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Planning Services for Sludge Treatment Installation (IPLT) Nganjuk Regency

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Abstract. Nganjuk Regency is one of the regencies in East Java Province with a fairly high population of 1,103,491 people. The high population affects the rate of wastewater production in a Regency/City. The purpose of this study is to plan the installation of a sewage treatment plant (IPLT) and the services that will be applied to the IPLT. This research method uses data analysis methods. Based on the septic tank users and the service distance of the 100% serviced area selected for the priority zone served by 5 sub-districts, namely Nganjuk District, Rejoso District, Sukomoro District, Loceret District, Bagor District, because these districts are the closest to the planning area. The toilet suction pattern that will be applied is the direct transportation pattern and the collective transportation pattern

Keyword: Feces, Fecal Waste Services, IPLT

1. Introduction

The increase in the population level in an area will be directly proportional to the increase in the community's primary needs, namely housing or settlements. This increase in settlements also affects the capacity of the waste produced in an area in the form of activities in the settlement (Mende et al., 2015). Domestic wastewater comes from households, there are two sources of domestic wastewater including black water (domestic wastewater containing human waste in it) gray water (domestic wastewater that does not contain solid substances usually from toilets, kitchens, and others - others). According to Metcalf & Eddy, domestic black water or fecal sludge is one of the sources of pollution that contains organic material and microorganisms in the form of viruses and bacteria, and contains dissolved solids.(Putra, 2021).

Nganjuk Regency is one of the regencies in East Java Province which is located in the western part of East Java Province. Nganjuk Regency has a population of 1,103,491 people divided into 20 districts (BPS, 2021). The increase in population in an area will increase the production of waste as well. Fecal waste (black water) is regulated in the Regulation of the Minister of Public Works and Public Housing Number 4 of 2017 in Appendix II, it is stated that if an area has a population of 50,000 people and there is a septic tank in each house, it is expected that the area has a IPLT with the aim of can treat waste communally by having a minimum of 60% coverage of the Local Domestic Wastewater Treatment System (SPALD-S) service plan (Republik Indonesia, 2017). The condition of the wastewater management system in Nganjuk Regency basically uses a local (individual) sanitation service system for fecal waste, this management is in the form of collecting fecal waste from the septic tank to the toilet suction tank. The next process is that the sludge is discharged into open land without being treated so that it has a negative impact on the environment. So to minimize the disposal of fecal sludge to be dumped into open land and pollute groundwater conditions in Nganjuk Regency, it is necessary to carry out further processing in the form of a Sludge Treatment Plant (IPLT). On the other hand, this research aims to improve the facilities and infrastructure of Nganjuk Regency which focuses on managing feces.

1.1 Scheduled slurry service (LLTT)

Scheduled Sludge Service (LLTT) is one of the services in the field of fecal management in the form of desludging the feces in the septic tank which is then processed at the IPLT in the city, this step is a mandatory step for the local government. In the Scheduled Sludge Service (LLTT), desludging has a certain schedule so that it can be carried out during the desludging period. This service process is mandatory, which is generally carried out every 2-5 years. (USAID, 2021).

After calculating the sewage service planning, then doing service planning which requires data in the form of location, service area, and planning in developing IPLT in the short, medium, and long term. Based on the transportation pattern for sewage sludge, there are two service patterns, including::

a. Direct transport pattern

In this pattern, the transportation process is carried out using a single truck transport unit, then desludging several septic tanks after which they are transported to the nearest processing plant. This pattern is carried out at locations that have easy access for trucks to pass.

Figure 1. Direct transport pattern
Source: (Kementerian PUPR, 2017)

b. Collective Freight Pattern

This pattern has a slightly different method because usually the area cannot be reached by a desludging truck, so the transportation uses a smaller facility which is then transferred to a fecal truck for further processing at the local IPLT.

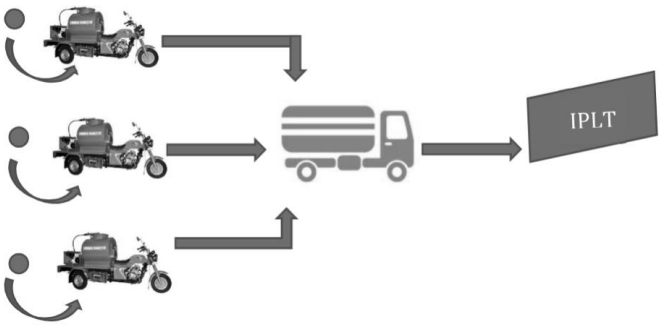

Figure 2. Collective Freight Pattern
Source: (Kementerian PUPR, 2017)

2. Research Method

2.1 Research ideas

The idea of this research was obtained from the existing condition where the toilet suction trucks operating in Nganjuk Regency dump their effluent into open land and rivers. Based on research, 62.8% of the final distribution of household feces disposes of feces into the septic tank.

2.2 Study of literature

The literature study stage is the stage to determine the theoretical basis related to planning calculations as the basis for implementing planning. The literature studies used in this planning are:

a. Detailed technical planning manual for sewage treatment plants (IPLT)
b. Medium-Term Infrastructure Investment Program Plan (RPI2-JM) for Human Settlements in Nganjuk Regency 2015-2019

c. Supporting data for planning similar to previous master plan documents, City Sanitation Strategy (SSK) documents, results of Environmental Health Risk Analysis (EHRA) studies
d. Previous journals supporting research

2.3 Data Analysis

Table 1. Data Analysis

Primary data	Secondary Data
• Stool Truck Service Data: This data is needed to find out the number of fecal truck services in each sub-district, how many times they are offered for drainage, cost data for each service, and the capacity of fecal trucks. This data was obtained from privately owned WC vacuuming entrepreneurs because Nganjuk Regency does not yet have its own stool truck	• Administrative Area Boundary Data: The required data includes the planning area, and the boundary between the planning area and the Regency/City. • Population Data: Population data is obtained from BPS data and then projected into the next 10 years. Population data is then used in the process to determine the pattern of IPLT management, capacity in IPLT processing, and the right technology in the planned IPLT processing.

3. Results and Discussion

3.1 Service Zone Division

The division of service zones has a function in accelerating the management process and streamlining the movement of the sludge fleet so that this facilitates the performance of LLTT operators. The division of service zones applied at the Nganjuk IPLT. Based on the users of the septic tank and the distance of service to the planned location, the priority service area is 100% and 5 sub-districts were selected, namely Nganjuk District, Rejoso District, Sukomoro District, Loceret District, Bagor District. This area is indeed an area with a fairly dense category under 100 people per hectare with the highest number of septic tank users in the service area coverage area.

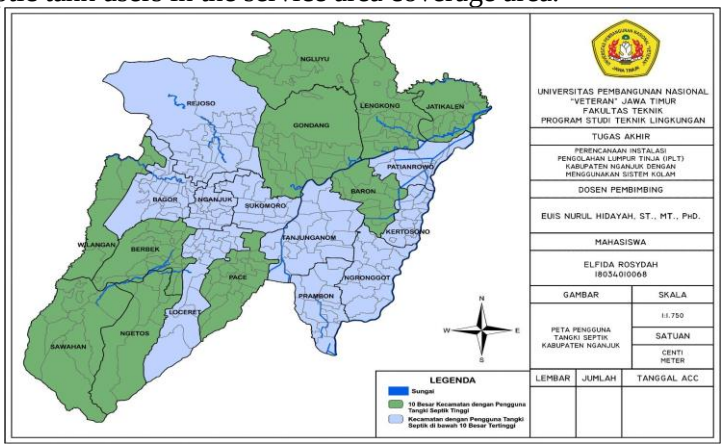

Figure 3. Map of Nganjuk Regency Septic Tank Area

The following is the distance from Kedungdowo Village, Nganjuk District to the service priority zone area as follows:

a. The distance from Loceret District to Nganjuk District is about 11 km
b. The distance from Sukomoro District to Nganjuk District is about 5 km
c. The distance from Bagor District to Nganjuk District is about 4 km
d. The distance from Rejoso District to Nganjuk District is about 10 km

3.2 Determining Disposal and Transport Patterns

There are 3 options for determining the suction pattern that can be applied to the Nganjuk IPLT, namely the overall suction pattern, fixed volume suction, and proportional suction. Of the three suction patterns, only 1 suction pattern was selected, namely the fixed volume suction pattern. The reason for choosing this pattern is because this pattern can reduce the incidence of total draining in the septic tank so that the contents of the septic tank are completely drained. This pattern can make it easier to calculate the feces to be processed at the local IPLT. This pattern can also reduce the factor of the lack of knowledge from homeowners about the volume of their septic tank.

For the desludging transportation pattern that will be applied at the Nganjuk IPLT is the direct transportation transportation pattern, the collective transportation pattern. The collective transport pattern is usually used for the location of the septic tank which is located far from the processing site and locations that do not have wide road access, making it difficult for vehicles to enter and requiring smaller vehicles to enter the area. In determining the transportation pattern, it can be determined based on the topography of the service area, the width of the road, the calculation of the initial cost efficiency and the transportation facilities used, and the efficiency of the cost calculation in the management process and transportation facilities so that it can be applied according to the district or city.

3.3 Determining the Dewatering Period

In determining the length of suction can be done for at least 3 years. From several previous studies, the desludging period was designed using the assumption of 3 years. Based on the LLTT manual issued by IUWASH Plus in 2016, septic tanks are generally designed to hold sludge for 3 years. The desludging period is obtained from the average volume produced from the septic tank to be treated.

3.4 Service Target

The process of planning service targets, factors that need to be considered include the implementation of applicable regulations in an area, the actual condition of the septic tank and the processing capacity of the IPLT. This program requires regulation for the regular desludging process and in considering the condition of whether the septic tank is still feasible or not. Based on the calculation, the maximum processing capacity that can be carried out by the Nganjuk IPLT is 108.1 m3/day. The following table presents the percentage of service for the number of septic tank units to be served:

Table 2. Total Septic Tank Units To Be Serviced

Subdistrict	Total population	Number of Houses (Unit)	Owner Percentage Septic Tank (%)	Number of Houses Tank Owner septic (Unit)	Percentage Service (%)	Number of Houses Who Served (Unit)
Sawahan	10.031	3249	55.81%	1813	50%	907
Ngetos	9.431	351	55.81%	196	50%	98
Berbek	14.845	5142	55.81%	2870	50%	1435

Loceret	19.065	13131	55.81%	7328	100%	7328
Pace	16.198	6521	55.81%	3639	50%	1820
Tanjunganom	30.184	18125	55.81%	10116	50%	5116
Prambon	19.013	9747	55.81%	5440	50%	2720
Ngronggot	20.945	11009	55.81%	6144	50%	3072
Kertosono	14.323	10803	55.81%	6029	50%	3015
Patianrowo	11.309	8133	55.81%	4539	50%	2270
Baron	13.299	7489	55.81%	4180	50%	2090
Gondang	13.789	6064	55.81%	3384	50%	1692
Sukomoro	11.614	8991	55.81%	5018	100%	5018
Nganjuk	18.3	17162	55.81%	9578	100%	9578
Bagor	15.719	9341	55.81%	5213	100%	5213
Wilangan	7.418	5809	55.81%	3242	50%	1621
Rejoso	18.338	7876	55.81%	4396	100%	4396
Ngluyu	3.754	121	55.81%	68	50%	34
Lengkong	8.608	2629	55.81%	1467	50%	733
Jatikalen	5.362	2787	55.81%	1555	50%	778

3.5 Analysis of the Operational Cost of Nganjuk IPLT Services

In analyzing the value of the amount of costs carried out by several respondents who carried out the process of draining the septic tank using the services of slurry, it is necessary to have data on the amount of costs incurred by the respondents. The average desludging fee ranges from IDR 300,000 to IDR 500,000 for one suction. This cost is considered a fairly high cost category for the community in Nganjuk Regency. Based on the data recorded in the District Sanitation Strategy (SSK) of Nganjuk Regency in 2016, there is no regulation that regulates the amount of levies or fees for providing desludging services.

In the operation of sewage treatment, it is necessary to calculate the basic tariff which is an obligation for users of IPLT facilities. The cost calculation is based on the Nganjuk Regent's Decree Number 188 of 2021 concerning Standard Unit Prices, namely the cost recovery principle by including all LLTT operating costs.

a. Calculation of Stool Rates

In determining the cost of desludging, it is necessary to consider transportation costs, processing costs at the IPLT, and management costs. The cost recapitulation value will be recapitulated and then the tariff will be calculated for each customer each month. (using the assumption of 3 years for the desludging service cycle). Rates for processing are calculated based on units of m^3.

b. Operational of Stool Truck

In the operational process of a stool truck, there are several things that need to be considered and recorded regularly, including: Distance traveled by a stool truck, amount of fuel consumption, amount of fuel for vacuum pumps, employee salaries, maintenance costs for stool trucks.

4. Conclusion

Based on the septic tank users and the service distance of the 100% serviced area selected for the priority zone served by 5 sub-districts, namely Kec. Nganjuk, District. Rejoso, Kec. Sukomoro, district. Loceret, Kec. Bagor, because the sub-district is the closest to the planning area. The toilet suction pattern that will be applied is the direct transportation pattern and the collective transportation pattern

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