# Final Processing Techniques for Adi Waste Using Landfill Control Methods in Mamuju District

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## ABSTRACT

The existing condition of the Adi-adi Waste TPA still tends to be operated in the Open Dumping manner even though the construction of the TPA is designed with the concept of controlled landfill management. Thereforeone of the aims of this research is to know the technical processing of Adi-adi Waste TPA from the planning and implementation aspects, as well as to design a development concept to increase work effectiveness in the landfill block area with the help of technological devices. This study uses a qualitative method with a descriptive approach. Methods of data collection through interviews, observation, and study of documents. In this research, it is known that the technical processing model tends to be open dumping ˆwhich only covers land 2-3 times in one fiscal year. The design of the development concept in the technical aspect of processing is the use of a Garbage Truck Vehicle Detection Sensor combined with direction guide lights in the Garbage Cell area that is being operated.

**Keywords:** TPA; open dumping; controlled landfill; technical processing; sensors; lights.

## INTRODUCTION

The construction of the Adi-adi Waste Landfill, Mamuju Regency, West Sulawesi Province, began in 2008 and was completed in 2009, originating from two funding sources, namely the Mamuju Regency APBD for land acquisition costs and from the APBN funding source of the Ministry of Public Works for the construction of waste landfill infrastructure and facilities. . The landfill block was built with a Sanitary Landfill design, while the management concept for the landfill block will use the Controlled Landfill method or what is usually called the controlled landfill method. The available landfill land area is + 8.4 Ha, while the built-up landfill block area is 0.76 Ha (2009 Development Document).

The current condition of the existing Adi-adi Waste Landfill still tends to be operated using the Open Dumping method even though the construction of the TPA was designed with the concept of controlled landfill management. A book published by the Sumatra Regional Environmental Management Center written by Sabar Ginting, 2009, divides the forms and types of environmentally friendly landfills into two, namely; TPA Sanitary Landfill, and TPA Controlled Landfill. Open Dumping TPA is said to be a traditional way of managing landfill which has a negative impact on the environment and health (Sumatra Regional Center for Life Management, 2009).

Management of landfills using open dumping causes many environmental pollution problems such as odors, dirt, polluting water and a source of disease because it can become a breeding ground for disease vectors such as flies and rats (Murtadho and Sahid, 1987 in Priatna et al., 2019).

All landfill management activities are closely related to three things, namely how the human resources are responsible for and managing the landfill, how the institutional management of the landfill is, and how waste is treated in technical processing in the landfill block area. From this thought, then

One of the objectives of this research is to understand the technical processing of the Adi-adi Waste Landfill from the planning and implementation aspects, as well as designing a development

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concept to increase work effectiveness in the landfill block area with the help of technological devices.

## RESEARCH METHODS

In this research, the author used a qualitative method with a descriptive approach, from two data sources, namely (1) primary data with data collection methods through interviews and observations, (2) secondary data with data collection methods through document studies which include TPA plan design documents, waste generation data, and population data in the waste service coverage area in Mamuju City.

## RESULTS AND DISCUSSION

### General description of the Adi-adi Waste Landfill

The Adi-Adi Waste Landfill, Mamuju Regency, West Sulawesi Province is located in Botteng Village, Simboro and Islands District, Mamuju Regency with a distance from the City Center of ± 17 km. is on the Majene - Mamuju axis road access route with quite good road quality, asphalt type road layer structure.

In an effort to improve waste services, the construction of the Adi-Adi Waste Landfill in Mamuju Regency is being carried out in stages as follows:

- 2008 (New construction of Adi-Adi TPA)
- 2009 (Improving the Performance of the Mamuju Regency Waste Landfill)
- 2010 (Trial Operation of Waste Landfill in Mamuju Regency)
- 2013 (Optimization of Waste Landfill in Mamuju Regency)
- 2021 (TPA Rehabilitation, Mamuju Regency, West Sulawesi)

Each stage, starting from 2008 to 2021, was carried out with funding sourced from APBN funds from the Ministry of Public Works and Public Housing through the Regional Settlement Infrastructure Center of West Sulawesi Province, PPK for the Development of Settlement Environmental Health.

### Target and Scope of Service

The main target for service coverage consists of 2 sub-districts located in the center of the district capital, namely Mamuju District with 8 sub-districts/villages with a population of 64,696 people and Simboro sub-district with 8 sub-districts/villages with a population of 36,063 people, so the total target population for service coverage is as much as 100,759 people (BPS Mamuju District in figures, 2021 and BPS Simboro District in figures, 2021) with a target of 100% service level. Based on service data from the Mamuju Regency Environment and Hygiene Service, the current service target achievements are as follows:

- Of the 16 sub-districts/villages which are included in the administrative area of the capital city of Mamuju Regency, 6 new sub-districts have received access to solid waste services, namely Simboro District, 2 sub-districts, namely Simboro Sub-district and Rangas Sub-district, and Mamuju Sub-district 4 sub-districts, namely Binanga Village, Mamunyu Village, Rimuku Village, and Karema Subdistrict or 37.5% of the Subdistrict/Village area served.
- The total population served by the 6 sub-districts is 74,096 people from the total population 100,759 people, or the level of service has reached 73.54%.
- The average daily waste generation is 68.52 tons, of which only 21.91 tons are transported or only 31.98% of the waste transportation service level has been reached.

### Type, Number and Condition of Landfill Infrastructure and Facilities

The types and number of infrastructure and facilities at the Adi-adi Waste Landfill that currently exist are as follows (data source, Mamuju Regency Environment and Hygiene Service and results of direct observations in the field):

- The landfill area is 18 Ha, the landfill area used for facilities and infrastructure is 8.4 Ha.
- Landfill block area of 0.76 Ha, target useful life of not less than 10 years, in good functioning condition.
- The leachate collector, in the form of a 30 cm diameter PVC pipe from the landfill block to the leachate pond area, functions well.
- The leachate processing plant is functioning properly.
- Monitoring wells, 2 units (1 upstream and 1 downstream), are no longer functioning because they are covered with soil.
- Gas ventilation pipes, 11 points, are no longer functioning because they are covered by piles of rubbish.
- Cover soil, abundant stock around the landfill.
- The entrance road from the main road is 450 meters in good condition with 250 meters of asphalt pavement and 200 meters of concrete pavement.
- Drainage of the block landfill area is not functioning because it is covered with piles of rubbish.
- Excavators, 2 units in good condition.
- Bulldozer, 1 unit in very damaged condition (no longer functioning)
- Truck Arm Roll, 6 units in good condition
- Dump Truck, 13 units in good condition
- Weighbridge, 1 unit not functioning (damaged condition)
- TPA gate, 1 unit, not functioning (heavily damaged)
- TPA Nameplate, 1 piece, good condition
- UPT TPA office, 1 unit in good condition
- Heavy equipment garage, 1 unit in good condition.
- Toilet facilities, 2 units in good condition
- Clean water, 1 unit of drilled well is functioning well, but is not eligible for consumption due to high lime content.
- PLN electricity is available and functioning well.
- Guard Post, 1 unit in good condition and also a weighbridge registration room

Based on the research results, there are several supporting facilities that must immediately receive priority repairs, such as weigh bridges and bulldozers, because these two pieces of equipment are very urgent in the operation of the landfill. The weighbridge is the only equipment at the Adi-adi Waste Landfill that can accurately measure the weight of incoming waste and produce reliable inventory data. Meanwhile, bulldozers are important equipment that must be used in the technical processing of the controlled landfill method, especially in the leveling and compacting stages of waste and overburden, including equipment that performs quickly to move material by pushing and displacing.

Apart from these 2 pieces of equipment, several supporting infrastructure must also receive attention because they are in a damaged condition so they do not function according to their respective purposes, such as:

- Monitoring wells located upstream and downstream must be repaired or rebuilt because they are important facilities for physically controlling groundwater quality by
- compare the water quality in the upstream well and the water quality in the downstream well.
- The drainage area of the landfill block must be remade while still adapting to the existing land conditions, namely the priority from the weigh bridge to the current demolition point, because this route has a higher elevation than the landfill block so that when it rains, there is sufficient water runoff. large amount towards the landfill block and will burden the capacity of the Leachate Processing Pond.
- The TPA gate which is equipped with a security portal has the main function of protecting other parties who wish to dispose of waste at the TPA without coordination with the UPT. Because one of the factors that triggers the disorderly management of waste entering the landfill is illegal or unofficial users.

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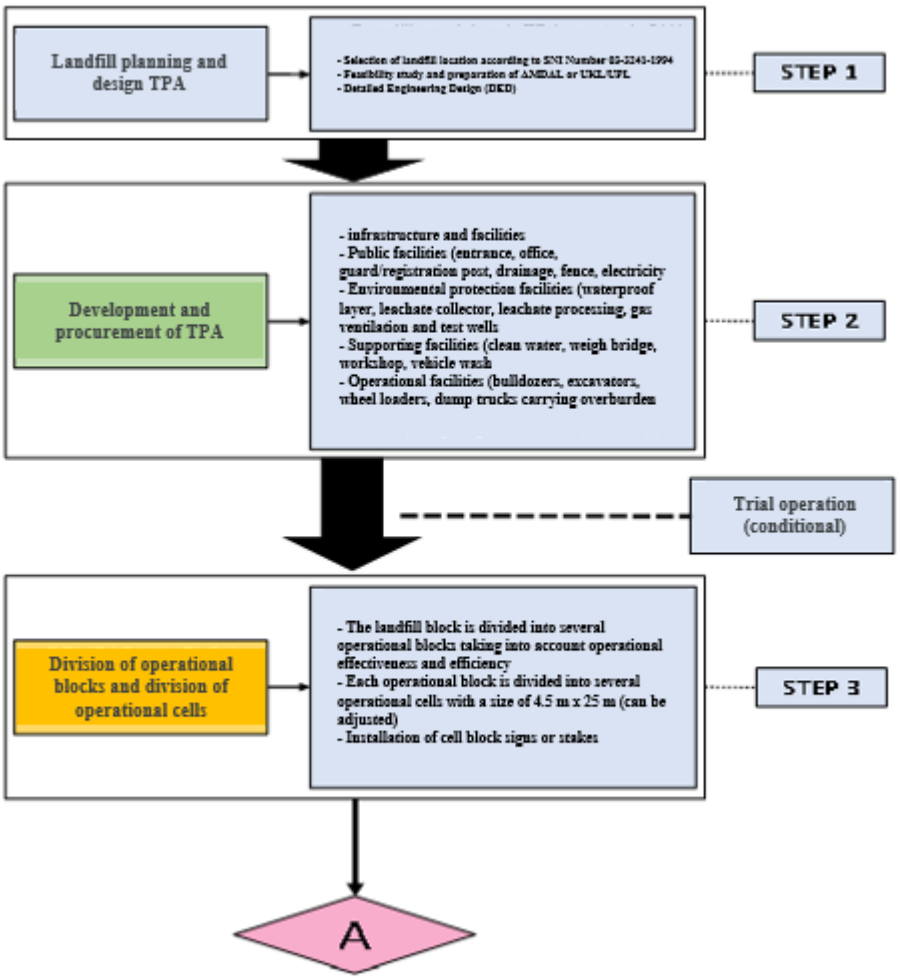
- The gas ventilation pipe must be repaired immediately because in the long term, with the volume of incoming waste being quite large, the Adi-adi Waste Landfill has the potential to experience an explosion due to the buildup of methane gas which is not channeled freely to the surface.

Infrastructure and other facilities that do not yet exist but are important to provide to support the smooth operation of the TPA, namely:

- One of the obstacles is not dismantling waste in the landfill block area
- is that there is no operating road in the area. Therefore, if you want to encourage landfill operations using the controlled landfill method, then one of the infrastructure that must be immediately created is an operational road in the active cell area.
- Heavy equipment workshop equipped with mechanical equipment (tool box). The workshop can be combined with the existing heavy equipment parking hangar.
- It is necessary to wash the vehicle so that the garbage truck which has finished dismantling can be washed immediately, at least by watering the vehicle bed and vehicle wheels. so that there is no leftover leachate or waste remaining at the bottom in urban areas.

**Plan and Implementation of TPA Operation Methods**

Comprehensively managing Waste Landfills using the controlled landfill method starts from the planning and design stage, the construction stage, the operational implementation stage starting from receiving waste at the registration post, transporting it to the operated cell, dismantling, leveling, compacting and covering the land, up to the maintenance of infrastructure and facilities.



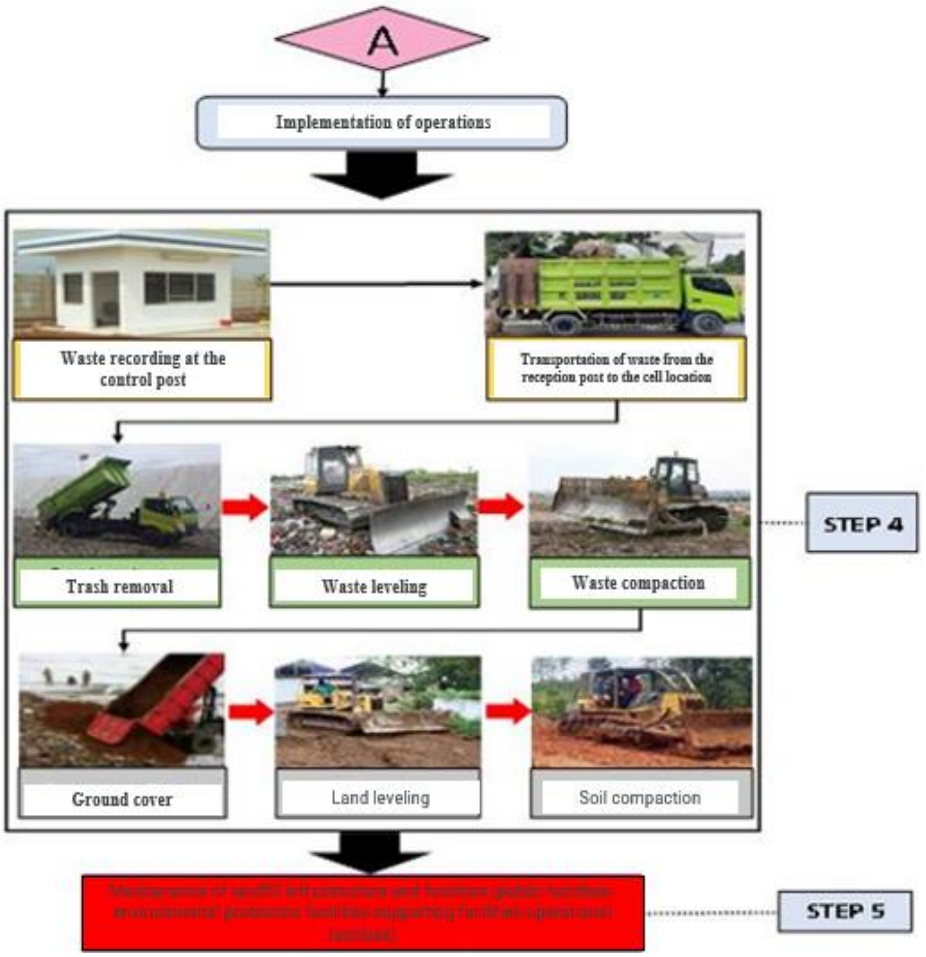



**Figure 1.** Controlled Landfill Method Management Process Flow

The adi-adi waste landfill was planned and built using a controlled landfill system, and to ensure consistency in the implementation phase of landfill operations, a trial operation was carried out in 2010 by the West Sulawesi Settlement Environmental Health Development Working Unit involving the Regional Government, in this case the related Department, namely the Cleaning Service and District Spatial Planning. Mamuju is in charge of the sector.

**Figure 2.** Documentation of TPA Trial Operations, 2010

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Carrying out the trial operation, the accompanying team not only provided theoretical input regarding Operation and Maintenance Standards (SOP) but also practiced the processing process in the landfill block area starting from leveling waste, compacting waste, taking cover soil, delivering and pouring soil, leveling the land, and finally the soil is compacted.

The operation of the Adi-adi Waste Landfill experiences ups and downs in various conditions, not only limited infrastructure and facilities, but the technical aspect of the operation is also difficult to maintain so that the landfill tends to be operated using an open dumping method. operational budget, and is usually carried out every 3 months or every 6 months or between 2-3 land coverings in one budget year.

Sequentially, the existing processing flow in the landfill block area based on the results of the researcher's observations is carried out as in the picture below, namely waste from the generation source directly to the demolition point and continued with leveling, without weighing and recording.

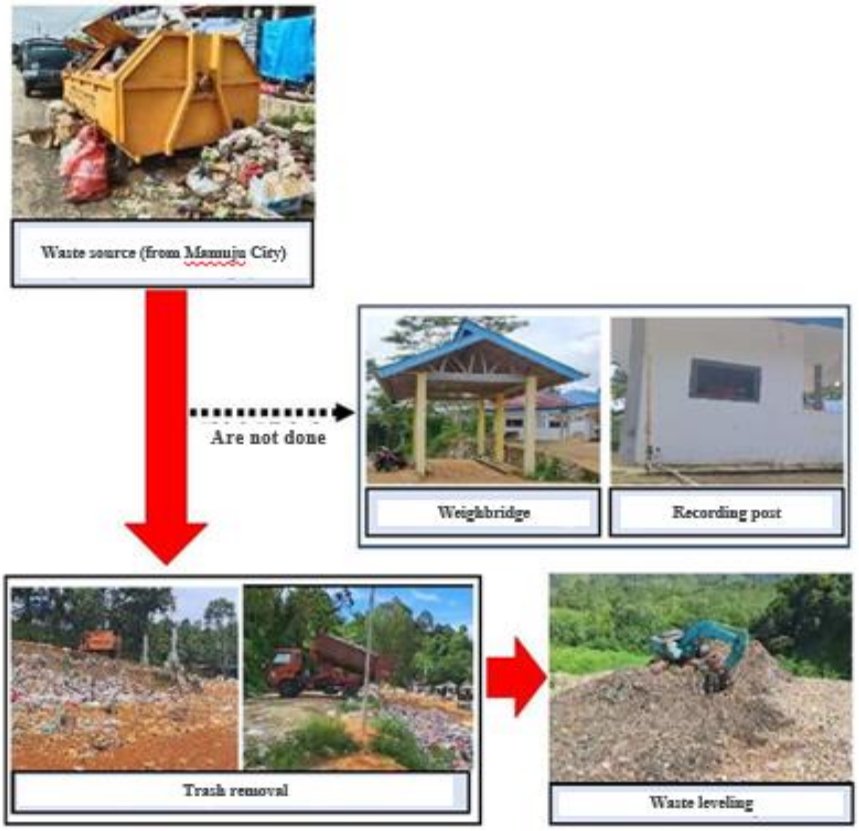


**Figure 3**. Existing Processing Flow in the Landfill Block Area

**Concept Design for Technical Processing Development with the Assistance of Technology Sensors and Guide Lights**

The development concept is directed at improving management performance and technical processing in the operational block area using the controlled landfill method through the use of sensor technology and guiding lights in the waste cell area, so that technically this technology offers ease in managing the truck fleet's operating area and setting up the active cell area within the block. operation.

The device used consists of a metal detection sensor placed on the weighbridge and a minimum of 2 alarm lights placed in the active cell area. The sensor functions to detect garbage trucks

when they enter the weigh bridge, then the sensor sends a signal to the alarm light placed in the active cell area via a connecting cable.

If this device functions well, several conveniences that can be achieved in implementing the controlled landfill method in the operational phase include:

- The arrival of a garbage truck will be detected automatically by a metal detection sensor.
- Truck drivers will easily find out the waste unloading point without having to be directed by human supervisors.
- Garbage cell arrangements will be more orderly and garbage truck drivers will get used to unloading at designated points by just following the path with the lights on.

Garbage trucks that operate at night will be very helpful, because they will automatically know at which point they will unload by simply following the signal when the lights are on or flashing.

Before this technological assistance device is implemented, socialization is first carried out to all truck fleet drivers and heavy equipment operators regarding the sensor's working mechanism, the function of the alarm light as an active cell marker, as well as the commitment to comply with the established SOP. The use of sensor technology + alarm lights, as well as technology-based supervision and monitoring devices as per the institutional development concept, all run in an integrative manner and at the same time can reduce the use of human labor for field supervisors, especially in landfill block areas.

Figure 4 explains the simulation layout for the placement of detection sensor devices and guide lights, namely the detection sensor is placed at point B on the weighbridge, while the guide light, assuming it uses 2 guide lights, is placed at point C, namely light 1 on the active cell and light 2 on the next active cell. When the sensor detects an object, the light automatically turns on on the active cell.

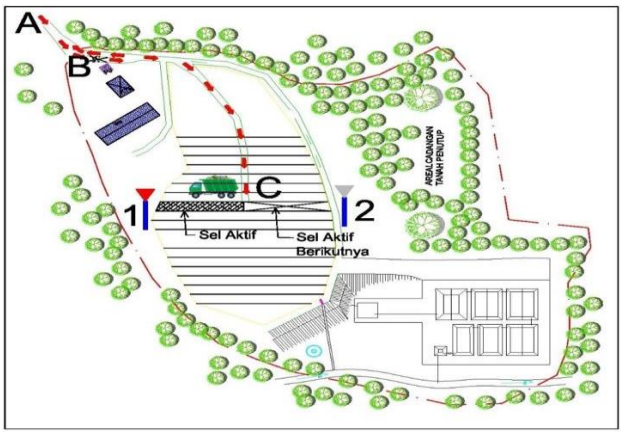


**Figure 4.** Simulation layout of detection sensor and guide light devices


**Figure 5.** Existing Landfill Block and Cell Division Simulation

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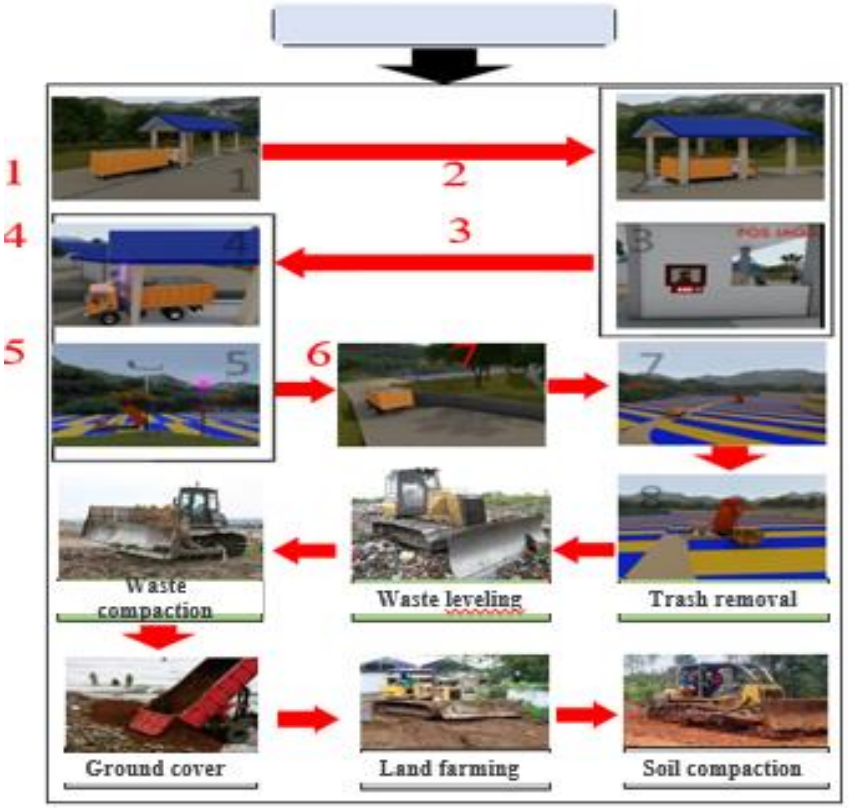


**Figure 6.** Controlled Landfill Processing Flow (Development Concept)

Figure 6 above explains the controlled landfill processing flow in the development concept design for activities from the recording post to the truck carrying out demolition. The standard controlled landfill flow, activities from the recording post to the cell area being operated are directed by field supervisors (human personnel), but in the concept of developing activities from the recording post to the cell area being operated using the help of sensor technology and guide lights, starting from the picture number 1 to image number 8, with the following explanatory description:

- In picture number 1 the truck enters the weigh bridge.
- Pictures number 2 and 3, trucks standing by at the weighbridge to be recorded, the weight of the load, the source of the waste, and the identity of the truck driver.

After the recording process in figure 3 is complete, the vehicle then moves out of the weighbridge past the detection sensor and at the same time the light will turn on in the cell block area at the unloading point in figure 5, the duration of the light will be set according to the required loading time of the truck until completion demolition.

- Figure 6 and Figure 7 show the vehicle operating route to the cell area that is being operated.
- Figure 8, the garbage truck has reached the unloading point.
- After figure 8, the waste is then leveled until the soil is compacted according to standard procedures in a controlled landfill.

To improve the management performance of the controlled landfill method, one of the activities that must be carried out is to divide the landfill block into several operational blocks, or directly divide it into several landfill cells. Figure 1 shows the existing condition of a landfill block without any cell division, while in Figure 2 a simulation is made if cells are divided in the landfill block area. Cell division does not have to be marked as a whole, but only on cells that are currently

active and cells that will be active next. The standard cell width is 1.5-3 of the width of the Bulldozer heavy equipment or generally a cell width of 4.5-5 meters is used. The cell length can be adjusted to the condition of the landfill block but in general a length of 25 meters is used.

## CONCLUSION

Technical processing of the Adi-adi TPA still tends to be carried out using the open dumping method, where land cover is carried out within a certain period, depending on operational budget conditions, and is usually carried out every 3 months or every 6 months or between 2-3 land covers in one year budget. The use of detection sensors and directional light will make it easier for the garbage truck fleet to reach the unloading point quickly and precisely.

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