being heterogeneous, it would be almost impossible to enforce such systems. It is also not possible here to enforce a system with no bins, due to lack of facilities to transport the bulky waste which would get accumulated during crowded days. Hence, a preferable system would be the one with separate bins for segregated storing of organic and inorganic waste.
- The cardinal rule of SWM is “no waste on ground”. Though closed bins would be much desired considering that the area is in a wildlife habitat, it would be illogical to think that people would try to open bins and deposit waste in them. It is an observed and recorded fact that in an area with much heterogeneity as in Sabarimala and associated areas, no body would bother to do these. This may be tried out in the long run once the pilgrims imbibe the idea of environmental protection being part of the pilgrimage and make it practical. As is seen all around, current practice is to deposit “waste on ground”, which is easier for animals to feed on. Placement of bins and training and awareness building exercises would lead a long way in upgrading this situation to a “waste in bin” concept.

2.3.3 Land Requirement for Upgrading SWM Services at Pampa, Sannidhanam and Nilakkal

The land area requirements for the proposed interventions have been detailed out during the development of Outline of Master Plan. This has covered requirements for:

- Secondary storage and service facility – In order to have smooth SWM operations, separate service roads and bays have to be developed separating the secondary collection, transportation activities from the main pilgrim routes.

- Re-planning of the treatment and disposal area to accommodate: (a) separate loading and unloading area; (b) sorting area to sort recyclable materials; (c) temporary storage area to store the recyclable materials, including a loading bay; (d) composting pits, (d) mechanical loading facilities for incinerator; (e) secured land fill area for disposal of incinerator ash [6], and clinical waste, (f) workers restroom and toilet facilities, and (f) designated areas for parking of SWM vehicles.
- Decongesting of Pampa and Sannidhanam by curbing non-essential activities is being one of the key recommendations of the Master Plan and hence no additional land requirement is envisaged for the medium term and long term activities. However, the long term proposals will have to be reviewed at a later stage taking into account, the actual developments, waste quantities, technology development etc.

[6] Ash should be disposed off safely, keeping in mind the possible feeding by elephants and other animals. Preferably, this should be provided at Nilakkal, but infallible transportation of ash would be difficult. However, the landfill should be as a lined deep burial pit, which would be inaccessible for animals to burrow.

3. WATER SUPPLY

3.1 Water Supply at Sabarimala

One of the most sought out facilities at Sabarimala is water: both for drinking as well as cleaning / washing purposes. Water supplied here could be graded as deficient both in terms of quantity and quality and there exist evident disparity in terms of demand and supply.

3.1.1 Existing System

3.1.1.1 Supply Mechanism

The present water supply scheme for Pampa and Sannidhanam was commissioned in the year 1984 and subsequently augmented. The water sourced from Thriveni in Pampa is treated and distributed for use. There are two separate water treatment plants of 6 MLD and 5 MLD capacities installed by Kerala Water Authority at Pampa. Thus the total treatment capacity at Pampa is for 11 MLD of water. However, requirement at Pampa is only 4.5 MLD and hence the water for use in Pampa is supplied by the 5MLD plant. The remaining treated water (from the 6 MLD plant) is available for serving the trekking route and Sannidhanam. The water is treated using pressure filters followed by disinfection with chlorine prior to distribution. A four-stage pumping system is used to supply water from Pampa to Sannidhanam and other areas around. The water supplied is being disinfected with gaseous chlorine at Pampa, Neelimala and Sharamkuthy to ensure water free from harmful effects of bacteria.

The water supply at Pampa, Neelimala Bottom, Neelimala top, Appachimedu, Sharamkuthy, Marakkoottam, Edathavalam at Chalakkayam, Nilakkal and Plappally areas are maintained by Kerala Water authority. Besides this, Kerala Water Authority is supplying the required quantity of water to Sannidhanam, Pandithavalam and Malikappuram areas but distribution in these areas are maintained by Travancore Devaswom Board. Kerala Water authority is supplying water through pipes in all places except Chalakkayam, Nilakkal and Plappally areas where it is conveyed by tankers from existing source of Pampa.

The TDB operates a 1 MLD scheme at Sannidhanam sourcing water from Kunnar. The water is sourced from Kunnar dam, located approximately 7 km away from Sannidhanam. Kunnar is mainly rain fed and hence faces water shortage during lean period. The water from Kunnar is taken to the sumps located at Pandithavalam by gravitational flow and stored here. Current storage capacity at Sannidhanam is for 4.50 MLD of water. Based on the information collected from the TDB officials, a 2 MLD pressure filter unit was handed over to TDB by Kerala Water Authority (KWA) for treating the water sourced from the Kunnar, prior to supply at Sannidhanam. However, this unit is not currently being used. The water is supplied under gravity after disinfection and no additional pre-treatment is given before distribution. Piped network for distribution of water exists to supply water to toilets, bathroom and hotels. Table 13 outlines the existing water supply system at Sabarimala.

Table 13: Water Supply Arrangements at Pampa and Sannidhanam

Item	*Capacity*
Treatment system	
Pressure filter - 2nos at Pampa	6 MLD and 5 MLD
Pressure filter - 1 no at Sannidhanam (not Operational)	2 MLD
Storage facilities	**Capacity in litres**
Reservoir at Pampa	2,75,000
Sump at Neelimala bottom (Pump house –2)	2,00,000
Sump at Neelimala top (Pump house –3)	2,00,000
Sump at Appachimedu (Pump house –4)	2,00,000
Reservoir at Sharamkuthy	6,00,000
Reservoir at Pandithavalam	11,5,000
Reservoir at Malikappuram	1,12,000
Sub-Total	**17,02,000**
Sumps at Pandithavalam	**35,95,000**

Source: KWA and TDB

3.1.1.2 Source Reliability

a) River Pampa

i. Reliability in terms of Quantity of Water Available

Main source of piped water supply for Pampa and Sannidhanam is the River Pampa. Water is sourced from Thriveni, upstream of the Pampa Manalppuram. Study and analysis was carried out to understand the reliability of flow in Pampa (based on the rainfall data of the catchment area from 1992 to 2001), the results of which are presented in Table 13 and Figure 2.

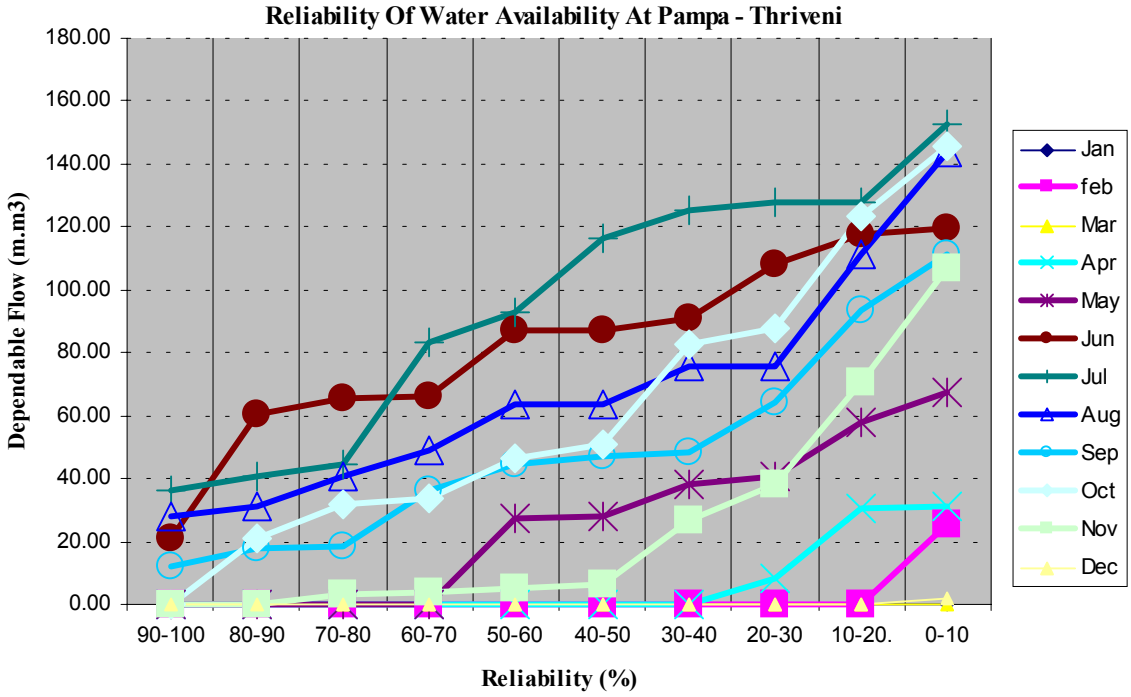


Figure 2 : Source Reliability in terms of Water Quantity: River Pampa at Thriveni

The study reveals that during the initial period of the peak pilgrim season, that is October and November months, required flow is available at 75 percent reliability. It is observed that during the peak period of the peak season (December and January) the flow is substantially low and reliability of flow is negligible.

Table 14 : Source Reliability in terms of Water Quantity: River Pampa at Thriveni

Reliability (percent)	***Dependable Flow in M.m^3***											
	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
90-100	0.00	0.00	0.00	0.00	0.00	20.80	36.50	27.80	12.20	0.00	0.00	0.00
80-90	0.00	0.00	0.00	0.00	0.00	60.20	40.70	31.30	17.60	20.70	0.00	0.00
70-80	0.00	0.00	0.00	0.00	0.00	65.30	44.50	40.70	18.70	31.60	3.20	0.00
60-70	0.00	0.00	0.00	0.00	0.00	66.00	83.40	48.90	36.10	33.70	3.60	0.00
50-60	0.00	0.00	0.00	0.00	27.50	87.30	93.10	63.90	44.50	46.70	5.40	0.00
40-50	0.00	0.00	0.00	0.00	28.30	87.30	116.30	63.90	47.30	51.10	6.60	0.00
30-40	0.00	0.00	0.00	0.00	38.20	90.80	125.60	75.70	48.40	82.40	26.40	0.00
20-30	0.00	0.00	0.00	8.20	40.80	108.30	127.60	75.90	64.10	87.70	38.10	0.00
10-20.	0.00	0.00	0.00	30.50	57.80	117.90	128.10	111.10	93.50	123.30	70.30	0.00
0-10	0.00	25.50	0.00	31.00	67.70	119.60	152.60	143.50	111.60	145.60	106.60	1.80

Source: Analysis

The River Pampa, with a length of 176 km is the third longest river in Kerala with total estimated annual discharge of 4641 Mm^3 and utilizable yield of 3164Mm^3. The river which starts from Idukki district and has a basin spread of 2235 KM^2 run through Idukki, Kottayam, Pathanamthitta, Alappuzha and finally empty into the Vembanad Lake Ecosystem at Kuttanad Wetlands. Upper third of the river has higher slopes which results in easier evacuation of waters to the lowly areas with less slope or the plains spread along its lower two-third reach.

The river water is used for irrigation of around 62000 ha of land and supply of water to 18.62 lakhs of people. Details of drinking water schemes in River Pampa are presented below **(Table 15)**:

Table 15: List of Water Supply Schemes Sourcing from River Pampa

S. No:	***Water Supply Schemes***	***Populated intended to be served(in Lakhs)***	***Capacity of the Scheme (in MLD)***
A	*Commissioned Schemes*		
1	Sabarimala Water Supply Scheme (at Pampa)	2.00	7.70
2	Vechuchira Rural Water Supply Scheme (RWSS)	0.50	2.50
3	Chittar RWSS	0.24	1.20
4	Ranni – Perunad RWSS	0.50	1.50
5	Adichipuzha RWSS	0.20	1.00
6	Vadasserikkara RWSS	0.20	1.00
7	Ranni – Thottamon RWSS	0.10	0.50
8	Ranni – Angadi RWSS	0.40	2.20
9	Ayiroor RWSS	0.40	2.00
10	Thottapuzhasseri RWSS	0.50	2.50
11	Kozhenchery RWSS	0.30	1.50
12	Mallapuzhasseri RWSS	0.20	1.00

S. No:	*Water Supply Schemes*	*Populated intended to be served(in Lakhs)*	*Capacity of the Scheme (in MLD)*
13	Aranmula RWSS	0.30	1.50
14	Chengannur RWSS	0.50	2.50
15	Augmentation of Chengannur Water Supply Scheme (WSS)	0.60	3.00
16	Cherukole – Naranganam RWSS	0.60	3.00
17	Thiruvanvandoor WSS	0.10	1.00
18	Augmentation of WSS to Thiruvalla and Changanassery WSS	1.22	25.00
19	Ranni – Iythala WSS	0.30	1.50
	Total	*9.16*	*62.1*
B	*Schemes in various completion stages*		
1	WSS to Alappuzha and 8 adjoining Panchayats	4.37	80.00
2	WSS to Panchayats in Kuttanad region	3.52	18.00
3	WSS to Ranni – Pazhavangadi and Vadasserikkara Village	1.60	8.00
	Total	*9.49*	*106*
	Grand Total	***18.65***	***168.1***

Source: Kerala Water Authority (Nov 2005)

The Sabarigiri Hydro Electric Project situated at its upper reaches is the third largest hydro-electric project in Kerala. Around 230 MW of electricity is generated here using two storage dams – one in Pampa and other in Kakkiyar, its tributary. Proposed hydroelectric projects include Sabarigiri Augmentation scheme, Swami Saranam scheme, Kakkad Hydro-electric project, Urumpani Hydel project and Azhutha Pampa Hydroelectric scheme.

The river is fed by rainfall, around 65 percent of which is contributed by the South West monsoon (June to August annually) around 25 percent by the north-east monsoon (September to November) and remaining by summer rains. At Sabarimala, the water flow at Pampa is comparatively less during the season, though the rainfall is gauged higher in the region. Structures to hold water upstream when there is flow (during rains) and to slowly release during summers is less in the upper reaches, not only in the case of River Pampa, but also in all main rivers of Kerala. Three major dams constructed by the Kerala State Electricity Board (KSEB) as part of Sabarigiri hydroelectric project at Pampa, Kakki and Anathode, besides four small dams on its tributaries, Kullar, Gaviyar, Meenar-I and Meenar-II, as part of the Sabarigiri augmentation scheme in the upstream reaches of the river, have restricted the normal flow of the Pampa. The lean flow in the river had affected the flushing out of filth from the bathing ghats along the Pampa Manalppuram during the peak pilgrim season.

National Water Development Agency had prepared a feasibility report for the Pampa Achenkoil Vaipar Link Project on the basis of water balance study conducted in the 1980s for diverting 634 $M.m^3$ of surplus water to deficit Vaipar basin of Tamilnadu. The study conducted by CWRDM shows a deficit of 3537 $M.m^3$ of water in Pampa-Achenkoil Rivers by 2051 which makes the transfer unfeasible.

ii. Reliability in terms of Quality of Water Available

The water quality in River Pampa is highly deteriorated owing to the feacal discharge which is mainly the result of religious congregations such as Sabarimala pilgrimage at its sand bed on the upper reaches during November to January each year and Maramon and Cherukolpuzha conventions in the sand beds in its mid-reaches during February, each year. The water quality is recorded the worst from November to January annually. The River Pampa gets extremely polluted during these festival seasons as the huge mass of pilgrims, who converge at Pampa, use the river for bathing purposes after easing themselves in the vicinity of the river. The same water which gets polluted with human excreta and other filth due to mass defecation of pilgrims in and around the river is said to be used for cooking and other purposes here. Water quality of the River at its various points is presented below **(Table 16)**

Table 16 : Water Quality of River Pampa at Various points

Location	***BOD (mg/l)***		***Faecal Coliforms (per 100ml)***	
	(High values observed)	*(Low values observed)*	*(High values Observed)*	*Low Values observed*
Azhutha	2.5	1.2	17100	11700
Njonangar	16.5	2.5	210000	62500
Pampa	19.2	1.3	205400	71500
Vadasserikkara	11.5	8.8	23800	22100
Ranni (upstream)	10.9	8.8	22400	19800
Ranni (down stream)	13.8	11.7	32400	22500
Chengannur (upstream)	3.2	1.6	24500	23100
Chengannur (down stream)	3.8	3.1	82800	73400
Edathuva	58.1	49.9	54400	41400

Source: Kerala Water Authority (Nov 2005)

Increased incidences of water borne diseases such as Gastro-enteritis, Cholera, Jaundice etc and other diseases such as Malaria, Wheels disease, Leptospirosis and Dengue Fever are observed among the people in Pampa basin.

The geographical disposition of Kerala, with a steep East – West natural gradient from the point of origin to the final emptying point warrants that the waste reaches the Ramsar site, the Vembanad Lake quickly. However, from mid December to mid March, the Thanneermukkom Barrier across the lake remains closed as a win – win solution to the agriculture *versus* fisheries debate in the Kuttanad (where, most of the area is mostly 1 to 2 m below the MSL) which further prevents the waste from being washed off ultimately into the sea. Instead, it accumulates at the Lake and harness many communicable diseases. A look at the coliform content of the river water at Pampa before and during the season is indicative of the pollution levels. Increase in the number of cases of communicable diseases immediately following the peak pilgrim season proves the case. The medical practitioners downstream refer to this situation as the 'Sabarimala Fever'.

The following figures describe the levels of BOD and feacal coliforms at various points along the course of River Pampa.

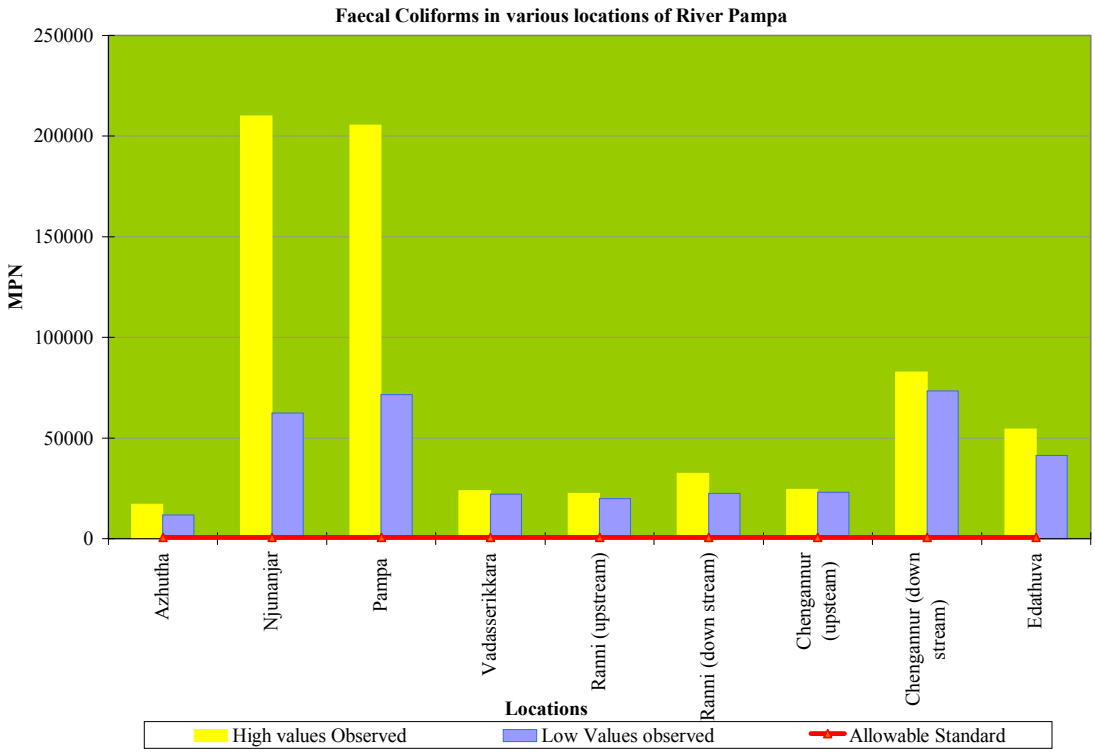


Figure 3 : Comparison of Coliform Levels in River Pampa with Allowable Standards

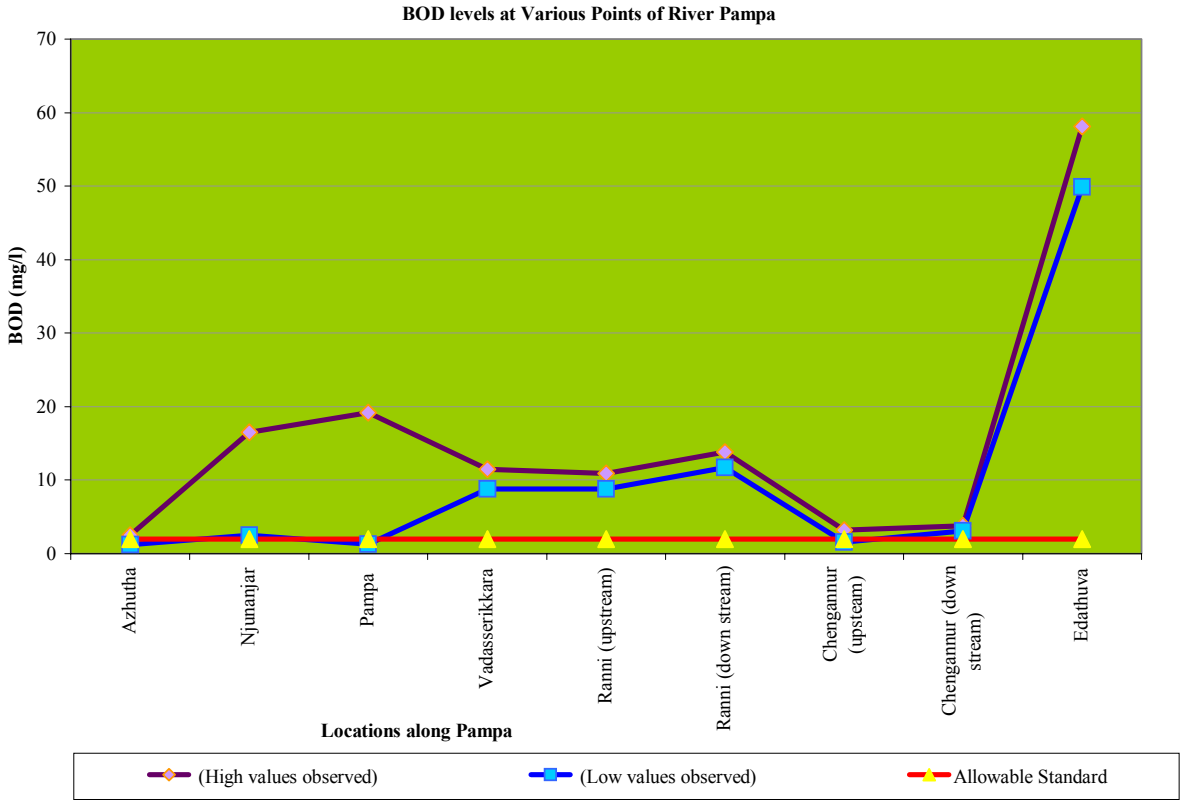


Figure 4: Comparison of BOD levels in River Pampa with Allowable Standards

b) Other rivulets and streams

Other main streams at Sabarimala include Njonangar which flows to Pampa, the Urakkuzhi Theertham which is located near Pandithavalam at Sannidhanam, Kumbalamthodu and Kakkathodu. Pilgrims use Urakkuzhi extensively for bathing purposes.

Chenthamarakokka or *"the gorge with blossomed lotus"* is at a higher elevation than Sannidhanam and is an eco-tourism destination gaining much fame for its pristinity. This is the nearest area to Sannidhanam where the natural gorge can be utilised with modifications to store huge quantity of water.

Kallar River that flows through the forests about 1.75 km from the Sabarimala Sannidhanam carries sufficient water in its upper reaches. It may be possible to channelise the water in Kallar to the Sannidhanam, Marakkoottam and Pampa by gravitational flow.

c) Ground Water

Wells and Bhasmakulam are the main ground water sources at Sannidhanam. Reliable literature and age-old pilgrims testifies that over the years most of the ponds / tanks which existed at Sannidhanam were closed and the space was used for building purposes. *In addition to Bhasmakulam and Valiakulam there is another pond towards the north of Bhasmakulam near the street. This is used as 'Paathrakulam' (pond for washing utensils)'....*[7]. It is also known that the location of the sacred Bhasmakulam[8] itself was changed for construction purposes years ago. Currently, water from these tanks is used mainly for religious purposes and even by the pilgrims for bathing.

3.1.2 Water Supply Characteristics

3.1.2.1 Quantity of Water Supplied

Quantity of water supplied at Pampa for various uses is 5 MLD and the requirement at Pampa also works out to be the same. The water supplied at Sannidhanam and the trek route from Pampa to Sannidhanam is 6 MLD treated and disinfected water supplied from Pampa and 1 MLD disinfected water from Kunnar, supplied to (Sannidhanam). However, the pilgrims suffer from lack of access to water for drinking and sanitation purposes. During the peak season, the pilgrims have to stand in the queue from Marakkoottam to Sannidhanam *"…….for 12 to 18 hours in the hot sun without any toilet facility, water or food or any protective roof*". [9]

Volunteer groups like Akhila Bharatha Ayyappa Seva Sangham (ABASS) supplies hot water / medicated water to the pilgrims mainly at stalls set up in specifically allotted points at Sannidhanam and along the trek route from Pampa to Sannidhanam. TDB also operates few counters to supply hot / medicated water. However, the supply is limited and the pilgrims waiting in the queue for darshan could seldom access this facility as they are mainly unwilling to lose the priority in the queue during the wait by moving out to fetch

[7] Narayana Pillai, Kurumalloor (Vidwan) (2004 reprint), "**Sri Bhoothanaathasarvaswom**" Devi book stall, Kodungalloor

[8] Bhasmakulam is as per legends the place where legendary saint Sabari attained moksha by reducing into ashes

[9] Public Accounts Committee (PAC) (2005), "**Eighteenth Report – PAC (2005-2006) Pilgrimage to Sabarimala: Human Problems and Ecology**", (14th) Lok Sabha Secretariat, New Delhi. pp 4

water. Volunteers are now being engaged to supply water to waiting pilgrims during peak days, though the coverage is less.

Due to non-availability / lack of access to water, pilgrims usually carry mineral water bottles or buy them from the numerous shops at Pampa, Sannidhanam or the trek routes.

3.1.2.2 Quality of Piped Water

Congregation of very large number of people in a limited area at Pampa for a limited period exerts enormous pressure on the environment especially the River. All pilgrims are customarily used to have a dip in this holy river. The pilgrims use the river for all their requirements and river banks for open defecation. The large number of hotels and shops during the season discharge huge volume of both liquid and solid wastes into the river directly or indirectly contributing significantly to the pollution load of the river. All these pollute the river beyond limits, affecting the health of not only the pilgrims but also the settlements along the banks of the river downstream. This is a crucial issue to be addressed in the Master Plan by proposing curbing of unwanted activities, provision of proper sanitation, sewerage facilities and segregated storm water drains.

The existing water supply scheme at Pampa is maintained by drawing water from river Pampa, then filtered through pressure filters and distributed after super chlorination. There is no proper treatment plant for the scheme. During peak days river will be highly polluted and water is distributed with high residual chlorine content in order to make the water potable. Similar is the case of water supply to Sannidhanam with water from Kunnar as source. Due to increase in number of pilgrims year by year and due to occasional high turbidity and contamination of river water, proper treatment is to be arranged.

Results of primary analysis of piped water samples collected during the peak pilgrim season 2005-06 are presented in the following **Table 17**. Pipe water samples both at Pampa and Sannidhanam indicates good quality, safe for drinking. In all pipe water samples the traces of chlorine was found, such residual amount ensuring the quality of the water.

Table 17 : Quality Analysis of Drinking / Piped Water Supplied at Sabarimala (2005-06)

Parameters	***Units***	***Permissible limits***	***Test results***		
			Piped water at Pampa	***Raw water at Thriveni***	***Raw water at Njonangar***
pH	Unit	6.5-8.5	5.7	5.7	6.3
DO	mg/l	>6	8.6	6.9	7.1
BOD	mg/l	<2			
COD(waste water)	mg/l	600-900			
Chlorides	mg/l	250	Trace	Trace	Trace
Total hardness	mg/l	300			
MPN	MPN / 100 ml	Not more than 2.2 MPN /100 ml	---------	>460/100ml	>460/100ml
E. coli	Count/ 100ml	0	Absent	Present	Present

Source: Primary Survey, 2005-06 (peak pilgrim season)

3.1.2.3 Water for other purposes

As discussed earlier, main water body used for other purposes at Sannidhanam per se is Bhasmakulam. Currently, water is circulated to Bhasmakulam and back from an existing well connected by a pipe. Aeration through a cascading foundation is provided. However, the quality of water in Bhasmakulam is extremely poor. On visual examination, soap and dirt could be seen floating around. Suspended solids are high mainly due to overflow from nearby septic tanks during peak days.

Water quality tests conducted during the last pilgrim season (November 2005 to January 2006) at Bhasmakulam and the results are presented in **Table 18**.

Table 18 : Water Quality of Bhasmakulam 2005-2006

Parameters	***Optimal Ranges***	***Sample taken from Bhasmakulam on 05Jan 2006 (mid season)***	***Sample taken from Bhasmakulam on 16 Jan 2006 (after peak season)***
Colour	Colourless	Colourless	Colourless
Odour	Odourless	Odourless	Odourless
pH	6.5 to 8.5	5.7	5.8
Dissolved oxygen	>_6mg/l	0.9	1.2
COD (mg/l)		2.2	340.0
BOD (mg/l)	<_2mg/l	Trace	150.0
Acidity (mg/l)		1.2	0.5
Alkalinity (mg/l)		55.7	173.4
Chloride (as Cl)		Trace	102.0
Coli form		Present	Present
E.Coli		Present	Present
MPN Count (/100 ml)	MPN <500 per 100ml	1100/100ml	1460/100ml

Source: Primary Survey and Laboratory Tests, 2005-06

Colour of the water in the water bodies is an indicator of its quality / potability / usability. On careful visual observation, the water at Kumbalamthodu, Kakkathodu and Bhasmakulam appears yellow, indicating the exposure to pollution due to sewage / waste water emanating from various landuses and overflowing sewage tanks.

Main source of water for bathing and all general purposes at Pampa area, Cheriyanavattom and Valiyanavattom (main transit camp in the trek route from Erumely to Pampa) is the River Pampa.

The solid and liquid wastes which include human excreta and other degradable wastes like food wastes, leaves etc., and also the non-degradable wastes like plastic, bottle, metal cans etc; ultimately reaches the River Pampa, thereby leading to high level of water pollution. The pollution of water ultimately affects the quality of drinking water. At present there is no facility for purification and treatment of drinking water supplied to the pilgrims at Sannidhanam.

A primary survey was undertaken to examine the quality of water during mid and peak seasons. The results of the analysis of the samples collected are presented in the table below (Table 19).

Table 19: Water Quality in River Pampa

Parameters	*Optimal Ranges*	*Thriveni (Mid Season#)*	*Thriveni (after peak season*)*	*Cheriyanavattom (Mid Season#)*	*Cheriyanavattom (after peak season*)*	*Njonangar (after peak season*)*
Colour	Colourless	Colourless	Colourless	Colourless	Colourless	Colourless
Odour	Odourless	Odourless	Odourless	Odourless	Odourless	Odourless
pH	6.5 to 8.5	5.7	5.7	6.3	6.3	6.3
Dissolved oxygen	>_6mg/l	6.9	6.2	7.1	6.2	6.0
COD (mg/l)		2.2	4.0	0.6	10.8	8.0
BOD (mg/l)	<_2mg/l	Trace	2.4	Trace	9.4	2.8
Acidity (mg/l)		1.5	0.5	1.0	0.7	0.5
Alkalinity(mg/l)		13.4	16.8	11.6	22.3	18.6
Chloride (as Cl)		Trace	13.7	Trace	16.8	15.8
Coli form		Present	Present	Present	Present	Present
E.Coli		Present	Present	Present	Present	Present
MPN Count (/100 ml)	MPN <500 per 100ml	>460/100ml	>150/100ml	>460/100ml	>1100/100ml	>1460

Note: # Sample collected 31 January 2005
** Sample collected on 16 January 2006*
Source: Primary Survey, (2005-06 pilgrim season)

There are no point pollution loads like sewer or drain directly reaching Pampa. However, bathing areas such as Kakki Ar near parking area at Thriveni, upstream of Thriveni bridge, Nadappalam, Arattukadavu can be considered as areas of accumulated waste were coliforms are generated within the system by bathing of pilgrims at Sabarimala.

Physical analysis of water samples suggests that lower pH of water in Thriveni area of the River Pampa indicates acidic nature owing to discharge of waste water. Water was highly turbid in Njonangar during mid and after peak season, indicating the presence of faecal matter.

Water samples were subjected to chemical analysis for the parameters such as Chloride, Dissolved Oxygen (DO), Chemical Oxygen Demand (COD) and Biological Oxygen Demand (BOD). Chloride concentration during mid season was only in traces at Thriveni and Cheriyanavattom, whereas it was found to be more after peak season indicating contamination due to sewage / effluents. DO levels were well within permissible limits. However, BOD values show variation during mid and after peak season. This indicates increased accumulation of oxygen demanding wastes after the peak season. BOD and COD are higher in Pampa near Cheriyanavattom area after peak season.

The Most Probable Number (MPN) gives an index value for estimate of mean densities of coliforms in the samples. It has been noted that the values for Pampa near Cheriyanavattom are much higher than the permissible limits after the peak season even when compared to mid season. It is obvious that water quality at Pampa is especially poor, after the Makaravilakku season. This could be attributed to waste directly thrown into the river (after Pampa Sadya, Pampadanam, waste from hotels etc), waste water and sewage (from open defecation, direct waste water outflow into the river from septic tanks,

hotels etc). Flow is hampered not only by the check dam regulator upstream, but also slackened by the increasing number of cloths thrown into the river by the pilgrims after bathe. As presented in the test results, the pollution level at Pampa increases as the season progresses. Samples taken from Thriveni, Cheriyanavattom and Njonangar indicate that the coliform content is in critical levels which may warn of a potential health disaster.

Main visually observable foreign bodies in River Pampa at Thriveni and Cheriyanavattom stretch include cloths, plastic carry bags, bottles and lids, food waste, floating soap and oil etc.

It is observed that pilgrims use plastic mineral water bottles as floats for floating the decorated temple models in which the 'vilakku' (lighted lamps) is lit during 'Pampa vilakku', a ritual performed at Pampa. These settle ultimately along the banks, downstream, spilling oil and leaving the bottles along the river edges. In contrast to the earlier times when pilgrim visitations were low, now the intensity of such usages and waste deposits is higher. After the season, multi-varieties of flies harbour all along Pampa and downstream where such wastes get deposited. While bathing, the pilgrims also leave aside their cloths at Pampa River, which clogs up the River which is already shallow. TDB tenders out the collection of these cloths from the River to contractors who mostly recycles the same. In addition, pilgrims throw soiled banana leaves into the river in huge quantities after the Pampasadya. These get washed away down the river. Pampa is the ultimate reservoir where all different types of wastes emanating due to various activities are collected.

Three major dams constructed by the Kerala State Electricity Board (KSEB) as part of Sabarigiri hydroelectric project at Pampa, Kakki and Anathode, besides four small dams on its tributaries, Kullar, Gaviyar, Meenar-I and Meenar-II, as part of the Sabarigiri augmentation scheme in the upstream reaches of the river, have restricted the normal flow of the Pampa. The lean flow in the river has affected the flushing out of filth from the bathing ghats along the Pampa Manalppuram during the peak pilgrim season. It has been reported that the water flow decreases to around 1 to 1.6cu.m/sec during peak season. The two vented cross-bars constructed by the Water Resources Department at Pampa and Sreeramapadam are found to be of less help in flushing out the wastes from the bathing ghats during the peak pilgrim season.

A simulation of flow requirements needed for dilution of coliforms to the stipulated standards by using Enhanced Stream Water Quality Model QUAL 2E[10] by National Energy Engineering Research Institute (NEERI)[11] shows that around 35 cusecs of water is required to be released to flush out all the pollutants from Pampa during the peak days of the peak pilgrim season.

3.1.3 Pilgrims Demands and Preferences

Results of the pilgrim perception survey to understand the demands and preferences of the pilgrims reveal that the pilgrims accord highest priority to the availability of safe drinking

[10] A steady state model for conventional pollutants
[11] NEERI (2002), **Carrying Capacity Based Development Planning for Greater Cochin Region** Vol 2, MoEF

water and access to water at Sabarimala. Access to water during the long wait for darshan seemed to be the most important requirement of the pilgrims.

Most of the pilgrims prefer bathing in River Pampa, Urakkuzhi Theertham or a dip in the Bhasmakulam. Pilgrims generally views ponds / tanks / hand pump or common bathing arrangement as a possible solution in this religious precinct.

3.1.4 Issues and Constraints

a) River Pampa gets highly polluted during the peak pilgrim season as the pilgrims resort to open defecation. Effective measures have to be undertaken to prevent such pollution to safeguard the health of the pilgrims.
b) The present location of intake at Thriveni is highly polluted on account of open defecation by pilgrims.
c) There exists water shortage at River Pampa before the end of festival season especially during December and January and Vishu Season. Study on reliability of flow in Pampa (based on the rainfall data of the catchment area from 1992 to 2001) reveals that during October and November, required flow is available at 75 percent reliability. However, during peak pilgrim days (December and January) the flow is substantially low and reliability is negligible.
d) Shortfall in the release of water by KSEB in the upstream reaches of the river results in low water flow at Thriveni. Because of the low flow, the full capacity of the pressure filters could not be used. Also this lean flow affects the flushing of filth in the bathing ghats.
e) The four-stage pumping to supply of water to Sannidhanam is power intensive and failure-prone during electricity failures resulting in reduced dependability of the water supply to Sannidhanam.
f) Bathing facilities are not sufficient in quantity or quality.
g) Deteriorated quality of water at Bhasmakulam is a concern.
h) Source of water at Kunnar is not dependable during peak pilgrim seasons due to shortage of water, especially if the rainfall is low.
i) Water Quality at Pampa and the all the streams reaching it has been deteriorated owing to the Solid waste and liquid waste reaching them. Uncontrolled access to river and streams and lack of basic facilities are the aspects promoting the same.

3.1.5 Projected Demand and Quality Requirements

Examining the extent of water use, the average per capita consumption is estimated as 40 liters. Among pilgrims those who stay at accommodation centers with attached toilet facilities use more water, while those who do not stay overnight use lesser quantity. Besides the seasonal variations in water demand during peak, lean and off peak pilgrim season, there is a large variation within the peak season demand, especially, the during the Makaravilakku and Mandalapooja days. Maximum demand is reached only during the peak day of Makaravilakku / Mandalapooja period.

The total demand is estimated based on the maximum number of pilgrims who can have *darshan* at Sannidhanam on a day. To this pilgrim population, population of the service personnel are included while working out the requirements in addition to the Fire and commercial demands. Currently however, the demand thus worked out seems to be on a

higher side as maximum darshan capacity is not utilised for around 85percent of the days. Thus it is clear that the demand worked out here is for maximum requirement which may arise at Pampa, trek routes and Sannidhanam if the maximum darshan capacity is utilised on all days of the year. But it is equally important to plan and provide for this - ever maximum requirement - today, as during few days of the year this demand is reached at Sannidhanam and our aim is to provide fully for the demand which may arise. Since water can be stored and reused, this provision of capacity would always be beneficial to pilgrims.

3.1.5.1 Demand Estimation: Water Requirement at Pampa

Population which would arrive at Pampa, Valiyanavattom and Cheriyanavattom are considered here.

Population

1	Pilgrims from Nilakkal (Out of this 50 percent of the pilgrims is expected to move on to Sannidhanam directly and the remaining 50percent is expected to stay for a few hours at Pampa)	100,000
2	Pilgrim from Erumely (They are expected to remain at Pampa for a few hours)	24,000
3	Permanent additional staff during season, staff of shops/Commercial, establishments, service personnel etc.	2,500
	Total population	1,26,500

Water Demand

1	50percent of pilgrim from Nilakkal @ 10 lpc; 50,000 x 10 lit	5,00,000
2	Balance + 50 percent of pilgrims from Nilakkal @ 20 lpcd 50,000 x 20	10,00,000
3	Pilgrims from Erumely	
	Pilgrims reaching Pampa 40percent @ 20 lpcd 24000 x 0.4 x 20	1,92,000
	Balance 60percent staying at Valiyanavattom 24000 x 0.6 x 40	5,76,000
4	Permanent staff and residents 2500 x 110	2,75,000
5	Food preparation and servicing needs(for short stay pilgrimage and permanent staff) 126500 – (50000 + 9100) = 66900 = (x 15)	10,11,000
6	Fire demand @ 1lt/head (Considering the proximity of the river and easiness in water availability) (1,26,500 x 1)lt	1,26,500
	Total	36,80,500
	Add for loss @ 10 percent	3,68,050
	Grand Total	40,48,550
		Say 4.50 MLD.

As of date, the total treated water quantity aimed only for Pampa is 5 MLD. Thus it could be inferred that sufficient water would be available for use at Pampa even in the existing situation. When Nilakkal is developed as a base camp and the pilgrim movement is streamlined, the requirement of toilet and bathing facility at Pampa would get further reduced.

3.1.5.2 Demand Estimation: Water Requirement at Sannidhanam and Trek Route from Pampa to Sannidhanam (including proposed Queue Complex)

Population

1.	Maximum Pilgrims who would be trekking from Pampa	1,24,000	
2	Pilgrims trekking for Uppupara	7,500	
3	Other population		
	Government staff	3,000	5300 say 6000
	Private shop workers , vendors etc	1,600	
	Helper, additional service staff etc	550	
	Transport staff	150	
	Total population	**1,37,500**	

Water demand

1	Maximum Pilgrims who would be trekking from Pampa	
A	Pilgrims staying less than 6 hours at Sannidhanam – 56,000 (on observation) @ 20 lpcd – 56000 x 20	1,120,000
b	Pilgrims staying between 6 to 12 hrs -68,000 @ 40 lpcd 68000 x 40 (through proposed Queue Complex)	2,720,000
2	Pilgrim trekking from Uppupara7500 @ 40 lpcd : 7500 x 40 (through proposed Q Complex)	3,00,000
3	Permanent staff – 6000 @ 110 lpcd = 6000 x 110	6,60,000
4	Food preparation and servicing needs 68000 + 7500 + 6000 = 81500 @ 15 Litres. – 81500 x 15	12,22,500
5	Fire demand (100 √137500 / 1000) =1173 m^3	1,173,000
6	Water demand to trekking route @ 10 lpcd 124000 x 10	1,240,000
	Total	84,35,500
	Losses @ 10 percent	8,43,550
	Grand Total (litres)	92,79,050
		Say 9.5 MLD

3.1.6 Proposed Improvements to Water Supply Arrangements at Sabarimala

3.1.6.1 Proposed Projects at Pampa

a) Improving the flow at River Pampa

The water policies of both Government of India and Government of Kerala grant first priority for drinking water needs over any other need including power generation. Hence it should be ensured that K.S.E.B. releases enough water through the river during the festival seasons. Based on earlier studies a minimum of 5 cum/sec of water is to be maintained at Pampa and Thriveni in addition to carrying out pollution prevention measures. It is to be ensured that this amount of water is released every year promptly on time based on the demand.

In the medium and long-term, it is proposed to have weirs / check dams upstream of Pampa and the Kakki River to capture water during the monsoon that would provide water for the pilgrims in the season. This measure would also support in raising the water table in the area.

In the long-term watershed management in the upper reaches of River Pampa would provide beneficial results in recharging the river and improving the water flow.

b) Improving the Facilities to flush out pollution in River Pampa

As proposed in Pampa Action Plan, storage weirs and allied works (one each) may be provided for flushing pollutants in Pampa River and Kakki River in the immediate term.

c) Improving Facilities to prevent entry of Pollutants to River Pampa

Proposal for interception barriers for preventing sewage from Kakka Thodu and Urakkuzhi Theertham reaching Pampa River has been suggested in Pampa Action Plan. It is observed that the flow in these is very low during the season, except for rainy days. Rather than attempting to arrest this source of pollution from Sannidhanam after it has flown all the way to Pampa, it would be preferable to control the pollution in the water reaching these streams from Sannidhanam area itself. Hence suitable treatment of sullage and sewage at Sannidhanam need to be enforced and the treated water which may reach these streams should meet the standards prescribed by the monitoring authority.

Construction of a weir downstream of bathing ghat at Arattukadavu would prevent pollutants of Njonangar River from entering the bathing ghat at Pampa in the area under use by TDB.

d) Bathing Facilities

Bathing facilities in the form of bathing ghats are provided in Pampa River. It is proposed to improve the bathing ghats as proposed in Pampa Action Plan.

However, few pilgrims may need other means of bathing and hence it is proposed to provide 200 showers for bathing which can cater for a maximum of 25000 pilgrims a day. It is advisable to club toilet, wash and bathing facility in the toilets blocks (300 latrines) proposed at Pampa under Pampa Action Plan.

e) Treatment facility

Currently, proper facilities for treating the water supplied are non-existent. As of date, the existing water supply scheme at Pampa is maintained by drawing water from river Pampa, then filtered through pressure filters and distributed after super chlorination. However, there exists no proper treatment plant for the scheme. During peak days river is highly polluted and water is distributed with high residual chlorine content in order to make the water potable. A treatment plant is proposed at the rear side of TDB Guest house, from which water can be pumped to the existing boosting stations for water supply to Sannidhanam and water can be conveyed by gravity to G L tanks at Pampa for distribution in Pampa area. For constructing the treatment plant, 0.60 ha of land near TDB Guest house would be required.

Detailed engineering report need to be prepared for undertaking these works, which can be entrusted to the Investigation and Planning Division of KWA.

f) Shifting of Water Supply Intake Point

As the water samples from the present source indicated faecal contamination, it is proposed to shift the intake point upstream to a cleaner site inaccessible to pilgrims and general population. It is also important to provide necessary signages, watch and ward to prevent pilgrims from 'unauthorised access' to such areas.

g) Drinking Water Facilities

It is proposed to provide 20 numbers of manned drinking water kiosks with coolers and hot water provision each with ten supply outlets at convenient points at Pampa as an immediate measure. Here compact water purifiers may be used with technologically advanced supply system such as water vending machines after 10 to 15 years from date or as and when the place is ready to adopt such technologies.

h) Distribution System

At present there is an existing piped distribution system. From the system separate lines are to be laid for bathing showers and for drinking water Kiosks. It is proposed that after complete replanning of the area, such pipes be renovated wherever required and laid in specially provided chambered ducts so as to facilitate easy repair and maintenance by minimising inconvenience to the pilgrims.

However, lack of a standby pump is noticeable. Hence, it is suggested that a 200 HP stand by pump be installed to effect uninterrupted supply.

i) Fire fighting arrangements

A dedicated distribution network with pumping systems and fire hydrants is to be provided exclusively for fire fighting. Water demand has been estimated with provision for fire fighting needs as well, sourced from River Pampa. An independent fire station with all facilities is to be provided, preferably near Thriveni (on the banks of the river). From here separate service access may be provided to access the commercial area in Pampa till the beginning of the trek route to Sannidhanam and to Cheriyanavattom area.

j) Improving Water Supply to KSRTC Chalakkayam, Police Control Room and Parking Ground (left Bank of River pampa) and Valiyanavattom area

The water supply at Pampa area is served from GLSR and OHSR of capacity 2 lakhs, 0.75 lakhs and 4.50 lakhs respectively. From the GLSR, water is served to Pampa Manalppuram to the left bank of River Pampa. From OHSR water is served to Devaswom Mess, Temple, Cheriyanavattom, Valiyanavattom and all the fire hydrants. A portion of the distribution line to Valiyanavattom passes through an elevated terrain, the level of which almost coincides with the level of the bottom of OHSR. Hence Valiyanavattom area reports scarce supply. It is proposed to feed Valiyanavattom and KSRTC areas from an OHSR to be constructed. Distribution lines to KSRTC area can be laid through the top of the existing weir at the river crossing.

Detailed engineering report need to be prepared for undertaking these works, which can be entrusted to the Investigation and Planning Division of KWA.

3.1.6.2 Proposed Projects at Sannidhanam

i.) Source development

It is estimated that 9.5 MLD of water is required at Sannidhanam and routes from Pampa to Sannidhanam. Around 6.5 MLD can be sourced from Pampa. This may be used for toilets along the routes from Pampa to Sannidhanam and the queue complexes. Additional requirement at Sannidhanam would be 3 MLD. For this, 1 MLD is sourced from Kunnar and distributed without treatment. Thus in the present condition, additional water required at Sannidhanam would be 2 MLD.

At present the main source of water is River Pampa at Thriveni. To make available the required quantity of water both at Pampa and Sannidhanam and to flush pollutants, 5.0 cu.m/sec of water is to be released by KSEB on demand during the leaner flow times coinciding with the pilgrim season. But pumping water against gravity from Pampa to Sannidhanam is a four stage process which incurs higher electric power requirements and associated costs. Such a system is not reliable as it is dependent fully on electric power and proper working of pumps and therefore it is essential to identify a source at higher level, near Sannidhanam to enable gravity flow both for the requirement at Pampa and Sannidhanam.

Thus it is necessary to explore the possibility of finding and developing alternate dependable sources, based on detailed techno-economic feasibility studies and environmental impact assessments.

ii.) Alternate dependable source

Alternate water flows near Sannidhanam are Kumbalam Thodu, Urakkuzhi and Kunnar, Chenthamarakokka and Kallar.

Water fall / spring at Urakkuzhi is used by the pilgrims for bathing purposes. This can continue for the purpose but with additional caution to the pilgrims regarding waste deposition and use of polluting soaps and detergents. Kunnar dam is above this bathing area. Currently, Kunnar as a source is being utilised for supply of 1 MLD of water to Sannidhanam. However it is rain fed and cannot hold and provide sufficient water in case of lesser rains. Kumbalamthodu which also draws from same source mostly reduces to a waste stream running from Sannidhanam to Pampa during the season.

Pilgrims also bathe in Kallar stream towards the east of Sannidhanam which ultimately joins Pampa. Upon examination it was found that the water in the Kallar can be channelised to the Sannidhanam, Marakkoottam and Pampa by gravitational flow.

It is proposed to close the access to such streams which ultimately reaches Pampa, so as to reduce pollution load from upper reaches which would otherwise have an impact on the quality of water and subsequent treatment needs.

Chenthamarakokka or the gorge with a beautiful water fall is at a higher elevation than Sannidhanam and is an eco-tourism destination gaining much fame for its pristinity. This is the nearest area to Sannidhanam where the natural gorge can be utilised with modifications to store water. In the year 1994-95 the departments of KWA, Forest and KSEB together prepared a project report with the proposal for a weir at Chenthamarakokka. The proposal was for a weir, contour tunnelling and power station to generate power to the order of 3.0 megawatts. The tail race water is proposed to be utilised to meet the water requirement both at Sannidhanam and Pampa. In addition, the tail race water discharging to Pampa was proposed to flush off the filth and debris in the river Pampa during the pilgrim seasons. Details regarding the proposal are provided in Annexure 3. This arrangement was expected to provide sufficient water for use, considerably reduce the pollution of the river and reduce power and cost intensive multi-stage pumping of water from Pampa. It may be worthwhile to examine in detail the water availability and other aspects from the social, economic and environmental point of views. The environmental standing of the place requires careful scrutiny. Hence it is proposed that during the initial phase of implementing this Master Plan (Perspective 2025), detailed feasibility study be conducted to ascertain its reliability and Environmental and Social Impact Assessment Study be conducted as per the MoEF guidelines to finally decide on implementing the scheme.

In a nutshell, the following are proposed:

1. Wider Impounding facility for Kunnar dam to augment supply
2. Exploration of Chenthamarakokka as a possible source for water and power

It is proposed that during the initial phase of implementing this Master Plan (Perspective 2025), detailed feasibility studies be conducted to ascertain the reliability of these sources through reputed specialised agencies and Environmental and Social Impact Assessment Study be conducted as per the MoEF guidelines to finally decide on implementing the most suitable scheme.

iii.) Laying of rider pumping main from Neelimala bottom pump house to Sharamkuthy

The existing 250mm CI pumping main was laid more than two decades back. During festival season pumping is often interrupted due to leakage of pipes, joint failure etc. As the area is undulating and rocky, repair works are time consuming. Also the pipe lines passes through the pilgrim movement ways and forest area and it is difficult to repair the pipes especially during night time. A 300 mm Cl rider pumping main for a length of 3200m is proposed to be laid through the forests.

Detailed engineering report need to be prepared for undertaking this work, which can be entrusted to the Investigation and Planning Division of KWA.

iv.) Proposed Improvement to Bhasmakulam

Main pollutants at Bhasmakulam are oil and soap remnants and other left overs of bathing and ritualistic activities carried out here. For removing oil particles, it is suggested that an oil trap be provided. After passing through the oil trap, the water should be subjected to aeration (fountain / cascade arrangement). Aerated water will go to pressure filter for treatment. Treated water can be recirculated back to Bhasmakulam.

Thus, it is proposed to improve the water quality at Bhasmakulam, by oil trap, aeration, pressure filters and recirculation of water. In addition, proper landscaping may be provided around Bhasmakulam to prevent overflow water from around reaching the pond. Pilgrims should be directed not to use soap or detergents, clean vessels or defecate / urinate here considering its holiness. Watch and ward using volunteers and signages are essential towards this.

v.) Bathing facility

Additional bathing requirement at Sannidhanam would be minimal as a holy dip in Pampa is most preferred by the pilgrims. In addition to the existing bathing facilities at Sannidhanam, it is proposed to provide 200 more showers for bathing here so as to cater for around 25000 pilgrims per day. In Pampa Action Plan, around 100 bathrooms have been proposed. These can be clubbed with toilets blocks proposed under Pampa Action Plan and with the queue complexes proposed for waiting pilgrims.

vi.) Treatment facilities

The total water requirement at Sannidhanam is 9.50 MLD. Considering the facilities available at Pampa, additional requirement is 3.0 MLD over the surplus of 6.50 MLD supplied from Pampa by pumping. In addition, 1 MLD is supplied from Kunnar, which is currently untreated. It is suggested that in the immediate term, for treating the water sourced from Kunnar, suitable facility be put in place at Sannidhanam. Treated water should be supplied after disinfection.

Further, as and when the new water supply schemes are materialised, treatment units of same capacity also need to be installed to facilitate the availability of treated water for he pilgrims.

vii.) Drinking Water Kiosks

It is proposed to provide 35 no:s of manned drinking water kiosks with coolers and hot water provision each with ten supply outlets at convenient points at Sannidhanam as an immediate measure. Here compact water purifiers may be used with technologically advanced supply system such as water vending machines after 10 to 15 years from date or as and when the place is ready to adopt such technologies.

Suitable drinking water fountains are also to be provided along the trekking route. Compact units (which work on *Reverse Osmosis Process*) which treats and supplies water in eco-friendly glasses / pouches/containers may be provided along the trek route. These may be clubbed with the proposed resting areas from Pampa to Marakkoottam and the queue complexes.

viii.) Distribution system

Piped water distribution system is to be extended to the trekking route and to the proposed Queue complex. From the existing pipe distribution system separate lines are to be laid to the newly proposed bathing showers.

ix.) Fire fighting arrangements

An exclusive distribution network consisting of the required fire hydrants connected to a dedicated storage tank of capacity 10 lakh litres capacity is to be provided for fire fighting. A fire station with required staff and equipment shall also be provided. In queue complexes, fire – trigger sprinkler systems may be adopted.

3.2 Water Supply at Nilakkal

Nilakkal falls in Ranni – Perunad Panchayat, in Ranni Block of Pathanamthitta district. The Panchayat has a total area of 82.05 sq kms spread in 12 wards. Total population of Nilakkal / Attathodu Ward (Ward No:7) that contains the proposed base camp is 1387 distributed in 367 households. Based on the recommendation in the Outline of the Master Plan for Sabarimala Development, MoEF has accorded first stage clearance for diversion of 110 ha of forestland for setting-up a base camp with essential pilgrim facilities. Nilakkal area falls under the Ranni Forest Division. Around 95 percent of the area in Nilakkal is under rubber cultivation with around 1,50,000 rubber trees. Other main occupancies are under religious land use – Mahadeva Temple and Palliyarakkavu Devi Temple, together holding an area of 1.17 ha. In addition to the two temples mentioned earlier, labour sheds for labourers who are engaged in tapping the rubber trees, sheds, stores, office, few toilet blocks, four numbers of ponds and a guest house exist. TDB has constructed over head tanks to store and supply water during the peak pilgrim season. Based on the details provided by Ecosmart as part of Phase 1 of the Stage 2 of the Master Plan for Sabarimala (the Report on Immediate Interventions for 2005-2006 pilgrim season[12]), the construction of around 400 toilets, works on improving 70 existing toilets, developing the sewage treatment system, improvising the ponds, examination of the possibility to extract ground water, development of solid waste management system and development of access roads and parking are being carried out by TDB since September 2005. The area is to be developed after preparing detailed plans based on the layout suggested in the same report.

3.2.1 Existing Water Supply System

3.2.1.1 Supply Mechanism

Currently, water is drawn from existing ponds at Nilakkal, which are disinfected for the season. Temporary water supply lines are provided to supply water to toilets. People use ponds for bathing purposes also. Water availability is meagre and is supplemented with water supplied in tankers during the peak pilgrim season.

Existing Network:
Source: Ponds
Storage: 65,000 storage capacity permanent O.H. Tank at + 135 Level contour
10,00,000 litre sump, Four Syntex Tanks, 5,000 litres temporary tanks each at + 145 Level contour
Treatment / Purification: Chlorination
Issue: Coliform count in the source increases as season advances. Ponds do not get recharged sufficiently after continuous pumping to provide for the demand

[12] IL&FS Ecosmart Ltd (August 2005), ***Report on the Immediate Interventions proposed at Nilakkal, Pampa and Sannidhanam***, GoK (*unpublished*)

Table 20: Water Supply Details for the Immediate Requirement (2005-06)

Drinking Water Supply	
Source	Temple Pond and 3 bore wells
Pump	6 HP
Existing Tanks	10 Lakh litre Sump and OH of 65,000 capacity
Proposed O.H. Tanks	Two HDPE -OH tanks each of 100,00 litres at 160 level contour
Pumping Line	80 mm GI Pumping main
Toilet Flushing System	
Source	Pond No: 4 (in case of contingency, valve arrangement to connect water from bore well pumping mains at 160 Level)
Pump	15 HP
Existing Tanks	(Existing distribution to existing toilets would continue)
Proposed OH Tanks	Two HDPE OH tanks each of 10,000 litres at 160 level contour, 10,000 litre capacity OH tanks for each toilet block (total 1 lakh)
Pumping Line	150 mm GI

Currently water is drawn from 5 nos. of existing ponds and is disinfected by chlorination before supply during the season. Kerala Water Authority supplements water during peak season through tanker lorries.

At present there is an over head tank of capacity 65000 litres at + 135 m. level and a sump of 10 lakh litres capacity. Four nos. of storage tanks (*Sintex*) of 5000 litres capacity are provided at + 145 m. level.

Recently bore wells to extract ground water were dug here under the supervision of Ground Water Department, GoK. However, the yield was observed to be low and un-matching with the demand for water which would arise when the place gets converted into a full fledged base camp.

3.2.1.2 Institutional Arrangement

TDB is the main water supply provider. KWA supplies water in tanker lorries during the peak pilgrim season.

3.2.2 Water Supply Characteristics

3.2.2.1 Quantity of Water Supplied

It is can be understood that the present supply is limited as the demand is limited. However, once the area gets converted into a full fledged base camp, provision for supply of water to all the pilgrims would be required. An estimation based on the water supplied at Nilakkal for the pilgrims who had concentrated here during a peak day of 2006-07 season shows that it was around 35 litres pr capita per day. However, this condition would improve in the process of developing the area into a full fledged Base Camp.

3.2.2.2 Quality of Water

Nilakkal base camp area has an undulating topography with valleys and marshes. As proper sanitation facilities are not ready for use, the pilgrims resort to open defecation, and as a result of this the ground level ponds get contaminated with faecal matter. Water quality analysis indicated that coliform count increases as season advances. The results of water quality analysis are in Annexure 2.

3.2.2.3 Water for other purposes

As mentioned earlier, ponds are the main source of water for bathing purposes. Pilgrims also resort to open defecation and are seen to be soiling the ponds.

3.2.3 Pilgrims Demands and Preferences

Currently pilgrims use Nilakkal only as a parking area during the peak days. However, as the proposal to stop all private vehicles at Nilakkal and further transport to Pampa in dedicated shuttle services would come into effect, the area would get converted into a full fledged base camp. In this situation pilgrims would seek basic facilities here. Thus it would become imperative to provide easily accessible clean drinking water, toilets, bathrooms and other facilities here. As revealed from the perception survey carried out and discussions with various pilgrim groups, pilgrims prefer basic facilities at reasonable cost. Currently the facilities at Nilakkal are limited as the proposals are just getting implemented here. However, it is essential to provide for all basic facilities here in the medium term.

3.2.4 Issues, Resource Constraints and Impacts on Environment

a) Insufficiency of water to meet the demand.
b) Non availability of good quality water on account of faecal contamination.
c) Lack of proper protection to existing ponds.
d) Drinking water facilities like drinking fountain, water kiosks etc. are not available.

3.2.5 Projected Demand and Quality Requirements

It is proposed to develop Nilakkal with stay facilities for 30000 pilgrims and transit facilities for 70000. Water demand has been worked out considering the water requirement for transit pilgrims for varying stay hours ranging from less than 6 hours to 24 hours and for other purposes such as cooking and fire fighting demand, around 600 toilets, 500 urinals, 1000 shower bath facilities, and additional facilities for around 1500 staff. Water Demand at the base camp for 100000 pilgrims is estimated as **6.5 MLD**.

Detailed base camp design parameters, water consumption estimates and calculations are provided in Annexure 4.

3.2.6 Proposed System

a. Intermediate interventions

In the immediate term (details provided in the Report on Immediate Interventions for 2005-2006 pilgrim season[13]) it is proposed to augment the existing system through dedicated improvement to the existing ponds and addition of few bore wells to supplement the water availability. New supply network has been designed and planned, keeping in mind the immediate requirement. This would eventually form the part of the total water supply network, which will be catering to all the future requirements at Nilakkal.

As for the immediate requirement it is proposed to have separate designated water supply network for flushing and drinking purposes. It is expected that by putting into use the new

[13] Ibid

toilet blocks (400 toilets) along with the existing toilet blocks (70 toilets) the water requirement will be about 28,200 litres/hour for flushing and washing. To cater to this demand it is proposed to have a central overhead supply reservoir with a total capacity of 20,000 litres for Flushing requirement and providing 10,000 litres capacity overhead tanks for each block. In effect such a setup will create an additional water storage capacity of 1.2 lakh litres of water; in turn necessitate pumping at 3-4 hour intervals only. The main source of water for flushing requirement is Pond No-4 with supplemented intakes from other ponds also.

As part of immediate interventions at Nilakkal (2005-06 pilgrim season), four numbers bore wells were tried and the yield was found to be insufficient. As a temporary measure, synthetic ('syntex' type) tanks of 10000 liters Capacity were installed at +160mm level.

It is proposed to provide 15 drinking water Kiosks each of 10 taps at Nilakkal, totalling to 150 taps. It is expected that the water requirement for this would be about 20,000 litres/hour. So it is proposed that a separately designated tank of 20,000 litres capacity may be provided as drinking water overhead reservoir along side the proposed flushing overhead reservoir. The main source of water supply will be the temple pond. Chlorination is proposed for disinfecting the water before supplying,

b. Immediate Scheme to Supply Piped Water from Pampa to Nilakkal (short term and emergency reserve)

As proposed earlier in section 3.1.6.1 (j), it is proposed that, by providing a separate sump in the newly proposed treatment plant site at Pampa, water is to be pumped to Chalakkayam and stored in an OHSR to be constructed there. This water can be used for distribution to Chalakkayam area and can also serve the purpose of filling tankers for supply to Nilakkal and other areas in case of water shortage. This would prevent the tankers from moving all the way through the crowded Pampa area to fill water during peak days. Thus, pedestrian – vehicular conflict can be avoided.

A separate sump is also proposed to be constructed at Chalakkayam. This is for boosting water supply to Nilakkal area. Around 0.04 ha of land near Chalakkayam toll gate is required for constructing OHSR, sump and booster pump house. From the Chalakkayam boosting station, water is to be pumped to the proposed OHSR at Nilakkal for distribution here. Around 0.02 ha of land is required for this in the elevated portion at Nilakkal.

For water supply, 400 mm of class 8 pipe for a length of 1000m has to be laid from intake to proposed treatment plant site, for pumping raw water. Out of this, nearly 300m has to be laid through the forest. Land required would be 300m long and 0.4 m wide, totalling an area of 0.012 ha.

The Attathodu ST Colony can also be benefited by laying distribution lines for a length of 3000m from the OHSR proposed at Nilakkal parking ground. In addition, this would support the pilgrims who assemble here to watch Makarajyothi.

However, quality of water would be a major concern as the source would get polluted during the season.

Detailed engineering report need to be prepared for undertaking these works, which can be entrusted to the Investigation and Planning Division of KWA.

c. Development of storage reservoir for rain water harvesting (medium term)

The land to the extend 1,52,000 sq.m towards the south east side of Mahadeva Temple can be developed into a reservoir. Storage capacity of the reservoir is worked out as below.

- Contours taken are 135 m and 125 m
- Total area at 135m contour is 152,000 sq.m.
- Total area at 125m contour is 5260 sq.m.
- Thus, on an average the area would be 78,810 sq.m.
- Capacity of the reservoir would be (78,810 x 10 m (elevation between the contours)) 7,88,100 cu.m.

The total requirement of water for the entire season of Mandalapooja and Makara Vilakku works out to be 6.5MLD. The storage capacity of the proposed reservoir would be sufficient to provide for the demand. However, during the initial period of the peak season, the reservoir may not get filled to the full capacity. Still, the requirement is less than the derived storage capacity and hence this could be considered as a feasible option. The source of water would be the rivulet of Kaduva Thodu which flows through the forest, abutting the boundary of Nilakkal base camp. A bund needs to be constructed in the upper reaches (in the forests) of Kaduvathodu and overflow can be diverted by suitable eco-friendly means to the proposed reservoir for impounding water. Forest department should be given the responsibility to construct the bund and the diversion using suitable eco-friendly technology with funding support from TDB / GoK as it falls under the forests.

To prevent faecal contamination, it is proposed to construct a sanitary earthen bund along the 136.00m contour. This bund is proposed to be constructed by digging a contour trench of two meters width at bottom and depth of one meter. This trench will also function as temporary rain water harvesting / storage facility. The water would gradually seep into the reservoir.

Algae may develop in the reservoir due to effect of sun light up to a depth of 60 cm. Therefore, it is proposed to provide the intake point at a depth of 1.00 m which is sufficiently below the algae zone. The intake arrangement proposed is of floating type.

While developing the reservoir, the vegetation, trees, garbage etc, in the reservoir area is to be cleared. Barbed wire fencing should be given around the reservoir trench to avoid the unauthorized entry of pilgrims and subsequent contamination of the reservoir.

d. Additional water supply scheme for Nilakkal

In course of time, as Nilakkal develops into a full fledged base camp, it would be essential to consider a long term water supply scheme for the area, sourcing from possibly another water source. For this, inclusion of Nilakkal in the proposed Chittar Seethathodu scheme is highly recommended. This would also benefit other neighbouring areas of immense pilgrim activity. For adjoining areas such as Ranni, Vadasserikkara, Athikkayam and Perunad, new water supply proposals need to be mooted.

e. Improving existing ponds

- The pond near Mahadeva Temple: At present, water from this pond is pumped to the ground level sump and subsequently to the O.H. Tank for drinking and other uses. Therefore, it is necessary to protect the pond by providing random rubble masonry retaining wall around the pond to a height of 1.5 m above ground level. The outer side of retaining wall should be filled with earth and slopped to the ground level. This arrangement will increase the percolation length of water thereby considerably reducing chances of pollution. Fencing should be provided all around to prevent pilgrims from taking bath in the pond.

- Other ponds: There are four ponds in Nilakkal area, in addition to the temple pond. Water from the small pond near the Temple and labour sheds is taken for the domestic use of the staff staying there, which is to be retained as such, until the entire sewage and water supply arrangements are completed. The other three ponds are to be maintained as bathing ponds for the pilgrims. It is proposed to increase the area of all the ponds to provide more facilities for pilgrims. Sides of all ponds may be protected by random rubble masonry and bathing ghats are to be provided all around to facilitate bathing. To improve the quality of water it is proposed to install surface aerators. In addition, approximately one third quantity of water is proposed to be treated through pressure filters which are to be housed in a building near the ponds and treated water can be re-circulated back into the pond.

f. Overhead tanks

A minimum storage capacity to be provided is 2.2 ML which is one-third of the daily requirement (i.e. 1/3 of 6.5 ml). However, a 65,000 litres OH tank and 10 lakh litres sump capacity tank exists at Nilakkal. It is proposed to provide a 2.2 MLD, OH storage capacity at Nilakkal with a minimum stage height of 10.00 m is to be provided at the elevation of 160 m.

g. Treatment

At present no treatment is provided except chlorination. For the future requirement of water at Nilakkal it is proposed to pump water from the proposed artificial reservoir. This water is to be treated through pressure filters and disinfected by chlorination and stored in the sump.

h. Drinking Water Kiosks

It is proposed to provide 25 Nos of drinking water Kiosks each with 10 taps at Nilakkal. Already 15 kiosks are provided as immediate intervention during 2005-06 pilgrim season. In addition, 10 Kiosks with 10 taps each or suitable other water vending systems are to be provided.

i. Distribution System

All the water demanding units such as toilets, water kiosks, etc. are to be properly connected by a closed grid network system from the over head reservoir. Pipe lines may be laid in well planned, chambered underground ducts so as to facilitate easy maintenance and repairs without hampering pilgrim movement.

j. Fire fighting Arrangements

A distribution network with dedicated pumping system and fire hydrants is to be provided exclusively for fire fighting. The source of water will be the proposed artificial reservoir and a separate fire station is to be provided near the proposed reservoir.

3.3 Water Supply at Erumely

Erumely Panchayat has an integral role in the ritual and geographic maps of Sabarimala Pilgrimage. First time devotees (Kanni Ayyappan) are supposed to undertake the ritual of Petta Thullal before visiting Sabarimala. Also these devotees are supposed to have holy dip in Erumely thodu in font of Valiyambalam as per rituals. In addition a large percentage of pilgrims from other states and from Kerala who approach from the north also pass through Erumely. Thus around 50 percent of the pilgrims who visit Sabarimala pass through this town which is a part of Kottayam district while being at the border of Idukki district. The anointments for the purpose of 'pettathullal' such as coloured powders of 'Kalabham' (Bhasm) and 'Sindooram' (Kumkum) applied on the body of pilgrims gets washed away in the Erumely thodu during their customary dip. This makes the water heavily polluted especially as during this period, the flow in Erumely thodu is practically nil. To facilitate bathing, TDB is pumping water from Manimala River to the bathing ghat in front of Valiambalam, which has proved grossly inadequate.

According to the 1991 census, the resident population of Erumely is 38908, while it has become 65,000 as per 2001 census estimates. This increase in population is because of the addition of two wards of neighbouring Panchayat in addition to the normal population growth. Considering a decennial increase of 10percent the projected population in 2021 is 79,000.

The pilgrims either travel through the Erumely - Plappally – Pampa road or trek from Erumely to Cheriyanavattom along the traditional trek route. Latest pilgrim count shows that the average number of pilgrims who arrive at Cheriyanavattom per day during the Mandalapooja season is 24,000 where as it is even more during the Makaravilakku season. Considering these aspects the average pilgrim population passing through Erumely is assumed as 40,000 while the peak is assumed as 100,000. In order to provide service facilities to the pilgrims a short term population (service personnel / shop owners / assistants etc) of about 5,000 stay at Erumely for two months.

Pilgrims demand water for toilet purposes, bathing, ablutions and cooking. It is noticeable that no permanent arrangement has been made so far to cater for these needs.

3.3.1 Existing System

3.3.1.1 Water Supply Mechanism

Presently Erumely is served with two rural water supply schemes of 0.025 and 0.05 MLD capacities. This supply is insignificant when compared with the actual demand. Hence there is a need to formulate a more elaborate plan to provide for the requirements of the resident population as well as for the pilgrims and service needs. Water for supply is sourced from Manimala River. It is observed that during peak Makaravilakku season; the flow in the river is inadequate.

In Erumely Panchayat, 60 percent of the households have their own wells. Those who have no wells depend on public taps and other sources. The water availability in many of the tube wells is not sufficient and the quality of water available from this source is not satisfactory.

3.3.1.2 Proposals under consideration

There is a proposal for drawing Pampa water for use at Erumely by installing a tank at Koduthottam, which is estimated at Rs 10 crores.

3.3.2 Water Supply Characteristics

3.3.2.1 Quantity of Water Supplied

Erumely town is deficient in water supply. Existing water supply is through the scheme developed in 1964, which has not undergone improvement / upgradation over the years. KWA supply through Erumely rural water supply scheme is not enough for serving the general population. Pipelines of GI are old and dilapidated and often report breakdown. The water tank requires maintenance and its storage capacity is limited. The supply of water through public taps is irregular and the water supply system is defective.

3.3.2.2 Quality of Drinking Water Supplied

The drinking water problem is aggravated due to the flow of wastewater to the river from nearby rubber factories. The waste materials produced from nearby hospitals and toilets are deposited in the rivers. The water scarcity is a grave problem during summer, especially in the pilgrim season. Pollution during the season makes matters still worse. After 'pettathullal', pilgrims bathe in the temple pond and river; but due to non-availability of sufficient water level, waste water with dissolved coloured powders sprayed on the body for *pettathullal* gets accumulated there. It is essential to ensure sufficient water flow at these bathing areas.

There is no full-fledged treatment facility for the water supplied. The water intake pond is very near the bathing ghat and there is chance for coliform bacteria and pathogens for entering the intake water.

3.3.2.3 Water for other purposes

Pilgrims uses the streams for bathing purposes. The flow of water as well as the quality of water gets poor as the season advances due to the coloured powder reaching the water streams. In addition, in the absence of toilets, pilgrims resort to open defecation near available water bodies, thus polluting them.

3.3.3 Pilgrims Demands and Preferences

Most important demands of the pilgrims at Erumely were water and sanitation. They were alarmed at the colour of Erumelithodu, but preferred to have a dip there to wash off the colours anointed on their body for the ritual. Most of the pilgrims voiced the need for adequate water supply along the traditional route from Erumely to Pampa.

3.3.4 Issues, Resource Constraints and Impacts on Environment

Drinking water is an important problem faced by the pilgrims. There is no sufficient drinking water soppy to the pilgrims. Adequate pipe connections are yet to be provided. The pilgrims are not satisfied with the quality of water here and are forced to drink it for want of alternative drinking water facility. They use the same water for bathing and drinking. Inadequate supply of piped water as well as lack of kiosks to provide drinking water in areas of pilgrim concentration is the main issues faced by pilgrims.

Bathing facilities here are insufficient and the streams are polluted. A tributary of Manimala known by the name Valiyathodu passes through Erumely. The region in and around Erumely is the catchment area of the River Manimala. This river in fact stretches to 90 kilometers to join Pampa River at Valavjavattathu. Another tributary known by the name Achenkoil River also joins Pampa at Viyapuram near Haripad. The ecological imbalances at Erumely are certain to affect the whole of Kuttanad and Vembanad immediately through River Pampa which drains into it.

When millions of people stay in place for a limited number of days, the impact is enormous for the eco-system. Currently due to the lack of adequate water supply and sanitation arrangements, Erumely is not ready to accommodate millions of pilgrims.

Sand is a natural mechanism for filtering the water. The depletion of sand in the riverbeds due to sand mining has been reported in the rivers around Erumely. In addition, the pilgrims often resort to rivers and streams for their bathing and cooking purposes and deep gorges left after the extraction of sand pose danger to the pilgrims who venture into the rivers.

There are 14 drinking water projects in the Manimala River between Erumely and Thiruvalla. However purification processes are deficient at the pumping stations though the water is used for drinking purposes.

3.3.5 Projected Demand and Quality Requirements

Water demand for the resident population till 2021 works out to be 1.4 MLD while during the peak pilgrim season; water is required for an additional 1,00,000 transit population (4.0 MLD – considering the peak pilgrim flow through Erumely). Considering transmission losses as well, the total demand would work out to be 6 MLD. It is not possible to propose a separate scheme for pilgrims alone as the pilgrim activities are concentrated in the town centre. Existing schemes of 0.025 and 0.05 MLD are negligible considering the requirement and hence not considered in formulating the final water supply scheme. Detailed calculations are presented in Annexure 4.

3.3.6 Proposed System

Major interventions proposed at Erumely include:

- Improving the source of water supply
- Improving the quality of water
- Improving bathing facilities

a) Source Improvement

Water for supply is sourced from Manimala River. It is observed that during peak Makaravilakku season the flow in the river is inadequate. To solve this issue, it is proposed to construct check dams in Manimala River which can store required quantity of water and release during lean flows. Considering the water requirements, the gradient and cross section of the river, two check dams are proposed in the Manimala River to prevent excessive submergence of the river banks.

A lower level check dam is proposed to be constructed approximately 10 meter downstream of the Koratty Bridge. The approximate length and height of check dam would be 60 m and 1.50 m respectively. Vertical sliding wooden shutters are to be provided for flushing silt and polluted water during rains. If shutters are not provided at the ends, stagnant pool of water and debris would form here and would deteriorate the total quality of water. Hence, shutters of 5.00m length, two at the ends and one at the centre, are to be provided. To ensure the self removal of silt and debris from the reservoir, the sill level of the shutter opening should be at the bed level of the river.

An upstream check dam is to be constructed at the upstream end of the lower level reservoir. Hence the check dam is proposed near Koratty Pazhaya Palli, boundary of Mundakayam and Kanjirappally Panchayats. The size of this check dam proposed is 60.0 m length and 1.50m height. This check dam is also to be provided with three shutters as proposed for the lower level check dams. It is expected that the storage created by the construction of these two check dams would be sufficient for the requirement of both the pilgrims and the domestic use of the resident population of Erumely Panchayat. In addition storage capacity of OH tanks for supply of drinking water should be increased.

b) Improvement to Existing Water Supply Scheme at Erumely

In the immediate term, the existing water supply scheme need to be replanned, with additional pumping main, construction of 1.00 lakh capacity OH tank, laying of new gravity line up to Petta Junction, replacing the distribution line, construction of pump house etc. This need to be implemented based on a detailed engineering report to be prepared by Investigation and Planning division of KWA.

c) Additional Water Supply Scheme for Erumely

Possible sourcing of water from Pampa / Maniar may be explored. The Erumely South Water Supply Scheme proposed by KWA would support in providing sufficient water to the residents as well as the pilgrims through public taps and supply to base camp facilities which may be provided in due course. Panchayat should be provided suitable funding and other assistance to carry out this scheme for the benefit of the pilgrims.

d) Improving bathing facilities in Erumely thodu

As the pilgrim activities are widely spread in Erumely area, bathing sties are to be developed at varied locations. The pilgrims use mostly Erumely thodu for their bathing requirements after *pettathullal*. Flow in the Erumely thodu is negligible during the pilgrim season. It is hence proposed to make available water in the Erumely thodu for bathing and to minimise the

pollution here by ensuring sufficient flow. For this storage reservoirs are proposed to be developed by constructing five check dams. The location for the proposed check dams are given below.

1. First check dam of length 15.00 m and height 1.50 m is proposed to be constructed at Karingalammuzhi near forest range office.
2. Second one of length 15.00m and height 1.50m is proposed to be constructed at Karingalammuzhi Vettiyanikkal Pady.
3. Third check dam of length 15.00m and height 1.50m is proposed to be constructed at Chempakapara colony.
4. Fourth check dam of size 12.00 x 1.50m is proposed to be constructed near Manipuzha junction.
5. Fifth one is of size 12.00 x 1.50m is proposed to be constructed near Manipuzha deep junction.

For all the above proposed check dams openings with sliding wooden shutters are to be provided for flushing of silt and debris. Two openings at the ends and one at the centre of length 2.00 m each should be provided. The sill level of the openings should be at the bed level of the thodu.

Bathing site in front of the Valiyambalam has been developed by TDB with flow regulating devices at the downstream of the bridge. At present this lone bathing site for the pilgrims, is in a neglected condition. The accumulated silt and filth has almost filled up the bathing site making it difficult for the pilgrims to take bath. More over the water in the bathing site is highly polluted and unhygienic. It is proposed that the shutters in the regulating arrangement be removed to allow free flow of water after the pilgrim season, so as to flush the thodu.

After constructing the proposed check dams, there will be sufficient water in the newly created reservoirs. As and when the bathing site near the temple gets polluted, fresh water from the upper storage reservoirs can be released, for flushing out the polluted water.

e) Development of bathing facilities in trekking route

At present facilitations are inadequate for bathing along the trekking route where pilgrims stay overnight. This is mainly because of insufficiency of water in Peruthodu and Azhutha. At Peruthodu, viri facilities are arranged in the land under the Forests, during the peak pilgrim season. Many pilgrims take bath in the stream available here. It is necessary to provide bathing facilities at this site and to construct a check dam across Peruthodu. The size of the proposed check dam is 15.00 x 1.50m. Shutters of 2.00 m length for flushing out silt and debris are to be provided at the two ends and the middle of the check dam. After the pilgrim season the shutters should be removed to facilitate self cleansing.

At Azhutha River in the Erumely – Pampa traditional route, it is customary to take bath and collect pebbles as a religious observance. It is necessary to provide improved bathing facilities at Azhutha River and construct a check dam of 1.50m height across Azhutha River. Necessary flushing arrangements with removable shutters are to be provided here.

f) Water treatment

Periodic monitoring of the quality of water supplied for drinking (especially during the peak pilgrim season) and suitable treatment augmentation measures to be adopted.

Water treatment plants are to be constructed near the check dam adjacent to Koratty Bridge for which 50 cents of land will be required. Here, a 2 MLD conventional rapid sand filter plant and pressure filter for 4 MLD are to be constructed. This system is to provide treated water to the resident population of the Panchayat. It is proposed to construct an Overhead Tank of 20,00,000 litres capacity to facilitate storage and distribution of water along with proper distribution network.

g) Drinking water Kiosk and bathing shower facility

- It is proposed to provide 20 nos. drinking water kiosks each with 10 taps at Erumely at points of pilgrim concentration. Alternately, manned water supply points may be provided which could later be converted to portable purifiers on Reverse Osmosis or with water vending machines as and when the technology becomes available and accessible.
- For bathing purposes, pilgrims would mainly use the bathing ghats proposed in addition to Erumelithodu and Manimala River. However, for the aged and the sick, around 200 bathing showers are to be provided as phased addition till 2021.
- It is necessary to provide drinking water along the trekking route from Peruthodu to Azhutha. This is proposed to be achieved by pumping water from Azhutha River to a higher elevation at Kalaketty to enable gravity flow up to Peruthodu. A pressure filter treatment unit of capacity 0.50 MLD coupled with disinfecting arrangement is to be installed at Kalaketty. A storage tank of two lakh litres capacity needs to be provided. Necessary pipe lines may be taken along the trekking route and required drinking water kiosks provided at various locations.
- It should be ensured that all water supplied for drinking purposes are either boiled or chlorinated.

To maintain the pristinity of the forest by adopting mechanisms which would least affect the environment, it is proposed that the responsibility for implementing the proposed arrangements in the forest area should be vested with or carried out with participation of the Department of Forests, GoK.

River Pampa flows along the boundary of the Panchayat for about 11 km. The pilgrims who take road route to Pampa, use the banks of the river Pampa for open defecation and thus the river gets highly polluted. While considering the requirements of pilgrims passing through Erumely, the facilities needed along the bank of the river Pampa are also to be taken care of. Since this portion of Erumely comes under the Pampa Action plan, provision for these facilities is to be included in the Pampa Action Plan. All possible Water Supply and Sanitation related interventions may be considered for inclusion Pampa Action plan, as Pampa runs through near Erumely and receives the waste flows both from other streams joining it and due to indiscriminate pilgrim activities along its seams.

3.4 Water Supply at Vandiperiyar

Pilgrims mostly from Tamil Nadu, Andhra Pradesh and Karnataka coming through Kumily route moves to Sabarimala via Vandiperiyar. During Makaravilakku season, the pilgrims reaching Vandiperiyar passes through Uppupara and Pandithavalam for *darshan* at Sabarimala. Few pilgrims may after *darshan* return to Vandiperiyar and stay here for a day or

two till Makara Jyothi. For viewing Makarajyothi, pilgrims move to Uppupara, then return to Vandiperiyar and usually stay here for about a day or two before their journey back home.

3.4.1 Existing System

Water demand of Vandiperiyar is met through an existing rural water supply scheme aided by Life Insurance Corporation of India (LIC water supply scheme), with an installed capacity of 0.05 MLD, sourcing water from River Periyar. A check dam is constructed across the river for drawing water. Water is drawn to an Over Head Tank to meet the needs of the town / main settlement area. No water treatment facility exists here and the water is directly pumped from the river, filtered, disinfected and supplied to the people.

3.4.2 Pilgrims Demands and Preferences

Most important demands of the pilgrims who were interviewed at Vandiperiyar were to develop water and sanitation facilities to cater the demand of increasing pilgrims.

3.4.3 Issues, Resource Constraints and Impact on Environment

The issues arising out of existing sytem of water supply mainly include inadequacy of good quality drinking water and proper bathing facilities for the pilgrims.

3.4.4 Projected Demand and Quality Requirements

Demand for water has been worked out based on the existing water demand for the resident population and projected demand for the next 15 years for the projected population of 60700 people. Peak pilgrim population is taken as 30000 based on the pilgrim survey results. Demand is estimated as 4.00 MLD also considering the probable losses. Detailed calculations are provided in Annexure 4.

3.4.5 Proposed System

a) Drinking water kiosk and bathing facility

It is proposed to provide 15 numbers of drinking water Kiosks with 10 taps each. These may be later replaced with water vending machines or portable water purifiers as and when available.

Pilgrims use bathing ghats in the river Periyar. It is proposed to construct a check dam of height 1m around 10m down stream of the existing bridge. By this check dam, a pool will be formed which can be used as bathing ghat. For the convenience of the pilgrims, steps on the banks at suitable locations are to be provided. In addition, for the sick and aged people 100 nos. of additional bath showers are also proposed in the land proposed to be acquired by the Panchayat for providing facilities for the pilgrims.

b) Water Treatment and Supply

It is proposed to construct a check dam in the tributary of Periyar below Muppathu Palam so as to draw the required water of 4.0 MLD. In addition, 4 Nos. of pressure filter of 1 MLD capacity each is to be provided for treatment. The area required for installing this is 50 cents. To facilitate storage and distribution, an over head tank of 15,00,000 lit (1.5

ML) cu.m. capacity is to be constructed. Necessary piped distribution network for supplying water to toilet blocks, showers, drinking water kiosks etc is to be provided.

3.5 Water Supply at Sathram

3.5.1 Existing Situation

At present pilgrims resort to the water storage provided by a small check dam across the stream flowing through the area and five wells to meet their water demand. Due to inadequate toilet facilities people resort to open defecation, there by polluting the natural stream.

3.5.2 Proposed System

Details based on which the water demand has been estimated is presented in the table 21 below:

Table 21: Proposed Water Requirement at Sathram

Residential population	1,000
Peak floating population (Based on the assumption that once Sathram is developed as a base camp, about 30percent of the pilgrim will take Vandiperiyar Sathram route.)	30,000
Average floating population	7500
Water Requirement	
Water requirement for local residents	0.07 MLD
For floating population	0.06 MLD
Loss	0.33 MLD
Total Requirement	1.00 MLD

a) Drinking water kiosk and bathing facility

It is proposed to provide 10 Nos. of drinking water Kiosks with 10 taps each. To provide bathing facility to the pilgrims, 80 Nos. bathing showers are proposed.

b) Source Development

There is an existing bund across the small stream called Azhuthathodu. This bund would not be able to store the total requirement of 1.0. MLD of water. However, it is suggested that additional requirements can be met from bore wells.

c) Water Supply and Treatment Process

Treatment proposed is pressure filter set-up followed by disinfection. Also it is proposed to provide an O.H. tank of capacity for 350 cum for storage and distribution. Appropriate pipe network system is to be provided from the tank to distribute treated water.

3.6 Water Supply at Uppupara

3.6.1 Existing situation

Uppupara attracts large number of pilgrims especially during Makaravilakku time as the place offers uninterrupted view of Makarajyothi which appears at Ponnambalamedu. Presently this area has no formal water supply arrangement. Amenities are arranged here through EDCs under the control of Forest Department.

3.6.2 Proposed System

Daily maximum water requirement at Uppupara is estimated as 0.60 MLD, considering a maximum flow of 30000 pilgrims a day. As construction is not recommended, the required water may be conveyed from Vandiperiyar / Vallakkadavu by 10 tanker Lorries and stored here in 10 nos of temporary tanks / PVC tanks each of 5000 lit capacity. Ten tanker Lorries of 10,000 litres capacities to make six trips a day may be required for this.

However, during the Stakeholder Consultations held on August 11, 2006, the forest department has suggested that the Koop road would not be able to carry the load of transporting this quantity of water.

As the area is in reserve forest, and the demand for use exists only for two or three days nearing Makaravilakku day, permanent constructions are not recommended.

Possibility of providing shallow water tanks to store rain water which could also be used by the wildlife during off seasons to be explored. Ground water extraction using bore wells may not be a feasible option considering its geography.

Another option is to lay pipeline to Uppupara from Azhutha thodu (approx. 7 kms) or Sabarimala Thodu at Sathram by creating an impounding reservoir across the stream. Temporary tanks may be provided before the peak days and water may be stored for use during Makarajyothi. Possibility of laying pipeline from Vallakkadavu by constructing a check dam across River Periyar may be explored.

Temporary water supply network with taps is to be attached to each synthetic tank from where pilgrims can collect water.

4. SANITATION

Master Plan for the integrated development of Sabarimala which witnesses huge influx of population during a span of just 45 days need to incorporate to schemes designed to improve sanitation and drainage as they are closely linked to health and environment not only of the pilgrims, but also of other service staff, population downstream and the wild habitat of the forests around. The existing sanitation and drainage facilities at Pampa, Sannidhanam, Nilakkal, Erumely, Vandiperiyar and Sathram and on trekking routes are inadequate and therefore require an upgradation.

4.1 Sanitation Facilities at Sabarimala

4.1.1 Existing System : Sabarimala

Current arrangement for sanitation includes permanent toilets and temporary ones set up for use during the peak pilgrim season. The sanitation and drainage facilities now available at Pampa and Sannidhanam are not adequate to cater to the demands of lean and peak pilgrim seasons. Due to lack of toilet facilities, inadequate associated infrastructure, along with operational mismanagement related issues, many pilgrims resort to open defecation polluting the entire water body, especially near the bathing ghats of Pampa and Thriveni-Pampa. Open defecation and urination in the forests around Sannidhanam and the trek route are obvious.

4.1.1.1 Toilets and Sewage Treatment System

a) Facilities at Pampa

i.) <u>Pay and Use Common Toilets</u>

There are permanent and temporary toilets (provided during pilgrim season) at Pampa and Sannidhanam. The permanent toilets are concrete structures, single and multi storied. Some of the toilet blocks are provided with tile flooring and wall tiling, while the old toilet blocks have cement flooring. Each block is provided with a ground level tank from where the pilgrims have to collect water by dipping the bucket in the tank. This water is used for bathing and flushing. The water in the tank is found getting contaminated due to dipping of buckets. In addition, no hand washing facilities are provided in the common toilet blocks. These toilet blocks are connected to septic tanks. Effluent is dispersed through soakage pits that frequently overflow during peak pilgrim season. Toilets in the lodges, other accommodation facilities and institutions are connected to the septic tanks. Currently at Pampa there are around 850 permanent toilets.

Temporary toilets are provided by placing squatting platform over earthen pits during peak pilgrim season. Thatch is used to provide temporary walls and these toilets are open to sky. The water supply system is almost similar to that of permanent toilets.

Open defecation is common along the banks of Pampa especially in Thriveni-Pampa area. Water sample studies conducted in past have shown high level of faecal coliform contamination during the pilgrim season. The studies have indicated coliform contamination levels as high as 1,600,000 MPN vs. the safe limit of 500 MPN in River Pampa.

ii) Sewerage Treatment at Pampa

A 3.5 MLD capacity Sewerage Treatment Plant (STP) has been installed at Pampa (Cheriyanavattom) for treating raw sewage and sullage collected from Pampa. The sewerage network consists of pumps and pipe lines connected to the septic tanks and collection pits. The treatment plant is operational only during the peak pilgrim season. The sewage from septic tanks and the sullage collected from the hotels and restaurants is pumped to the STP for treatment.

The effluents from the toilet blocks are taken to the nearby septic tanks. The effluent from the septic tanks is taken to the STP at Cheriyanavattom. The treatment system adopted in based on physico-chemical process. The sludge is treated in sludge digestion tank and subsequently sun-dried. It has been observed that a piped outflow is provided near the forests currently. However, this ultimately flows back into Njonangar / Pampa as discharge is pointed rather than sprinkled.

The existing STP at Pampa is inadequate to meet the peak pilgrim season demand from Pampa, Valiyanavattom, toilets along trek route etc. In addition, the treatment plant has operational problems and is therefore unable to meet the regulatory standards prescribed for the effluent by the KSPCB prior to discharge into river.

iii) Sullage Collection at Pampa

The sullage generated in the hotels and restaurants is collected in the collection pits installed near the source of generation. These are constructed at a maximum distance of 30m from the river edge. Since these pits are not lined, seepage from these pits contaminates the sand beds at Pampa river bank. These are seen over flowing even in the lean season, as there is no pumping system in operation. The top level of these tanks coincides with the ground level and these are provided with wood mesh covers. Hence control of overflow from these tanks is difficult.

During the peak days in peak pilgrim season, the pits over flow as the treatment unit is unable cater to the entire wastewater generated in and around Pampa. Even though there are some earthen/masonry drains they are not sufficient for the discharge of storm water.

b) Facilities at Sannidhanam

i.) Toilets at Sannidhanam

At present there are 768 public toilets and 1,144 toilets attached to around 700 buildings at Sannidhanam. Based on the information collected on the site it can be assumed that about 400 latrines out of the above 1144 latrines are' also used by the public during the festival season. All the above 1936 latrines are sources of liquid waste, which is could be source of high degree of pollution.

Effluents from there are taken to septic tanks for treatment. In addition to this temporary pit latrines are provided during pilgrim season. However, no sewage treatment system exists today at Sannidhanam. Details of the existing system have been collected presented below (**Table 22 and 23**) is based on a detailed study of waste water generation points here.

Table 22: Public Latrines at Sannidhanam

S.No	*Location Description*	*No of Latrines*
1	Kumbalamthodu	28
2	Incinerator Bottom'	50
3	Donor- 7 –Back	93
4	PC III (water tank back)	65
5	Donor House (DH) 4 (Public)	45
6	DH 4 E	54
7	DH 4 F	49
8	Pandithavalam	100
9	Pandithavalam	100
10	Pandithavalam	40
11	(DH Back Side)	50
12	Electricity	34
13	Jyothi Nagar	30
14	Police Barrack (Side)	30
15	Latrine complex beyond Telecom Centre	24
	Total	768

Source: Primary Survey

List of latrines attached to various buildings in Sannidhanam (in addition to dedicated toilet blocks is provided in the table below.

Table 23 : Latrines of Other Buildings at Sannidhanam

S. No.	*Description*	*No. of Latrines*
1	Guest house	16
2	Annexe	16
3	Sabari Nivas	60
4	Information centre	3
5	Nadappanthal East lobby	12
6	Nadappanthal Hall	8
7	Pilgrim Centre I	134
8	New mess	16
9	Vella Nivedyam Counter	1
10	Dormitory west side	25
11	Administrative Block	18
12	Executive block	18
13	Bank building	5
14	Bottom of fly over	4
15	Pilgrim Centre II	118
16	Pilgrim Centre III	144
17	Malikappuram Counter Bldg	6
18	Melsanthi	2
19	Post office bldg	4
20	Ghee Abhishekam Counter	1
21	DH 1	24
22	DH2	20
23	DH 3	24
24	DH 4	24
25	DH 5	22

S. No.	Description	No. of Latrines
26	DH 6	24
27	DH 7	24
28	GKD	5
29	Hariharaputhra	4
30	Poorna Pushkala	4
31	Malikappuram Shop bldg	16
32	Press room	2
33	Accommodation Office	2
34	Old ghee counter	1
35	Maramath Complex	29
36	Maramath Staff Quarters	14
37	Police Station	6
38	Cottages (27Nos.)	54
39	Police Barracks (A B. C. D)	135
40	Police mess	2
41	Old Guest house (SPoffice)	4
42	Shelters	28
43	N.S.S.	6
44	Ayyappa Seva Sanghom	32
45	M.N. Nambiar	5
46	Subrahmonian Guest house	8
47	Guest house	14
	Total	**1144**

Source: Primary Survey

The following table (Table 24) gives the details of hotels at Sannidhanam of permanent and temporary nature. There are 18 hotels at the site and these hotels are the major sources of sullage which are generally of less polluting nature.

Table 24 : List of Hotels at Sannidhanam

Sl. No.	Description	Permanent	Temporary	Total
1	Jyothi Nagar	1	1	2
2	Valiya Nadappanthal	1	0	1
3	Malikappuram	2	0	2
4	Bottom of fly over	2	0	2
5	North of Malikappuram	2	0	2
6	East of DH 6	0	1	1
7	Pandithavalam	0	3	3
8	Near Maramath Bldg	1	0	1
9	North of Police Barracks	0	1	1
10	West of DH 4	0	1	1
11	South of Malikappuram	0	1	1
12	Near Malikappuram Vedikkalam	0	1	1
	Total	**9**	**9**	**18**
	Note: Average Seats per Hotel is one hundred			

Source: Primary Survey

ii.) Urinals

There are not many separate urinals. It was observed that in the existing urinals no water supply/flushing system existed. The urinals are subjected to misuse and are usually rendered unusable by using for defecation.

iii.) Septic Tanks at Sannidhanam

In the absence of a sewerage system, the toilet waste treatment is carried out in the individual septic tank attached to toilet blocks and buildings. There are 69 septic tanks of total capacity to the tune of 8,253 cubic meters. Septic tanks are simple units used for relatively small quantities of domestic wastewater where the suspended solids are allowed to settle and undergo biological degradation. These are sufficient during the lean period. As the usage exceeds design capacities during peak pilgrim season, the soakage pits overflow resulting in unstabilised (untreated) effluent flowing out to the premises. The raw sewage and sullage eventually gets mixed with Kumbalamthodu, near Bhasmakulam, and finally drains into Njonangar near River Pampa, causing pollution of the bathing ghats. The estimated wastewater generation today at Sannidhanam varies from 0.015 MLD during off-peak pilgrim season to 8 MLD during peak pilgrim season.

iv.) Sullage Disposal at Sannidhanam

At present, sullage disposal facility including conveyance system does not exist at Sannidhanam except pits for temporary collection of sullage (soakage pits). During peak season these pits overflow and pools around or flows to open drains / streams which leads to Njonangar which discharges into Pampa near Cheriyanavattom.

Table 25 : Location and Sizes of Septic Tanks at Sannidhanam

Sl. No.	*Description*	*Nos.*	*L (m)*	*B (m)*	*H (m)*	*Vol. (CuM.)*	*TYPE*	*Toilets*	*Bathroom*
1	Near Nadappanthal	1	8	4	3	96.00	RCC	12	
2	South side dormitory	1	8	4	3	96.00	RR	35	
3	Hospital -Cardiology	2	4.5	3	2.5	67.50	DR	21	
4	Latrine block electricity board	1	3.5	2	2.5	17.50		34	
5	Forest	2	4	2	2.5	40.00		6	
6	Electricity	1	4	2	2.5	20.00		13	
7	Water Authority	1	5	3	2.5	37.50		4	
8	Police guest house	1	6	3	2.5	45.00		8	
9	Telecom	1	5.5	2.5	2.2	30.25			3
10	Hari Haraputhra (homeo)	1	8.5	1.2	2.8	28.56		6	
11	Jyothi Nagar	1	8	4	2.8	89.60	DR	8	
12	Ay. Hospital	1	8.5	1.2	2.5	25.50	DR	10	
13	PWD/Engg.	1	4	2.5	2.5	25.00	DR	5	
14	Pilgrim Centre Near Mess	1	12	5	3	180.00	RR	134	
15	Dormitory side public	1	5	2	2.4	24.00	DR	35	
16	Dormitory back.	1	6;8	4	2.8	76.16	DR .	24	
17	Bank back side	1	"7	4	2.8	78040	RR	5	
18	Round Latrine	1	8	5	2.8	112.00			
19	Bhasmakulam top	1	9	5	3	135.00	RR	100	
20	Bhasmakulam top	1	18	8	3.6	518.40	RR	26	
21	Police Barrack	1	14	5.6	3.6	282.24	RCC	30	
22	Mess Backside	1	1.4	5.6	3.6	282.24	RCC	35	
23	Mess Backside	1	12	5.5	3	198.00	RCC	35	

Sl. No.	*Description*	*Nos.*	*L (m)*	*B (m)*	*H (m)*	*Vol. (CuM.)*	*TYPE*	*Toilets*	*Bathroom*
24	Shelter Backside	2	12	4	2.8	268.80	RCC	35	
25	Toilet Block	2	12	4	2.8	268.80	RCC	24	
.26	Toilet Latrine Nr. Malikappuram	1	32	2	2.5.	160.00	RCG	93	
27	D.HA	1	6	2	2.5	30.00'		24	
28	Near Health Bldg.	1	10	4.5	2:5	112.50		5	
29	Pilgrim Centre II back	1	10.5	10	3.1	325.50	RCC	118	
30	Store back	1	12	6	3	216.00	RCC	50	
31	Store back	1	8	4	2.5	80.00	DR	229	(93+40+72+ 24)
32	Latrine Block (Near Store)	1	12	5	2.8	168.00	RCC	Not in use	
33	Old Latrine - Kumbalamthodu	1	20	2.4	2.5	120.00		28	
34	Kakkathodu	1	6	3	2.5	45.00		50	
35	NSS	1	5	2	2.5	25.00	RCC	6	
36	GKD	1	6	3	2.8	50.40	RCC	5	
37	Front of DH2	2	6	4	3	144.00	RCC	20	
38	Front of Police Station	1	6	3	2.8	50.40	RR	49	
39	Maramath Side Complex	1	4	1.5	2.5	15.00	RR	49	
40	Old GH (SP office)	1	4	2	2.5	20.00		4	
41	Sabarinivas	1	13	4	3	156.00	RCC	60	
42	Annexe II	1	6	2.5	2.5	37.50		16	
43	Health	1	41	2	2.5	20.00.		4	
44	Seva Sangam (Ayyappa)	1	5	2	2.5	25.00		32	
45	Publicity	1	4	2	2.5	20.00		3	
46	Cottage back	10	4	2	1.3	104.00		18	
47	Sannidhanam Hotel sides	2	4	1.5	2	24.00		44	
48	M.N. Nambiar	1	4	2	2.5	20.00		10	
49	PC III back side	1	27	12	3.6	1166.40	RCC	144	
50	Guest House	1	6	3	2.5	45.00		14	
51	Wireless Station top	1	6	3	2.5	45.00		1	
52	Near DH7.	1	2.5	12	3	900.00		24	
53	Near DH6	1	18	9	3	486.00		24	
54	New, Pandithavalam	1	20	10	3	600.00		200	
	Totals	**69**				**8253.15**			

Note:

R.C.C. - Reinforced Cement Concrete DR - Dry Rubble Masonry
RR - Random Rubble Masonry

In order to have a judicious selection of the treatment option and for the design of treatment units it is important to know the characteristics of the sewage. Typical Domestic Sewage consists of 0.1 percent solids and 99.9percent water. The solids are mostly organic in nature in suspended, dissolved and colloidal state. The organic solids being unstable and cause environmental degradation. It undergoes putrefaction emanating foul gases like ammonia, hydrogen sulphide, methane, carbon dioxide and so on under anaerobic condition. Once the sewage enters natural water bodies, the oxidation of the organic matter results in depletion of dissolved oxygen and there by destruction of aquatic life. Sewage contains pathogenic micro organisms which cause waterborne disease. Thus the various types of impurities and their relative amounts must be determined to ascertain the quality of sewage.

Representative sewage sample were collected from the site during the last Mandalapooja season. The samples were preserved at suitable temperature and were analysed. Following table (Table 26) shows the results of the analysis.

Table 26 : Composition of Representative Sewage Sample

Sl. No.	*Constituent*	*Concentration*
1.	pH	6.7
2.	Total COD (mg/l)	1650
3.	Total BOD5at 20°c (mg/l)	980
4.	Total Solids (mg/l)	1250
5.	Suspended solids (mg/l)	560

Source: Primary Survey and Analysis

The above concentration shows that the sewage generated at Sabarimala is very strong in nature. A typical domestic sewage designated as strong. A typical domestic Sewage designated as strong sewage will be having a BOD of about 400 *mg/l.* The very high values of BOD and suspended solids have to be considered while designing the treatment system. As such, preliminary, primary, secondary and territory levels of treatment are required to bring down the high BOD and suspended solids concentration to permissible levels.

4.1.1.2 Institutional Arrangement

The sanitation facilities are provided by TDB and SSS. The latter constructs temporary toilets at Pampa and trek route and maintains the same during the peak season. TDB is primarily responsible for constructing and maintaining sanitation, drainage and sewerage system. The daily operation of the permanent public toilets is being auctioned out and private operators operate and maintain the services by collecting user charges. Although user charges are fixed by TDB, pilgrim surveys and site observations have proved that the contractors levy higher charges during peak pilgrim days. This is also indirectly evident from the higher auction rates for which these toilets are let to the private contractors by TDB. The wastewater treatment unit at Pampa is also being run on contract basis during the pilgrim season. NGO participation in Sanitation is minimal.

4.1.2 Supply Characteristics: Sanitation Facilities

4.1.2.1 Extent of Facilities viz a viz Requirements

Existing Sanitation facilities at Pampa would be sufficient for the possible accumulation of pilgrims at Pampa once the Nilakkal area is developed. Proposed facilities at Nilakkal would cater for the road users while the facilities proposed at Pampa would cater mainly for the pilgrims trekking from Erumely. However, Cheriyanavattom area, at the end of the trek route from Erumely to Pampa, would need more toilet facilities. In addition, temporary toilets would be required at Hilltop area to serve on the Makarajyothi day.

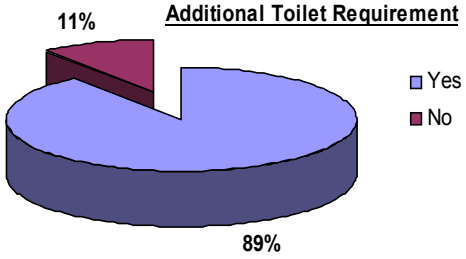
4.1.2.2 Quality of Facilities Provided

Permanent toilets are poorly maintained by the contractors. It has been reported that the contractors mostly close the toilet wings as if to clean and forces the pilgrims to queue up outside and thus create a ‘false’ demand. Because of this, there exists a perceived insufficiency of permanent toilets.

In addition, temporary toilets are poorly maintained and not provided with sufficient water. It is equally important to maintain these. Along the trek route from Pampa to Sannidhanam, temporary facilities are provided, which are rendered unusable after initial use itself. The closet pan gets hot and becomes difficult to squat and the area gets muddy and unhygienic. Lack of sufficient water, inadequacy of the pit latrine arrangement and maintenance of the toilets are the main issues here.

4.1.3 Pilgrims Demands and Preferences

4.1.3.1 Demand – Supply Gap in Sanitation Facility Requirement



Results of the pilgrim perception survey and discussion with pilgrims and staff points out that around 85 percent of the pilgrims required adequate toilet facilities. When indicated that such facilities are already available, the pilgrims reasoned that they are costly and inaccessible.

Figure 5 : Pilgrim Perception on the need for Additional Sanitation Facility

Thus the most important gap between demand and supply is the quality of services and lack of accessibility.

4.1.4 Issues, Resource Constraints and Impacts on Environment

a) At Pampa

Most of the issues given below are temporary till Nilakkal is developed as a base camp (then Pampa would be just a place of ritualistic importance for majority of pilgrims)

i. Toilet facilities are inadequate and inaccessible due to both operational and siting issues.
ii. Pilgrim resort to open defecation near the river and in the forests around
iii. Capacities of septic tanks are in adequate.
iv. The existing STP does not have sufficient capacity to cater to the peak demand during the Mandalapooja and Makaravilakku periods.
v. The procedure now adopted in the STP will not deliver an effluent of acceptable standards for discharge into the river. The treated effluent from the existing treatment plant was tested and found to contain BOD ranging from 230 to 410 mg/l. This is much above the prescribed standards to discharge.
vi. The river gets polluted on account of open defecation
vii. Lack of proper system to collect and treat waste water from hotels without overflowing.

b) At Sannidhanam and Trek routes from Pampa to Sannidhanam

i. Toilets and urinal facilities are inadequate especially along the trek route from Pampa to Sannidhanam. Pilgrims queue up from Marakkoottam to Nadapanthal during peak days without enough sanitation facilities and resort to urination and alfresco defecation rendering the area with foul stink.
ii. Capacities of the septic tanks are not sufficient to take the load of pilgrim season.

iii. Effluents from the septic tanks do not meet the acceptable standards, which ultimately reach and pollute the river.
iv. Temporary latrines are rendered unfit for use after the very first use
v. The temporary latrines invite fly and develop foul odour nuisance. Pits usually overflow or looks unhygienic
vi. Collection of water for use in toilet by dipping the bucket in the ground level tank is unhygienic.
vii. There is no sewage treatment plant to treat the sewage.
viii. Facilities at toilet blocks including the water supply system are inadequate.
ix. People resort to open defection which totally converts Sannidhanam unhealthy and unhygienic.
x. Lack of drainage system
xi. Wildlife especially bovines are seen feeding on the waste and excreta left in the Sannidhanam area and the forests around after the season.

4.1.5 Projected Demand and Quality Requirements

a) At Pampa

The sanitary facilities are required for a population of 66900 including staff and service personnel. At present there are 850 toilets along with the proposed toilets at Pampa, would be sufficient to meet the requirement at Pampa when Nilakkal is developed as a base camp. The sewage quantity can be estimated as 80percent of the 4.50 MLD of water required here i.e., 3.60 MLD. In addition, sewage from Valiyanavattom and toilets along the routes from Pampa to Marakkoottam can be treated here.

Quality of treated sewage should conform to the norms prescribed by KSPCB. Quality should be such that it could be sprinkled deep into the forest. Chemical content in the treated sewage should be nil as it would otherwise harm the environment and hence biological process may be adopted.

b) At Sannidhanam

Similarly, considering the projected water demand for Sannidhanam (including Queue Complex) to cater for full *darshan* capacity at 9.5 MLD, sewage quantity can be estimated as 8Mld.

4.1.6 Proposed System

a) At Pampa

i.) Upgrading Sewerage Treatment Plant at Pampa

A 3.2 MLD capacity STP has been installed at Pampa for treating raw sewage collected from Pampa. The sewerage network consists of pumps and pipe lines connected to the septic tanks and collection pits. The treatment plant is operational only during the peak pilgrim season. The sewage from septic tanks and the sullage collected from the hotels and restaurants is pumped to the STP for treatment. Capacity of existing STP is inadequate capacity to handle peak demand load; existing treatment process may not be adequate

In order to meet the KSPCB's regulatory standards for discharging of effluent into River Pampa, the following process modification of the existing STP located at Pampa has been recommended:

- The existing Plant will be augmented with additional capacity to the tune of 1.5 MLD to cater the treatment of waste water arising from additional toilets including mobile units at Pampa parking area, toilets along the routes from Pampa to Sannidhanam. The additional plant will have the chemical process, and effluent from both units will be taken through anaerobic filter, sedimentation tank, chlorination and contact time tank.

- The existing treatment based on Chemical process need some improvement to bring the effluent to acceptable level. Additional requirements would be anaerobic bio-filter, sedimentation tank, sludge digester and sludge drying beds.

  The actual forestland requirement for upgrading the existing STP plant at Pampa would be **1.00 ha**

ii.) Provision of Toilet Blocks at Pampa

Due to lack of toilet facilities, inadequate associated infrastructure, along with operational mismanagement related issues, many pilgrims resort to open defecation polluting Sannidhanam and its surroundings, in addition to polluting the entire water body, especially near the bathing ghats of Pampa and Thriveni-Pampa.

As documented in the Pampa Action Plan, it is required to construct additional toilet blocks at Pampa to prevent open defecation and polluting Pampa River. Provision of 100 toilet blocks adjacent to the existing toilet blocks at Pampa is recommended, for which additional forestland area requirement is 0.03ha. In addition, it is also proposed to reconstruct existing toilet block near parking area (level one) at Pampa. For providing 50 toilets and sufficient hand-washing facilities here, an area of 0.025ha would be required.

Thus, a total of **0.055 ha** would be required for provision of additional toilet facilities at Pampa. The location earmarked for provision of additional toilet facilities falls within the leased area already in use by the TDB.

i) To reduce defecation in the open
   a) Provide sign board showing directions to toilets and ensure proper lighting.
   b) Provide proper barricades and lighting to avoid open defecation to prevent contamination of river banks.
   c) Conduct awareness programmes for pilgrim especially for pilgrim group leaders (Periyaswamis / Guruswamis) on environment protection. Service of NGOs, ASS, devote organization etc. can be made use of in the awareness programme
   d) Enforce strict prevention of open defecation with fencing and closing approaches, and watch and ward by staff / volunteers.

ii) Upgrading sewage collection net work.
   a) Sewage collection tank, pumping system and Sewer Lines at Pampa
   b) Connect all buildings (Permanent and Temporary) to the sewer network.
   c) Provide separate conveyance system for sanitary sewage and storm water.

d) Permanent septic tanks / pre cast tanks with effluent soaking pits to be dug in at places where temporary toilets would be provided. These should be connected to STP and every year, temporary toilets should be connected to these as against providing individual pits.
e) Clean all the septic tanks before the beginning of the pilgrim season.
f) Send all sanitary sewage to the sewage treatment plant

iii.) Performance improvement of the existing sewage treatment plant

Appropriate polishing biological treatment procedures should be integrated to the existing physico-chemical process to get effluent of acceptable standards.

iv.) Upgrading and augmenting toilet blocks

a) Provide sufficient hand washing facility in each toilet blocks.
b) Provide water taps in the toilets to prevent the present practice of dipping buckets in the tanks.
c) Provide urinals of 300 nos (inside toilet blocks) with proper design to prevent misuse.
d) Provide intermittent flushing facility both at toilets and urinals.
e) Provide metallic mugs to make ablution easier instead of pouring entire water from buckets and the mugs are to be chained to the toilet room wall.

v.) Improvement of sullage and drainage system

a) System to convey (open drain) and collect sullage from hotels and other sullage generators are required to be provided. Collected sullage should be directed to the area provided for upgrading the STP at Cheriyanavattom (1 ha already allocated) and treated using 'plug flow' baffle reactor and further subjected to disinfection through chlorination. Capacity of sullage treatment facility should be 1 MLD.
b) In the immediate, provide lined sump well with no spill / overflow possibility (grouped and raised above the ground, better traps for solids from hotels; overflow to be directed to separate sump) for collecting wastewater and sludge generated in hotels and buildings.
c) Arrangement through service access to suck the waste water with solids as immediate measure
d) Segregation of existing drains and provision of new drains
e) Clean existing drains frequently

b) At Sannidhanam

i.) Providing a Sewerage Treatment Plant at Sannidhanam

In the absence of a sewerage system, the toilet waste treatment is carried out in the individual septic tank attached to toilet blocks and buildings. There are 69 septic tanks of total capacity to the tune of 8,253 cubic meters. As the usage exceeds design capacities during peak pilgrim season, the soakage pits overflow resulting in un-stabilized (untreated) effluent flowing out to the premises. The raw sewage and sullage eventually gets mixed with the water flowing through Kumbalam thodu, near Bhasmakulam, and finally drains into Njonangar near River Pampa, causing pollution of the bathing ghats. At present, sullage disposal facility including conveyance system does not exist at Sannidhanam except pits for temporary collection of sullage (soakage pits). During peak season these pits overflow and pools around or flows to

open drain leading to Njonangar. Njonangar discharges into Pampa near Cheriyanavattom. The septic tank effluents will not meet the required standards and hence require further treatment.

The treatment proposed consists of high rate anaerobic process followed by aerated facultative polishing ponds. This is expected to provide an effluent of acceptable standards. However the effluent has to be disinfected by chlorination before discharging to the natural water- course. Total capacity of STP at Sannidhanam would be 5 MLD. This may also be constructed as two units in two locations in Sannidhanam considering the gradient requirements

This would require construction and commissioning of a sewerage treatment plant (STP) at Sannidhanam. The proposed STP should incorporate biological treatment concepts to meet the KSPCB's regulatory standards for discharging of effluent into Kumbalam thodu or to be sprinkled deep into the forests.

Components of the plant:

1. Equalization Chamber
2. Pump House
3. Screen cum grit chamber
4. UASB in modules of 2 MLD, 5MLD, 5MLD
5. Sludge transferring pump for sludge seeding,
6. H.R anaerobic bio filter in similar modules of UASB,
7. Secondary Settling,
8. Chlorination and contact time detention tank
9. Sludge pumping, drying and temporary storage of dried sludge,
10. Gas storage and flaring
11. Store and staff rest room

The actual forestland requirement for constructing a STP at Sannidhanam would be **1.25ha**

ii.) Provision of Sullage Treatment Facility

As the water supply to Sannidhanam gets augmented in Stages, separate sullage treatment facility may be provided for around 2 MLD. System to convey and collect sullage from hotels and other sullage generators are required to be provided. Collected sullage should be directed to the area provided for improving STP (1.25ha already allocated) and treated using 'plug flow' baffle reactor and further subjected to disinfection through chlorination.

In the immediate, provide lined sump well with no spill / overflow possibility (grouped and raised above the ground, better traps for solids; overflow to be directed to separate sump) for collecting wastewater and sludge generated in hotels and buildings.

iii.) Construction of Main Sewer Line from Marakkoottam to STP at Sannidhanam

A full-fledged "Queue" Complex between Marakkootam and Sannidhanam having basic facilities such as drinking water, electricity, toilets and food stalls to relieve the pilgrims of the inconvenience of standing in queues for indefinite hours has been recommended. Toilets provided in each cell / compartment of the queue complex, will be connected to septic tanks

which will in turn be connected to an equalization chamber which will be located at Marakkoottam. The effluents from the chamber will be pumped and conveyed eventually to the proposed treatment plant at Sannidhanam. For this, a main conveyance piping will have to be laid from Marakkoottam to STP at Sannidhanam

As the sewer line would be laid below the ground along the proposed right of way (of 7m finished width including the width of the existing route), no additional forestland would be required for this purpose

iv.) Equalization Chamber and Pump House at Marakkoottam

A full-fledged "Queue" Complex between Marakkootam and Sannidhanam having basic facilities such as drinking water, electricity, toilets and food stalls to relieve the pilgrims of the inconvenience of standing in queues for indefinite hours has been recommended. Toilets provided in each cell / compartment of the queue complex, will be connected to septic tanks which will in turn be connected to an equalization chamber which will be located at Marakkoottam. The effluents from the chamber will be pumped and conveyed eventually to the proposed treatment plant at Sannidhanam.

The actual forest land requirement for this purpose would be **0.25ha**

v.) Provision of Bathroom Facilities at Sannidhanam

Currently bathing facilities are limited to bathrooms attached to the lodging facilities. Hence, pilgrims resort to bathing in Bhasmakulam and small rivulets around, which leads to pollution and health and hygiene issues. In view of pollution in rivulets of Pampa, the Pampa Action Plan has recommended provision of additional bathing facility at Sannidhanam.

The actual forestland requirement for provision of 100 bathroom facilities at Sannidhanam would be **0.05ha.**

vi.) Provision of Toilet Blocks at Appachimedu

Currently, there are no toilet facilities along the traditional trekking route. Considering the lack of such facilities along the trekking route, it is recommended to provide toilet blocks at Appachimedu, almost half way up the trekking route.

The actual forestland requirement for provision of 40 toilets and 20 urinals along the traditional trekking route would be **0.025ha.**

vii.) Provision of Toilet Blocks at Swamy Ayyappan Road

i) Currently there are no toilet facilities except some temporary arrangements with inadequate facilities along the Swamy Ayyappan Road. Associated issues include overflow of pits leading to pooling of effluent and fly and odour nuisance due to improperly sealed earthen pits of temporary latrines. To address this, and considering the lack of such facilities along the Swamy Ayyapan route, it is recommended to provide toilet block along Swamy Ayyappan Road.

The actual forestland requirement for provision of a toilet block of 40 toilets and 20 urinals midway along the Swamy Ayyappan route would be 0.025ha.

ii) In addition to the proposed midway toilets along the route, it is also proposed to provide two additional toilet blocks along the Swamy Ayyappan road for which two pockets each of 0.008ha have been identified. The actual forestland area required for these two additional intermediate toilet facilities on Swamy Ayyappan Road would be 0.016ha.

Thus, actual forestland area required for provision of additional midway and intermediate toilet facilities on Swamy Ayyappan Road would be **0.041ha**.

viii.) Other proposals to

i) Reduce open defecation

a) Provide signboards showing direction to the toilets.
b) Conduct awareness program to the pilgrims especially for leaders on environment protection through NGOs, ASS, and other devotee organizations.
c) Enforce strict prevention of open defecation with the support of security staff and volunteers.

ii) Upgrade and augment toilet facilities

a) Provide sufficient hand washing and flushing facilities in the toilet blocks.
b) Provide additional 300 nos of toilets and 600 nos of urinals, preferably in the queue complex.
c) Provide water taps in the toilets to prevent the present practice of dipping buckets in tanks.
d) Provide intermittent flushing facility both in toilets and urinals.
e) Provide metallic mugs properly chained to the toilet wall.
f) Provide taps on the side wall of ground level water tanks to prevent dipping of buckets in the tank.
g) Improve the management and maintenance aspects. Contract clauses should spell out the time and duration for cleaning. Intermittent common flush to be provided. Preferable management through volunteer groups / NGOs
h) Access to toilets should be clear and visible.

iii) Upgrade sewage collection network

a) Sewage Collection Tank, Sewer Lines and Pumping System at Sannidhanam
b) Connect all buildings (permanent and temporary) which are not provided with septic tank to a sewer network.
c) Provide a sewer network to collect and convey all sanitary sewage to a sewage treatment plant.
d) The existing septic tanks in good conditions can be made use of.
e) The effluents of these septic tanks are to be connected to the sewer network.
f) Till an STP at Sannidhanam is established the septic tank near Bhasmakulam is to be emptied at required intervals using vacuum pump. The collected wastewater is to be disposed off through the STP at Pampa.
g) Provide squatting pans with water seal (ESP type) over pit latrines till sufficient number of permanent type latrines are made available. Trench latrines should be avoided to prevent fly and rodent nuisance. Precast septic tanks / permanent tanks

may be constructed / provided at places where temporary latrines are to be erected year after year and these need to be connected to nearest STP. Thus, the need for providing pits every year can be avoided.

h) Clean all septic tanks before the beginning of the pilgrim seasons. Tanks along trek route may be cleaned using tractor mounted sucking pumps.

iv) Upgrading Drainage Network

a) Wastewater to be sent suitably to the proposed STP / sullage treatment system.
b) To ensure better drainage, clean all the drains frequently.
c) Provide separate contour drainage system for storm water which can be discharged directly into the Kumbalam thodu.

4.2 Sanitation Facilities at Nilakkal

4.2.1 Existing System and its Characteristics: Nilakkal

At present the forest land is in the process of getting transferred for developing as a base camp. Existing facilities are only for those labourers who were earlier involved in the activities in the rubber estate here. Hence the facilities are being developed to cater for the pilgrims and staff.

4.2.1.1 Toilet and Bathroom Facilities

Initially there were around 70 nos of toilets existing at Nilakkal in additions to one used by plantation labourers. The wastewaters from these toilets are collected in septic tanks attached to toilets. The existing toilets had been renovated prior to last pilgrim season (2005-06) and were provided with proper flooring, pans and doors. These toilets are not adequate to cater to the needs of the pilgrims, support personal and administration staff. Water is supplied to the toilets for flushing and washing purposes from the existing overhead tanks through temporary pipelines. Water is collected in central ground level tanks in front of the toilet blocks and pilgrims dip the buckets in the tank and draw water. Hand washing facilities are not provided for these toilets. Method of taking water form tanks by dipping buckets is unhygienic. The pilgrims mostly resort to open defecation in the absence of toilet facilities.

After the transfer of 110 ha of land at Nilakkal for base camp development TDB has constructed around 400 toilets. Twin blocks of 80 toilets are provided at 5 dispersed locations. These toilets are designed to have proper hand washing facilities at the centre. However, these were not opened for use during the last pilgrim season for want of completion of sewage treatment system.

4.2.1.2 Sewage Treatment System

As such there was no sewage treatment system at Nilakkal except for septic tanks attached to the existing toilets. As the area is proposed for development as a base camp, it is proposed to have a full-fledged biological treatment system here. The construction of such a system had been initiated at Nilakkal prior to last pilgrim season (2005-06). Details of the proposed system are presented in section 4.2.5. Existing facilities need to be augmented if the area is to accommodate around 1 lakh pilgrims.

4.2.1.3 Institutional Arrangement

TDB usually leases out the toilets to the contractors on lump sum contract during pilgrim season. The contractor would be responsible for maintaining and operating the toilets during the season and would hand it over to TDB after the season. The pilgrims pay 'user fee' for using the toilet facilities.

4.2.2 Pilgrims Demands and Preferences

Pilgrims strongly feel that the aspect which needs improvement in any base camp area is the sanitation facilities. Around 57percent of the interviewed pilgrims feel that sanitation facilities should be given top priority for improvement. Around 37percent of the pilgrims opined that number of toilets should be increased. Pilgrims who were interviewed at Nilakkal pointed out that it would be a great respite if the 400 newly built toilets with hand washing facilities are opened to public for use.

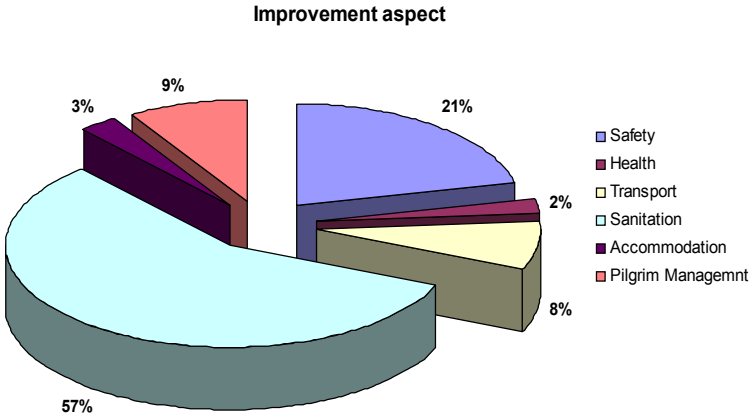


Figure 6 : Pilgrim's Preference for Various Amenities and Facilities at Nilakkal

4.2.3 Issues, Resource Constraints and Impacts on Environment

a) Lack of toilet facilities for the pilgrims
b) On account of open defecation, the water sources get contaminated
c) System for collection, treatment and disposal of sewage and sullage absent
d) Storm water collection and disposal system absent

4.2.4 Projected Demand and Quality Requirements

Quantity of Liquid waste to be treated has been estimated considering that a total of 600 toilets be provided here for a population of 1 lakh. Sewage generated would be at a rate of 6 litres per capita adding to a total of 6 lakh litres. In addition, sullage discharged as a result of permanent accommodation for 30000 people is assumed to be a rate of 70 litres per capita. Thus total quantity of liquid waste generated is estimated as 21 lakh litres.

4.2.5 Proposed System at Nilakkal

System required for 600 toilets (3 MLD sewage) is described here. As Nilakkal would further develop as a full fledged base camp, it is expected that a maximum of 600 more toilets would be constructed here. As a second phase, after 2015, once the camp gets into the next stage of

development, further facilities of similar dimensions (for 3 MLD additional) as provided here need to be constructed at Nilakkal.

a) Improvement of Existing toilets at Nilakkal

It is proposed that existing toilets (70 numbers) at Nilakkal be improved and 400 numbers of new toilet units at the ground floor be provided to serve the pilgrims, support and administrative personnel. In addition, it is proposed that sewage from the toilets is collected in a modified form of septic tank. Water supply to toilets for flushing and hand washing requirements is also proposed. Possible utilisation of roof space created for harvesting rainwater needs to be explored.

The existing 70 number of toilets were improved during the pilgrim season 2005-06. In addition 10 toilet blocks consisting 40 toilets each with hand flushing facility are constructed based on the details provided by Ecosmart[14].

b) Proposals for collection, treatment and disposal of liquid waste

The sewage from toilets is collected through pipe system and discharged into bio-reactor. From the bio-reactors the partially treated effluent collected is sent to collection well. From the collection well the sewage goes to the treatment system. The sewage generated from the toilets for the people of permanent accommodation of 30,000 also is to be connected to bio-reactors.

c) Sewage treatment and disposal

The pattern of wastewater that is generated at Nilakkal is quite different from the domestic wastewater that is generated in a colony or township. The quantity of wastewater generation, the pattern of pilgrim season and the location for the final discharge of the effluent are to be considered while adopting a treatment methodology. Basically there are two processes of biological treatment system viz, aerobic and anaerobic. Aerobic system is very sensitive especially when there are intermittent hydraulic /organic shock loads. In addition, continuous power supply is required for aeration, failure of which will upset the process. Restarting the process takes considerable time and during which period shock loads cannot be accepted. Hence aerobic system is technically not suitable in the present situation. Among the anaerobic systems, the UASB is the latest version consisting of improved technical features like GLSS, up flow mode of wastewater flow which considerably improves effluent standard. More over, the system will not fail with low input loads than the designed one. In addition, the system does not require continued power supply and require only very little maintenance. These advantages appear to be appropriate for the conditions prevailing at Nilakkal. Hence UASB technology is adopted with certain modifications to suit the local and environmental conditions prevailing at Nilakkal. Another anaerobic system is the fluidized bed reactor wherein the sludge bed is fluidized by providing a recirculation of the treated effluent by pumping. This is expected to increase the treatment efficiency. But in the case of domestic wastewater of which the BOD is relatively low the recirculation process for this reduces the organic strength and the treatment efficiency is limited by low concentration gradient. Moreover, the high up flow velocity will blow out the fine suspended solids in the sewage

[14] Ibid

thereby reducing the efficiency. Moreover, the system demands high operating energy due to recirculation pump. Hence that system is not appropriate and not adopted for Nilakkal.

It is proposed that the wastewater is to be subjected to two-stage biological treatment followed by tertiary treatment of disinfection. In the first stage, the wastewater is to be treated in a High Rate Bio-Reactor which is a version of UASB. The effluent from this Reactor is to be further polished in 'aerated plug flow facultative lagoon'. The effluent from this lagoon is to be subjected to tertiary treatment of disinfection before its final discharge into the natural ecosystem.

The quantity of wastewater generation in toilet blocks:

In order to design the wastewater treatment system it is necessary to know the quantity of wastewater produced from the toilet blocks. Each toilet block consists of 40 toilets. It is assumed that all these toilets will be under continuous use for 20 hrs a day during the peak days of Mandalapooja and Makaravilakku seasons. Assuming that, on an average the time taken by a person in the toilet is 10 minutes and the water consumed is 5 litres / person. It is worked out that 120 persons will be using a toilet per day and the sewage produced will be 600 litres/toilet at the rate of 5 litres/ head. Considering the water used for washing face, hands etc. the sewage production per toilet is taken as 750 litres/ day. Hence the wastewater flow from one toilet block is 30 m3/ day.

The wastewater treatment technology adopted:

High Rate Bioreactors: These are specially developed and designed wastewater treatment units based on concepts of well established and documented UASB reactors. Even though the reactors operates at low hydraulic retention time (HRT) the special provisions in the reactor for achieving biomass retention ensures high biological sludge retention time (BSRT). The wastewater distribution system provided at the bottom of the reactor, the up flow mode of the wastewater through the highly active bioflocs and the gas - liquid - solid separator provided at the top of the reactor contributes to the efficient BOD and suspended solids removal.

At Nilakkal base camp, the sewage from two toilet blocks (60 m^3 / day) is proposed to be treated in one High rate Bioreactor. The reactor is designed for a hydraulic retention time of 8 hrs. Providing additional space for storage of digested sludge the size of one reactor should be 3.5 x 3 x 4 m.

Second stage polishing treatment:

Even though bio-reactors are designed for the complete treatment of wastewater, the effluent from the bio-reactors cannot be directly discharged into the human habitat area / animal habitat area in forests, as the effluent may not strictly meet the specification for such discharges. Hence secondary polishing treatment of the effluent is needed to achieve the specific requirements. At Nilakkal, as indicated, this is proposed to be carried out in the newly developed 'aerated plug flow facultative lagoon', the concept of which is derived from the latest and established domestic wastewater polishing systems.

It is necessary to make the effluent that comes out after treatment of domestic wastewater in the proposed high rate bio-reactors eco-friendly. The effluent of low BOD needs aeration,

completion of the stabilisation process (a major part of stabilisation would have already carried out in the reactors) and disinfection. The latest technological findings indicate that specific microbial consortium could be developed to aid the polishing process for the particular wastewater to be polished to make the process more effective. In addition, the plug flow design will ensure fast and complete stabilisation of the effluent. (In plug flow mode the concentration gradient of organic matter will be much higher than that of completely aerated and mixed lagoons.) Aeration is proposed to be carried out through surface aerators. It is known that in Kerala, the appropriate microbial consortium is developed at the laboratory of School of Environmental Studies of Cochin University of Science and Technology, Ernakulam campus and is available on request. This, if available can be procured from other sources as well. Such microbial consortium is proposed to be used in the lagoon.

In the 'aerated plug flow facultative lagoon', only the top layer is to be aerated by the surface aerators. This will ensure removal of dissolved gases. In addition, the surface will not be suitable for mosquito larva growth. Thus, this process will ensure elimination of mosquitoes and odour. (Technology is available to separate element sulphur from sulphur compounds through specialised microbes. This also is proposed to be tried in the present proposals. This procedure will help to eliminate the production of hydrogen sulphide that takes place in the process of anaerobic digestion). The depth of the lagoon is so designed to support facultative microbial activity of the settled sludge at the bottom portion. The geometry of the lagoon is so planned to have length / breadth ratio of more than eight for the flow to develop plug flow conditions. The polishing system explained will complete the stabilisation of the unstabilised part of the organic matter. The effluent from the plug flow lagoon is proposed to be taken out through an overflow weir arrangement. This arrangement will control the escape of microbes and suspended solids along with effluent.

The tertiary treatment:

The effluent from the lagoon is to be discharged into another tank of designed capacity for disinfection of the final effluent before its discharge into the drain/canal/water course. This disinfection is proposed to be carried out by adding bleaching powder solution (or alternatively any effective disinfectant) and mixing with the effluent from the lagoon. The capacity of the tank is so designed to provide enough contact time for effective disinfection. After the disinfection, the effluent will be stable and free from any bacteria for safe discharge into any drain/canal/watercourse or sprinkled amidst the trees in the natural ecosystem. The effluent is to be discharged through properly designed outlet of the tank.

d) Collection, treatment and disposal of sullage

Sullage generated from permanent accommodation area is proposed to be collected separately through open drains and connected to a sump well. Separate sullage treatment facility may be provided for around 1.5 MLD. System to convey and collect sullage from hotels and other sullage generators are required to be provided. Collected sullage should be treated using ‘plug flow’ baffle reactor and further subjected to disinfection through chlorination. After 2015, additional provision (minimum 0.5 MLD) to treat sullage from mainly bathing facilities may be provided.

e) Collection and disposal of storm water

Storm water is proposed to be collected along contour drains. The water from the contour drains is to be inter-connected to the radial drains which are to be ultimately drained in to the contour trench on the periphery of the proposed reservoir.

4.3 Sanitation Facilities at Erumely

Congregation of large number of pilgrims in a small town like Erumely for a short duration is imposing much pressure on environment. Basic facilities such as drinking water, sewage disposal, garbage disposal, transportation, food and accommodation remain inadequate to meet the basic minimum needs. As a result, the environment is suffers from stress resulting in water pollution, land pollution, air pollution and consequent ill effect on the health of the people.

4.3.1 Existing System: Erumely

4.3.1.1 Toilet and Bathroom Facilities

There are 225 toilets owned and operated by the Devaswom Board (Temple Trustee ship) in addition, there are 142 privately operated toilets, about 100 temporary toilets are also made available every year, totaling to 470. Separate urinals are not seen provided. The Kerala Tourism Development Corporation has established a Pilgrim Service Centre with 100 toilets, worth Rs.1.5 crores. These numbers do not add up much for the lakhs of people who throng the township. Hence it is natural for the pilgrims to resort to Al fresco / open defecation. The whole place becomes, in the pilgrim season a single open air latrine. The Panchayat records reveal that, only 55 percent of the families have sanitation facility at household level. Most of the facilities during the season are provided by households who have land along the routes. The toilet facilities thus provided are mostly open pit latrines.

4.3.1.2 Sewage Treatment System

Facilities provided at Erumely for the collection, conveyance, treatment and disposal are grossly inadequate. At Erumely, most of the toilets are on-site trench type (temporary) and are being constructed near the river and hence the leachate from the latrines reaches the river. Unscientific disposal of sewage is causing severe water pollution problem.

Even the wastes removed from the township are left untreated in the open places or the rivulets. Stench and mosquitoes/fly menace is highly noticeable. All the tanks of the latrines empty into the Koratty River and no mechanism to treat the human waste exists today. Drains are not made permanently. The waste water from hotels and other commercial establishments also finds no proper disposal option.

Septic tanks of almost all the toilets leaks and overflows, and sewage reaches the rivulet, contaminating it. Open defecation is a prominent issue at Azhutha River. Bath, toilet facilities and food are priced very high during season due to the lack of monitoring by concerned authorities and lack of enforcement of common pricing system.

Fly menace and communicable diseases after the season exposes the lack of sanitation services and facilities.

4.3.1.3 Institutional Arrangement

In addition to TDB and the Jama-ath, main facility providers at Erumely are the households either for fixed fee or free of cost following the long followed tradition.

4.3.2 Pilgrims Demands and Preferences

4.3.2.1 Demand – Supply Gap in Sanitation Facility Requirement

Most important demands of the pilgrims at Erumely were water and sanitation. Open defecation along the rivers rendered most of the edges unusable. Pilgrims are concerned about the quality of water available for all purposes.

4.3.3 Issues, Resource Constraints and Impacts on Environment

a) Inadequate Toilet and urinal facilities
b) Lack of waste / sewage treatment systems
c) Open defecation and bathing activity of the pilgrims after the ritual dance, polluting the Erumely thodu, Manimala and Pampa River systems

4.3.4 Proposed System at Erumely

a) Toilet Facilities

It is proposed to provide toilet facilities for a population of 40,000 assuming that all the existing facilities will cater to the fluctuating demand along with the peak demand. The number of toilets required at Erumely is 500 (considering 60 persons can use one toilet in peak 5 hrs and providing facility for 80percent of population during peak hour. It is also proposed to provide 150 Nos. independent urinals.

- At Peruthodu, 40 toilets are proposed.
- Along trekking route at Koikalkavu 10 nos. toilets.
- At Kalaketty Temple, 20 toilets are proposed.
- At Azhutha 40 Nos. of toilets are proposed.
- At Orunkal kadavu where people resort to open defecation, 40 Nos. of toilets are to be provided to prevent the practices of open defecation.

In addition schemes for providing toilets to households in Erumely may be pursued especially as the households are traditionally involved in providing toilet facilities and accommodation for pilgrims.

Note: The toilet facilities proposed along the trekking paths may be arranged by the EDCs/ forest department.

Provision of facilities for toilets and bathing on the banks of River Pampa flowing along the boundary of Erumely Panchayat are to be included in the Pampa Action Plan.

Need to prevent open defecation at Azhutha and other rivulets along through signages and awareness building.

b) Sewage Treatment

For the newly proposed toilets at Erumely, treatment of sewage is to be carried out in high rate bio-reactors. Around 80 toilets can be connected to one bio reactor of size 3.50 x 3.0 x 4.0 m. Hence seven bio reactors will be required for 500 toilets (Bio reactors proposed are the

same as that proposed for Nilakkal). Effluent from the bio reactor is proposed to be further treated through a constructed wet land. The effluent from the wet lands can be discharged after disinfection into natural water course as it will meet the effluent standards. The area required for wastewater treatment including that for the construction of wet land is one acre.
The existing septic tanks attached to toilets do not have adequate capacity resulting in overflows and effluent of poor quality. It is suggested that wherever possible the effluent from existing septic tanks is to be treated in bio reactors. Waste water from the urinals is also to be connected to the reactors.

The sewage from the toilets proposed at Peruthodu, along trek route, Kalaketty, Azhutha and Orunkal Kadavu is proposed to be treated at the respective places in high-rate bioreactors of size 3.5 x 3 x. 4.0m. The partially treated effluent is proposed to be polished in a constructed wet land in the forest area except for Orunkal Kadavu. However, species of plants and other details need to be finalised in consultation with wildlife experts.

c) Sullage treatment

Facility for conveying sullage from all hotels and establishments need to be provided. Separate sullage treatment facility may be provided for around 1.5 MLD initially. Collected sullage should be treated using 'plug flow' baffle reactor and further subjected to disinfection through chlorination. After 2015, additional provision (minimum 1 MLD) may be provided to treat sullage.

Note on Land requirement

For the construction of toilets, urinals showers, treatment of wastewater etc. additional land is required. The Panchayat has already decided to acquire 3.0 acres of land by the side of Erumely Chennappady road in Erumely South village for providing pilgrim facilities. However land proposed for water treatment facilities is to be additionally acquired. In addition land requirement along the trekking route is to be arranged by the forest department as all the proposals coming in the forest area are proposed to be carried out by forest department. Land required at Orunkal Kadavu for toilet facilities and treatment of waste water need to be acquired.

4.4 Sanitation Facilities at Vandiperiyar

Pilgrims from Tamilnadu mostly pass through Vandiperiyar and Kumily. They either reach Kumily or Vandiperiyar town in private vehicles or public transport and hire private jeeps or avail KSRTC buses to travel to Uppupara through Vallakkadavu. Sanitation facilities are the critical requirements at Vandiperiyar Town, Uppupara (during Makarajyothi) and Sathram through which the pilgrims pass.

4.4.1 Existing System : Vandiperiyar

4.4.1.1 Toilet and Bathroom Facilities

At Vandiperiyar town, there are around 12 toilets constructed by the Panchayat, in addition to temporary ones, which are provided during the peak season by the private sector (who owns land along the road edges). Pilgrims bathe in the river Periyar or its tributaries. Due to the lack of toilet facilities, rampant open defecation is observable at Vandiperiyar, Sathram and Uppupara.

Major source of water are the river and the wells which usually gets polluted during the season. Panchayat also provides some toilet facilities at Sathram during the main pilgrim season. At Sathram, there are 5 toilets constructed by TDB near the temple.

Lack of toilet facilities at main places of pilgrim activity is evidently observable.

4.4.1.2 Sewage Treatment System

Sewage is mainly treated in Septic tanks connected to the toilets. Temporary toilets are generally pit latrines which are closed and covered after the season.

4.4.1.3 Institutional Arrangement

Facilities are mainly provided by the people who own land near road edges. As the passage of pilgrims is limited, the local body is not much involved in providing any appreciable facility.

4.4.2 Pilgrims Demands and Preferences

Currently they resort to open defecation in the forest areas or use temporary facilities provided. Pilgrims demand sanitation facilities at main points of pilgrim activities such as Uppupara, Sathram, Vandiperiyar Stadium, Kakki Kavala and Vallakkadavu.

4.4.3 Issues, Resource Constraints and Impacts on Environment

Main issues are:

- Lack of toilet facilities and sewage treatment system at Vandiperiyar Town and at places around where pilgrims concentrate.
- Open defecation harbouring fly menace

4.4.4 Projected Demand and Quality Requirements

Pilgrim count survey indicates that a maximum of 12000 pilgrims move to Sannidhanam from the Uppupara side in a day. Out of this, around 70percent alight at Vandiperiyar and take alternate transit mode. Around 120 vehicles are seen parked on a peak day at Vandiperiyar.

4.4.5 Proposed System

Considering the demand, it is proposed to provide 200 toilets for the use of pilgrims in the immediate term. As and when the usage increases, additional toilets (300 no.s more) are to be provided according to requirements. However, a major shift in the number of people who would be travelling through Vandiperiyar is not expected.

The waste water from the 200 toilets is to be treated in 3 nos. of high rate bioreactors of size 3.5 x 3.0 x 4m each. The effluent from the bioreactor is proposed to be further treated through a constructed wet land. It is proposed to set apart one acre of land for construction of toilets, bath facilities and sewage treatment facilities including constructed wet land.

The effluent from the constructed wet land is to be disinfected before discharging into the natural water course or used for irrigating plantation if found suitable as per standards set by KSPCB.

4.5 Sanitation Facilities at Uppupara

4.5.1 Existing Facilities

Uppupara grasslands are the main transit point of pilgrims from Tamilnadu who enters Kerala through Kumily border. They travel in buses or jeeps up to Uppupara mainly during the Makaravilakku season and move down to Sannidhanam from here. On return journey, they may prefer going to Pampa and returning via road / rail route. They congregate at the grasslands for around 8 to 48 hours for view of the Makarajyothi.

Currently temporary facilities are provided by the EDCs. However, large congregation of pilgrims here results in open defecation and heavy pollution of surrounding areas.

4.5.2 Demand Estimation

Main requirement of the pilgrims is sufficient toilet facilities and water supply at Uppupara grasslands during the peak days before viewing Makaravilakku. Pilgrim count survey indicates that on an average, around 160 vehicles is the peak concentration at Uppupara. Around 75,000 to 1,00,000 people concentrate here to watch Makaravilakku. Average stay duration here is 1.5 days.

4.5.3 Proposed System

a) Toilets and Bathing Facilities

The facilities presently available are not adequate to meet the requirement of the pilgrims. Additional toilets and related facilities are to be provided. It is proposed to provide 80 toilets at the rate of 1 toilet per 120 pilgrims for the average floating population. In addition to this, 40 urinals are also proposed to be provided.

Mobile latrines may be tugged to the location through the Koop road from Vallakkadavu currently used for movement of pilgrim vehicles. Suitable technology may be adapted for temporary toilets considering the water scarcity and wildlife movement.

b) Wastewater Treatment

The wastewater generated from the toilets is to be properly treated. It is proposed to treat the sewage in a high rate bioreactor of size 3.5 x 3.0 x 4.0 m. The effluent is to be further treated in a constructed wet land before final disposal. The area required for waste water treatment is one acre.

Alternately if mobile latrines connected to permanently laid pre-cast septic tanks are provided or if mobile septic tanks are provided, sucking units may be brought in as and when required and emptied to the STP proposed at Vandiperiyar.

Suitable technology may be adopted considering the less period of time the facilities are required and the wildlife movement. EDCs and NGOs traditionally involved in providing services to the pilgrims may be permitted to carry out season related arrangements here so as to preserve the environment.

4.6 Sanitation Facilities at Sathram

4.6.1 Existing Scenario

Currently, sanitation facilities at Sathram are meagre. Latrines attached to the temple are 5 in number and are used by the pilgrims. Water is provided from Azhutha Thodu by constructing a check dam. These would be insufficient for the proposed developments here.

As the Master Plan recommends development of Sathram as the main base camp for pilgrims, it is required to develop sufficient sanitation facilities for the pilgrims, drivers and other support personnel. Maximum number of pilgrims who move to Uppupara from Vandiperiyar (12000) may be taken as the maximum demand.

4.6.2 Proposed System

a) Toilet facilities

The facilities presently available are not adequate to meet the requirement of pilgrims once Sathram is developed as base camp. Additional toilets and related facilities are to be provided. It is proposed to provide 80 toilets at the rate of 1 toilet per 120 pilgrims for the average floating population. In addition to this, 40 urinals are also proposed to be provided.

Alternately, mobile latrines may be tugged to the location through the road from Vandiperiyar. Suitable technology may be adapted for temporary toilets considering the water scarcity and wildlife movement.

b) Wastewater Treatment

The wastewater generated from the toilets is to be properly treated. It is proposed to treat the sewage in a high rate bioreactor of size 3.5 x 3.0 x 4.0 m. The effluent is to be further treated in a constructed wet land before final disposal. The area required for waste water treatment is one acre.

Alternately if mobile latrines connected to permanently laid pre-cast septic tanks are provided or if mobile septic tanks are provided, sucking units may be brought in as and when required and emptied to the STP proposed at Vandiperiyar.

EDCs and NGOs traditionally involved in providing services to the pilgrims may be permitted to carry out season related arrangements in and around here considering the need to conserve the environment.

5. PROPOSED INTERVENTIONS

5.1 Development Vision

Provision of adequate water and sanitation facilities for the pilgrims in the region and at Sabarimala per se, with adequate care on conserving the environment and mitigating the existing environmental issues associated with lack of facilities.

5.2 Issue Prioritisation

The following issues are to be addressed to improve the water and sanitation services at Sabarimala and the region

- Inadequacy and operational issues of water supply schemes
- Lack of access to water for waiting pilgrims
- Poor quality of water available for drinking, washing and bathing purposes
- Open defecation in forests and along rivers and streams resulting in pollution of water bodies and impacts on health of the wildlife and people downstream
- Inadequate toilet and bath facilities
- Treatment related issues of water and waste water

Based on the detailed studies conducted, specific development interventions have been formulated. These include the following:

- Development and protection of water sources
- Development of adequate water treatment and supply facilities
- Development of drinking water supply facilities
- Development of Toilets, Latrines and waste treatment facilities
- Development of mechanisms to control pollution and to rejuvenate impaired environmental components

5.3 Compilation of Suggested Interventions for Water and Sanitation

Based on the findings of these studies, specific improvement proposals, both for short term as well as long term, have been formulated. The implementation of these development proposals would lead a long way in improving the facilities for the pilgrims, at the same time ensuring optimization of available resources and improving upon them wherever essential.

A compilation of all interventions proposed and their phasing is provided in the following table.

ANNEXURES

Annexure 1: Primary Surveys and Terms of Reference

Solid Waste Management

Scope:

The objective of this study was to collect baseline data related to the solid waste generated by the sources, the waste transported, disposed at present. The data generated through survey was used to arrive at the total generation, the present level of treatment/disposal, the backlog. The physical composition data was intended for assessing the scope for segregation for separating recyclables, treating organic waste, waste minimization especially plastic waste.

Water and Sanitation Surveys

Scope:

The study intended to assess the Quality and Quantity of water from various sources / used by various end users at Sabarimala. Proposed locations for quality assessment included Pampa, Kunnar (Sannidhanam) and Nilakkal (ponds and ground water). Sampling and testing was carried out as per the directions of Pollution Control Board / other applicable standards. Water quantity was assessed from the proposed users through water meters during appropriate time intervals. The collected data was analysed and compared with baseline data. Post-season studies were also conducted.

Terms of Reference

Solid Waste study

Waste Quantification and Characterization study

The objective of this study is to collect baseline data related to the solid waste generated by the sources, the waste transported, disposed at present. The data generated through survey should be used to arrive at the total generation, the present level of treatment/disposal, the backlog. The physical composition data is intended for assessing the scope for segregation for separating recyclables, treating organic waste, waste minimization especially plastic waste.

A. Listing and categorizing the sources of generation (Table –1)

- List the sources - area wise (Nilakkal, Pampa, Trek routes , Sannidhanam)
- Categorize the sources considering the quality/quantity of waste generated to identify the representative sources to be surveyed
- List the units of each category to be surveyed

B. Quantification of Waste generated (Table 2 a to 2c)

- Total waste generation /day during the season – Cover three days (a) during week days of the season, (b) during weekends, (c) during peak days
- Cover minimum of 5percent samples, minimum of one sample in each sub category.

C. Characterization - Physical composition of waste (Table 3)

- Analyze composite samples (Separate samples for each area) for the following parameters: food/organic/ flower/ green leaves, plastics (PET bottles, carry bags, plastic cans, other plastics) paper, cloth, glass, metals, cans, inerts (Silt, sand etc), others items like cattle dung/ donkey droppings etc.

D. Quantity of waste collected and transported, treated, separated for recycling (Table 4 and 5)

- Assess the quantity of waste collected and transported disposal yard - Three days
- Quantity of waste incinerated, composted, segregated for recycling
- Quantity of waste left without treating at the disposal yard

Separate tables have to be prepared for Nilakkal, Pampa, Sannidhanam and trek routes.

Sampling:

- Representative samples of all sources under B, C, D, E, F, and G covering all sub categories. A minimum of 2 sources will be covered under each sub category
- Dustbins /representative unit area of trek routes/parking area/ nadapanthals to assess the waste generated by pilgrims/others.

Sampling will be done for: 1. Week day in first half and second half of the season, 2. Weekend (Saturday/Sunday) in first half and second half of season. Generation of a day from the sources will be weighed and tabulated

Sampling of Dustbin and pilgrim route s will cover: stretch along Traditional trekking route, Swami Ayyappan Road, stretch in Pampa pilgrim route, Nadapanthal at Pampa and Nadapanthal at Sannidhanam.

Table 2a - Waste arising along trek routes, Nadapanthals and Parking area

Sampling area	***Length of route and no of bins***	***Qty in Kgs***		
		Day 1	***Day 2***	***Day 3***
Trekking route Stretch				
Swami Ayyappan Road Stretch				
Stretch at Pandithavalam				
Pilgrim route from Pampa foot bridge to Ganapathy temple				
Nilakkal-road stretches with dense movement of pilgrims				
Nilakkal- other stretches				
Parking area				
Nadapanthals and Parking area				
Nadapanthal at				

Sampling area	*Length of route and no of bins*	*Qty in Kgs*		
		Day 1	*Day 2*	*Day 3*
Ganapathy Temple				
Nadapanthal at Sannidhanam				
Temple premises at Sannidhanam				
Parking area at Pampa				
Nilakkal Nadapanthal Near Siva temple				
Other typical common area in Nilakkal				

Note : the dates on which the survey done has to be indicated. Use separate table if survey dates are different for Nilakkal, Sannidhanam, and Pampa.

Table : 2b Hotel and commercial establishments

Source sampled	*Type /area/location*	*No of employees*	*Qty in Kgs*		
			Day 1	*Day 2*	*Day3*
Hotels -Large					
Do- medium					
Do-small					
Shops					
Large					
Small					
Medium					
Appam Aravana complex					
Counters					
Others					

Note cover all categories of shops: e.g. Fruit /juice stalls, Stationery shops etc

Table: 2c Lodgings, Offices, Institutions

Source sampled	*Type /area/location*	*No of occupants*	*Qty in Kgs*		
			Day 1	*Day 2*	*Day3*
Pilgrim centres					
Lodgings					
Dormitories					
Others					
Police camps					
Staff /officers accommodation centres					
Workers camp					
Office Building					
Hospitals					

Table 3 : Physical Characteristics

Sl .no	Parameter	Date of sampling		Date of sampling		Average
		1	2	1	2	
1	Size of sample box,m3					
2	Weight of Sample box in Kg					
3	Weight of sample collected in Kg					
4	**Density in Kg/m3**					
A	**Physical Characteristics, percent to total weight**					
1	Organic matter Food /veg, fruit, flower waste, leaves					
2	Paper					
3	wood					
4 a	Plastic-Pet bottles					
4 b	Plastic- carry bags					
4 c	Plastic –other categories					
5	Rubber, leather, synthetic materials					
6	Metal					
7	Glass and ceramics					
8	Inerts- stone, earth					
9	Cloth/rags					
10	Others					

Table 4. : Quantification of waste transported

Sl no	*Vehicle no/type*	*Volume*	*No of trips*	*Qty transported*		
1				Day1	Day2	Day3
2						
3						
4						

Table 5: Quantification of waste recycled/incinerated/composted

Qty collected	*Incinerated*	*Composted*	*Recycled*	*Balance*
Day1				
Day2				
Day 3				

Water and Sanitation Study

I. Sabarimala Master Plan -Water Supply –Study of Resources

A. Identifying and Mapping of Sources
Water resources mapping with quantity, quality and sustainability aspects at Nilakkal, Pampa, Kunnar and other locations
Potential alternative sources possible to meet additional/-increased demand

B. Quantification
River flow measurement at Pampa/ Kunnar, Chenthamarakokka, Ambalakkayam and other locations as identified in the mapping
Water balance and possibility of release of adequate quantity of water from Pampa dam in lean period

C. Water Quality

Water quality/ pollution monitoring (E.coli, BOD, COD) along the river course for assessment of correct location of intake at Thriveni, Ambalakkayam and other identified locations of source

D. Detailed study of locations for check dams

Secondary data includes too sheet, remote sensing or similar data. Primary data includes width, depth, discharge and geophysical data. Indicative locations are:

a. Confluence at Thriven
b. Confluence of Kunnar and Pampa
c. Confluence of Gavair and Pampa
d. Confluence of Meenar and Pampa
e. Contour/ topo sheet/ remote sensing data for ascertaining the Carrying capacity and submergence at Nilakkal. (Kadauvathodu)

E. Ground water Study at Nilakkal:

Monitoring Ground water wells at Nilakkal during the season
Ground water potential in and around Nilakkal – quantity and Quality assessment

F. Surface water at Nilakkal

Yield test of ponds during the pilgrim season

G. Existing and proposed programmes

Existing Sources and the intake, treatment systems, issues
Proposed on going programmes and projects of KWA, TDB, Pampa Action Plan, Irrigation department, Ground Water department

II. Water demand study

A. Collection of base line data

1. Current estimated pilgrim arrivals at:
   - Nilakkal, Pampa, Sannidhanam.
   - Projections:
2. Current and projected Service persons of all sectors:
   - TDB, Police, KFD, KWA, KSEB, Hospitals, and NGOs Others: Staff, workers
   - Traders, vendors, Private service providers
3. Present and proposed land use patterns

Note: Part A will be covered under a separate study

B. Study of Existing System

The existing system for water extraction (groundwater or surface water intake), Quantity and quality of raw water, water treatment, Quantity and

quality of treated water, distribution network, wastewater collection, wastewater treatment and sludge disposal

Collect samples of raw water at sampling locations at Pampa, Kunnar and Nilakkal (Ponds and ground water.) Quality tests should be conducted (a) in the beginning of the season, (b) mid season, (c) prior to Makaravilakku

Quantity assessment should be made from

C. Water consumption (demand) Study

List all the users: Hotels, restaurants, shops, lodgings, offices, hospitals, toilet blocks Drinking water fountains, kiosks etc
Water usage at representative samples is measured using water meters or measuring consumption from on-plot storage tanks

Table a) Sample Survey for Assessment of Water Consumption

Users	Min. No. of Samples to be surveyed	Methodology
Toilet blocks	Two toilet blocks each at Nilakkal, Pampa, Sannidhanam	Get initial and final levels in the water tank provided in the toilet block during the period of survey, count number of pilgrims/others using the facility during the period. Count the users during week days, week ends, peak days Get per capita usage
Drinking water /wash fountains	One fountain block at Nilakkal	Provide meter to measure the quality consumed during the period of survey Count the number of pilgrims/others users of the facility during the period
Consumption in Hotels/restaurants	10percent Hotels/restaurants at Nilakkal, Pampa, Sannidhanam	Provide meter and measure the consumption during study period, count the number of costumers during the period
Do in shops/stalls	10percent under different categories	Do
Do in lodges/dormitories	Two each	Do and count the occupancy during the period
Do in office blocks	Two each at Nilakkal, Pampa, Sannidhanam	Do and count the number of users during the period
Temple and Prasadam preparation unit		Install meter and get daily consumption rates to cover weekdays. Week ends, peak days
Hospitals	One unit	Do
Annadanam units	One unit	Do
Fire fighting		As per the fire fighting norms
Water kiosks/drinking water supply units	One at Pampa, one along trekking route, one at Sannidhanam near Nadapanthal	Count the number of people utilizing the facility during a period and assess the quantity consumed
Other demands met by packed water consumption	One Shop each at Nilakkal, Pampa, Trekking route, Sannidhanam	Assess the consumption from shops, Interview pilgrims on consumption of bottled water

The survey should be carried out during the coming season starting from mid November 05 to mid January 06. Survey should be done during 3rd week of November, first week of December, 2nd week of January.

Expected Output

- Daily usage in representative toilet block and per capita usage in toilet blocks
- Daily usage in representative drinking fountains and Per capita usage
- Daily usage in representative establishments (commercial, institutional) and per capita usage
- Bottled /packed water consumption /day
- Fire fighting demand
- Present supply during normal and peak day
- Water quality analysis as detailed in task B

The primary data generated must cover all sectors/users so as to arrive at the total demand during first half of the season, second half and during peak days.

Annexure 2: Water Quality Study Results

Pollution Control Board guidelines for river water in Pampa

PH ---------->	Should be between 6.5 and 8.5
DO ---------->	Should NOT be less than 6mg/L
BOD---------->	Should NOT exceed 2mg/L
Total Coli form – MPN ---	Should NOT exceed 500/100 Ml

Time schedule for monitoring programme

a) Mid season
b) Immediately after peak season

Monitoring stations in Sabarimala

Nilakkal	Pampa	Sannidhanam
St.1- Near Kaduvathodu	St.1- Pipe water	St.1 – Bhasmakulam
St.2- Near oxidation pond	St.2- Thriveni	St.2 - Kunnar pipe water
St.3- Near guest house	St.3- Cheriyanavattom	St.3 - Pampa pipe water
St.4- Temple pond	St.4- Sewage treatment plant	
St.5- Pipe water	St.5- Njonangar	

NILAKKAL

Time schedule	Mid season
Samples taken on	16-12-2005(for water quality)
	21-12-2005 (for coli form)
Sampling stations at Nilakkal	
St.1- Near Kadavathodu	
St.2- Near oxidation pond	
St.3- Near guest house	
St.4- Temple pond	
St.5- Pipe water	

Following are the water quality analysis results of the collected samples from Nilakkal

S. No.	Parameters	St.1	St.2	St.3	St.4	St.5
1	Colour	Colourless	Colourless	Colourless	Colourless	Colourless
2	Odour	Odourless	Odourless	Odourless	Odourless	Odourless
3	pH	5.7	5.7	6.3	6.1	5.8
4	Dissolved oxygen	7.4	7.0	5.8	8.9	6.6
5	COD (mg/l)	6.8	2.3	2.8	5.6	2.8
6	BOD (mg/l)	1.9	1.4	1.9	1.6	0.35
7	Acidity	2.0	1.6	2.6	2.6	1.6
8	Alkalinity	9.5	7.7	32.9	23.1	10.3

S. No.	Parameters	St.1	St.2	St.3	St.4	St.5
9	Chloride	Trace	Trace	Trace	Trace	Trace
10	Total Hardness	80.3	78.9	84.3	34.4	28.6
11	Coliform	Present	Present	Present	Present	Absent
12	E.Coli	Present	Present	Present	Present	Absent
13	MPN Count (/100ml)	>2400	>2400	>2400	>2400	----

Time schedule	Immediately after peak season
Samples taken on	16-12-2006(for water quality and coli form)
Sampling stations at Nilakkal	
St.1- Near Kadavathodu	
St.2- Near oxidation pond	
St.3- Near guest house	
St.4- Temple pond	
St.5- Pipe water	

Following are the water quality analysis results of the collected samples from Nilakkal

S.No.	Parameters	St.1	St.2	St.3	St.4	St.5
1	Colour	Colourless	Colourless	Colourless	Colourless	Colourless
2	Odour	Odourless	Odourless	Odourless	Odourless	Odourless
3	pH	6.7	5.9	6.3	5.1	6.8
4	Dissolved oxygen	7.4	7.0	5.8	8.9	6.6
5	COD (mg/l)	6.8	2.3	2.8	5.6	2.8
6	BOD (mg/l)	4.9	3.4	5.9	4.6	0.35
7	Acidity	2.0	1.6	2.6	2.6	1.6
8	Alkalinity	9.5	7.7	32.9	23.1	10.3
9	Chloride	Trace	Trace	Trace	Trace	Trace
10	Total Hardness	82.3	68.9	74.3	34.4	28.6
11	Coli form	Present	Present	Present	Present	Absent
12	E.Coli	Present	Present	Present	Present	Absent
13	MPN Count (/100 ml)	>2400	>2400	>2400	>2400	----

PAMPA

Time schedule	**Mid season**
Samples taken on	31-12-2005 16-12-2005 (for water quality and coli form)
Sampling stations at Pampa	
St.1- Pipe water	
St.2- Thriveni	
St.3- Cheriyanavattom	
St.4- Sewage treatment plant	Sample from sewage treatment plant not for bacterial analysis
St.5- Njonangar	

Following are the water quality analysis results of the collected samples from Pampa

S.No.	Parameters	Pipe Water	Thriveni	Cheriyanavattom	Sewage treatment Plant
1	Colour	Colourless	Colourless	Colourless	Colourless
2	Odour	Odourless	Odourless	Odourless	Odourless

3	pH	5.7	5.7	6.3	6.1
4	Dissolved oxygen	8.6	6.9	7.1	0.2
5	COD(mg/l)	0.6	2.2	0.6	249
6	BOD (mg/l)	Trace	Trace	Trace	232
7	Acidity	0.7	1.5	1.0	Trace
8	Alkalinity	10.2	13.4	11.6	256
9	Chloride	Trace	Trace	Trace	358
11	Coli form	Absent	Present	Present	--------
12	E.Coli	Absent	Present	Present	--------
13	MPN Count (/100 ml)	---------	>460/100ml	>460/100ml	--------

Time schedule	**Immediately after peak season**
Samples taken on	16-01-2006 (for water quality and coli form)
Sampling stations at Pampa	
St.1- Pipe water	
St.2- Thriveni	
St.3- Cheriyanavattom	
St.4- Sewage treatment plant	Sample from sewage treatment plant not for bacterial analysis.
St.5- Njonangar	

Time schedule – **b)**

Following are the water quality analysis results of the collected samples from Pampa

S.No.	**Parameters**	**St.1**	**St.2**	**St.3**	**St.4**	**St.5**
1	Colour	Colourless	Colourless	Colourless	Colourless	Colourless
2	Odour	Odourless	Odourless	Odourless	Odourless	Odourless
3	pH	5.7	5.7	6.3	6.1	6.3
4	Dissolved oxygen	7.0	6.2	6.2	Trace	6.0
5	COD (mg/l)	3.4	4.0	10.8	650	8.0
6	BOD (mg/l)	1.5	2.4	9.4	410	2.8
7	Acidity	0.4	0.5	0.7	2.7	0.5
8	Alkalinity	11.4	16.8	22.3	28.3	18.6
9	Total Hardness	12.6	13.7	16.8	55.2	15.8
11	Coli form	Absent	Present	Present	--------	Present
12	E.Coli	Absent	Present	Present	--------	Present
13	MPN Count (/100 ml)	---------	>150/100ml	>1100/100ml	--------	>1460

SANNIDHANAM

Time schedule	**Mid season**
Samples taken on	05-01-2006 (for water quality and coli form)
Sampling stations at Sannidhanam	
St.1 – Bhasmakulam	
St.2 - Kunnar pipe water	
St.3 - Pampa pipe water	

Following are the water quality analysis results of the collected samples from Sannidhanam

S. No.	Parameters	St.1	St.2	St.3
1	Colour	Colourless	Colourless	Colourless
2	Odour	Odourless	Odourless	Odourless
3	pH	5.7	6.2	5.7
4	Dissolved oxygen	0.9	6.9	8.6
5	COD (mg/l)	2.2	0.2	0.6
6	BOD (mg/l)	Trace	Trace	Trace
7	Acidity	1.2	2.7	0.7
8	Alkalinity	55.7	28.3	10.2
9	Chloride	Trace	Trace	Trace
11	Coli form	Present	Present	Absent
12	E.Coli	Present	Present	Absent
13	MPN Count (/100 ml)	1100/100ml	240/100ml	----------

Time schedule	Immediately after peak season
Samples taken on	16-01-2006 (for water quality and coli form)
Sampling stations at Sannidhanam	
St.1 – Bhasmakulam	
St.2 - Kunnar pipe water	
St.3 - Pampa pipe water	

Following are the water quality analysis results of the collected samples from Sannidhanam

S. No.	Parameters	St.1	St.2	St.3
1	Colour	Colourless	Colourless	Colourless
2	Odour	Odourless	Odourless	Odourless
3	pH	5.8	6.4	5.7
4	Dissolved oxygen	1.2	7.1	7.0
5	COD (mg/l)	340.0	4.6	3.4
6	BOD (mg/l)	150.0	1.3	1.5
7	Acidity	0.5	0.4	0.4
8	Alkalinity	173.4	11.1	11.4
9	Total Hardness	102.0	8.4	12.6
11	Coli form	Present	Present	Absent
12	E.Coli	Present	Present	Absent
13	MPN Count (/100 ml)	1460/100ml	40/100ml	---------

Annexure 3: Details of the Existing Proposal for Water Supply to Sabarimala

Centhamarakokka Water Supply Scheme

Details of the proposed scheme are as under:
Source: Kallar and Pachakkanam Thodu
Location: Longitude of 77^0 5' and 77^0 10' and Latitude 9^0 35' and 9^0 30'. Downstream of Kallar dam and upstream of Chenthamarakokka about 2 kms west of KochuPampa – Vandiperiyar Road.
Proposed by: KWA and KSEB, GoK

The proposed site for weir is on the downhill of Vamanakulam Mala and Gavimala. The area to be formed as reservoir is not a dense forest, but mainly a grass land. Dam at this location with 20-25 m height will be suitable to form a reservoir of capacity 3 Mm^3. Surplus discharge of Kullar dam and Pachakanam thodu can be intercepted in this .The general elevation here is around 900 m and since the temple is at 467 m, it would be possible to provide water at gravitational flow to Temple premises and enroute. The head available may also be used to generate power. A third possibility is flushing Pampa with the excess water.

The water impounded in the reservoir will have to be diverted through a tunnel laid along its left bank and penstock to a power-house below Chenthamarakokka. The tail race has to be diverted by means of a pickup weir of 4-6 m height for providing drinking water supply to Sabarimala and flushing Pampa and Thriveni.

It is may be possible to conceive this as a combined hydro eclectic and water supply scheme. It requires detailed study including EIA which should be included in the midterm programme of the Master Plan.

Area requirements
Reservoir and tunnel: 18 ha
Power house and water treatment system: 2. 5 ha

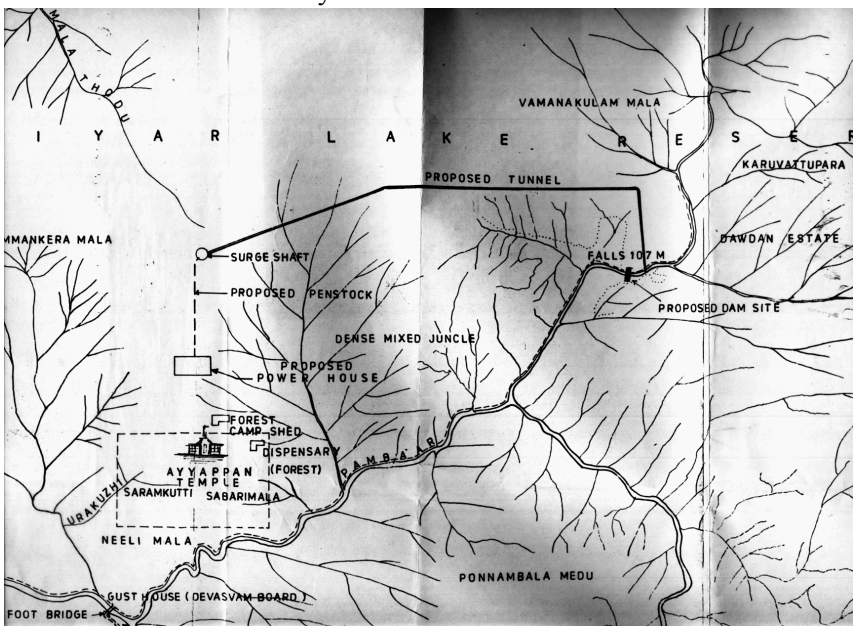


Diagram of the Proposed Chenthamarakokka Scheme

Annexure 4: Design Parameters

a) Base camp design parameters: Nilakkal

Adopted standards of per capita water consumption for calculating water demand :

1. Water Demand for transit pilgrims with less than 6 hours stay

Per capita consumption	= 20 lts/Head/Day
	(Spilt up Flushing = 10 lts, drinking = 5 lts and face and hand washing = 5 lts)

2. Water Demand for transit pilgrims with 6 to 12 hours stay

Per capita consumption	= 40 lts/Head/Day
	(Spilt up Flushing = 20 lts, drinking = 5 lts and face and hand washing = 15 lts)

3. Water Demand for transit pilgrims with less than 24 hours stay (Room stay)

Per capita consumption	= 110 lts/Head/Day
	(Spilt up Flushing = 30 lts, Bathing = 55 lts, Drinking = 5 lts, washing of clothes = 20 lts)

4. Extra for Cooking (in case of hotels/ canteens/group self cooking etc.)

Per capita consumption	= 15 lts/Head./Day
	(for cleaning, washing and Food preparation)

Base Camp design Parameters

1. Population to be accommodated – 1 lakh (ultimate)
   a. Permanent accommodation facility for 30,000
   b. Temporary accommodation facilities for 70,000

2. Types of Permanent Accommodation
   a. No. of staff requirement – Max – 1000 (Residential facilities for at
   b. least 300 staffs – those who are expected to stay there throughout
   c. the year and dormitory type for 700)
   d. No of pilgrims for whom permanent stay requirement is to be constructed – 29,000
   e. Room categorization

Room Capacity	Percentage of Room Type	No in Total	Total No. Pilgrim, Accommodated
2	7	1000	2000
5	8	500	2500
10	10	200	2000

15	25	500	7500
30	50	500	15000
	100percent	Total Rooms – 2800	Pilgrim No.-29000

Total floor space required for accommodating 30,000 peoples (taking approximate 4.5 sq.m./ person as standard area requirement) = 30,000 @ 4.5 = 1.35 lakhs sq.m.

Existing No – 400 (Newly built) and 70 (recently renovated which will be demolished later)

400 toilets can cater to 48,000 pilgrims (taking assumption that each person uses toilet for average period of 10minutes and like this the toilet is used continuously for 20hours – so total number works out to – 1 toilet / 120 persons)

Pilgrim Nos. which may require Temporary (viri Type) Accommodation – 70,000

No. of additional toilet requirement = (70,000 – 48,000) / 120 = 22,000 / 120 = 188 or Say 200 approximately (5 more additional toilet blocks (each of 40 units as provided in the details for implementation of immediate works) required to be constructed)

Other facilities

Shower bath – 1000 nos.
Urinals – 500 Nos (will have to be designed to avoid misuse) (Need to be provided so that the outlet can be connected to bioreactors)

Taking standards as –
110 lts water/person for permanent residents of the place – say 1000 nos
110 lts. Water/person for the population to whom permanent accommodation facilities had been conceived – say 29000
40lts water/person for 70,000 pilgrim provided temporary accommodation

Per-capita water requirement / usage = (1000 @ 110lts) + (29000 @ 110lts) + (70000 @ 40lts) = 6.22 MLD

Total water Demand – 6.5 MLD including fire demand.

b) Water Demand Calculation: Erumely

Resident population = 79,000 (2021)
Panchayat area = 84.5 sq.km.

Floating populations
Average = 40,000
Peak (including those who stay (5000) for providing facilities for pilgrims) = 1,00,000

Water demand for Erumely resident population is taken at 70 lts /person (Rural water supply with service connection)

For floating population water requirement would be 40 lts/person.
(RWS norms)

Total demand

- For Panchayat
  (town population alone is considered.
  This is assumed as 25percent ie. .25 x79,000
  = 20,000) 20,000 x 70 = 1.4 MLD

- For floating population
  (1,00,000 x 40 = 4.0 MLD

- For loss in transmission and supply = 0.6 MLD

  Grand Total = 6.0 MLD

c) Design Parameters : Vandiperiyar

Residential population		45,660 (1991 Census)
Considering 10percent decennial increase in population projected for the year 2021		60,700
Peak Floating population		30,000
Average floating population		7,500
Present town population		12,000
Projected town population		15,000
Design population (Peak pilgrim population and town population)		45,000
	Say	50,000
Water requirement 50,000 x 70 lit (Rural w.s. will have connection)		3.50 MLD
	Loss	0.50 MLD
	Total	4.00 MLD