ECONOMIC STUDY OF THE RELOCATION PLAN FOR THE BRAZIL DUMP PIT BENDILI PRIMA DEPARTMENT BINTANG PT KALTIM PRIMA COAL

M.R. De' Niro[1]*, D. Purbasari[1], E. Oktarinasari[1]

[1]Teknik Pertambangan, Universitas Sriwijaya, Palembang
[2]Teknik Pertambangan, Universitas Sriwijaya, Palembang
[2]Teknik Pertambangan, Universitas Sriwijaya, Palembang
*Corresponding author e-mail: dianapurbasari@ft.unsri.ac.id

ABSTRACT: *This study is based on the objective of optimizing operational cost efficiency and reducing hauling distances compared to the currently used J Void Dump location. The research aims to evaluate the economic feasibility of the redisturbance plan (reuse) of the Brazil Dump area as an alternative dumping point for overburden material at PT Kaltim Prima Coal (KPC). The methodology includes an analysis of the geometric design of Brazil Dump, calculation of the rehabilitated area affected by the redisturbance, and an evaluation of operational costs and the economic benefit of redisturbing the site. The results show that Brazil Dump is technically capable of accommodating approximately 13.4 million BCM of overburden with a tiered design ranging from elevation +50 to +150. However, the redisturbance process would affect 82.26 hectares of previously reclaimed land, with a total economic value of approximately USD 12.23 million. Despite an operational cost efficiency of USD 7.7 million, the analysis of economic benefit reveals a deficit of USD 4.53 million, indicating that from a direct cost-benefit perspective, the redisturbance plan does not provide a net economic gain when compared to the value of disturbed reclamation. Recommendations for future research include identifying alternative dumping sites that are closer to the active pit, minimizing the extent of redisturbance, and carefully considering reclamation costs and the economic value of impacted land.*

Keywords: Redisturb Plan, Dumping Point, Operational Efficiency, Mine Reclamation, PT Kaltim Prima Coal.

1 Introduction

PT Kaltim Prima Coal (KPC) is a large-scale coal mining company operating in the Sangatta region of East Kalimantan. There are 14 divisions in PT Kaltim Prima Coal. One of them is the Mine Operation Division (MOD), which is responsible for carrying out mining activities consisting of infrastructure construction within the mine, mining, and transportation to processing and refining sites. In addition, MOD is also responsible for pit and disposal design. One of the main challenges in mining activities is the management of waste material (overburden), which requires a strategic dumping point location so that hauling activities can run efficiently in terms of time, distance, and operational costs. In open pit mining operations, dumping is the process of disposing of waste material or cover material, also known as overburden, which has been excavated from the mining area to a predetermined disposal site [1].

PT Kaltim Prima Coal (KPC)'s mining operations have resulted in the volume of overburden material excavated exceeding the capacity of the in-pit dump, necessitating the use of an out-pit dump. Management of waste material (overburden). Currently, J Void Dump is one of PT Kaltim Prima Coal's dumping locations. This location is far from the Bendili Prima Pit operation area, but it remains under the management of the Bintang Department. The Mine Plan targets 15.6 million bcm of overburden volume to be dumped into J Void throughout 2026. Due to the distance and high cycle time, the idea of allocating dumping to the Brazil road has emerged. Longer cycle times, fuel consumption, and transportation equipment operating costs are all directly affected by this long distance. There are also water management issues at the J Void pond, which has silted up, making it prone to contamination and increasingly difficult to maintain water levels at Panorama Pond.

The solution is to redistribute the allocation plan to Brazil Dump. This location has been used as an overburden disposal site and has been reclaimed. Reusing this site is considered strategic because it is closer to the active mining area [2]. However, a restoration plan needs to be developed because the Brazil Dump has been rehabilitated or reforested. Therefore, this design will include reopening, contour adjustment, and redesigning the dumping according to the required capacity.

This is an important basis for economic research that considers many factors, such as estimates of redisturbance costs, past and future reclamation costs. These results will be compared with the operational costs at J Void Dump to determine whether the Redisturb Plan is feasible and economically efficient to implement. This study is expected to help the company determine whether the Brazil Dump Redisturb Plan is economically feasible.

2 Research Method

This research was conducted at PT Kaltim Prima Coal, which has a Mining Business Permit Area (WIUP) covering 61,543 hectares with a hilly morphology in Sangatta Village, East Kutai Regency, East Kalimantan Province. Geographically, PT Kaltim Prima Coal is located at 117° 26' 24" – 117° 33' 36" east longitude and 0° 34' north latitude to 1° 17' south latitude. See (Figure 1) for a map of the PT Kaltim Prima Coal area.

This study was conducted on Brazil Road, which is a hauling road from Panel Harapan to Dump J Void. On this road, there is Brazil Dump, which was once an active dumping point but has now been rehabilitated and overgrown with trees. Given that the distance between Panel Harapan and Brazil Road is not as far as Dump J Void, the idea arose to assess the economic feasibility of redesigning and reusing this rehabilitated area.

Administratively, PT. Kaltim Prima Coal's territory borders: North: Berau Regency, East: Makassar Strait, South: Bontang City, West: West Kalimantan Province. There are several ways to reach the location of PT. Kaltim Prima Coal, namely: 1) By land: Balikpapan-Samarinda-Simpang Bontang-Sangatta, which is 150 km from Samarinda and 220 km from Balikpapan, with good road conditions and takes approximately 7 hours. 2) By land route: Bontang-Simpang Bontang-Sangatta, with a distance of 65 km, with poor road conditions, especially on the Bontang-Simpang Bontang route, and can be reached in approximately 1 hour.

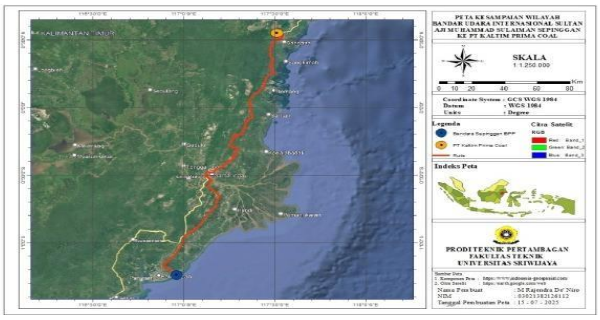

Figure 1 Map of PT. Kaltim Prima Coal.

Data collection is an activity carried out to obtain the data needed for this study. The data collection process can be done directly in the field or indirectly in the form of primary and secondary data. The primary data required is drone photos of the area to be redistributed, while the secondary data consists of topographic map data from Pit Bendili Prima, Department of Bintang, data on the Boundary Rehab area on the west side of Brazil Road, economic rehab valuation engine data, cycle time projection engine data, a map of the PT. Kaltim Prima Coal area, and Forecast Dump Allocation Jvoid Dump data.

After the data has been collected, the next step is to group and process it. The stages involved in this process include:

(1) Topographic map data processing at Pit Bendili Prima, Bintang Department, was obtained from Tango Base and then processed using Geo software to support spatial analysis and technical design in the dumping and redisturbance areas. The topographic data used came from field measurement survey results in the form of elevation point data (XYZ point cloud). The base topographic map was then overlaid with the dump, road, or redisturbance zone design plans using Geovia Minex 6.5 software. This allowed users to calculate elevation differences, estimate cut and fill volumes, and design layouts that matched the original contours.

(2) The data for the western boundary of the rehabilitation area on Jalan Brazil was obtained from PT Kaltim Prima Coal archives in (.dxf) format, then overlaid on the final design using Geovia Minex 6.5 software. This will show which areas of the dump design fall within the previous rehabilitation area. The results will be in hectares (ha).

(3) Economic valuation data is obtained from the environmental department for economic redistribution studies. This data is in the form of an Excel calculation template, which requires area data to be entered into the calculation system. The economic value of reclamation is calculated by multiplying the area (in hectares) by the cost per hectare, thereby obtaining the total economic value for each block or year of reclamation affected. These cost components include land clearing and preparation costs, planting and revegetation costs (such as seedling, fertilizer, and labor costs), as well as maintenance, monitoring, and other technical work costs such as the construction of drainage channels or

embankments. All components are calculated in USD per hectare.

(4) The data engine cycle time projection is obtained from the Midterm Engineer section in the Bintang Department. The first step is to calculate the distance from the loading point on the Harapan Panel to Brazil Dump and J Void Dump. This is done by creating a centropoid point for each design and then creating a string using the 2026 grid so that the comparison is equivalent. The output of this step is in the form of XYZ points which will be entered into the Excel engine cycle time projection format.

After the data has been collected, the next step is to group and process it. The stages involved in this process include:

(1) Analyze topographic data and then design a dump model using Geovia Minex 6.5 software in accordance with the total overburden volume capacity to be allocated, set the bench height, slope angle, berm width, and road grade for the ramp.
(2) Identify rehabilitated areas of the Brazil Dump, overlay the redesigned dump onto the existing reclamation area map, and perform calculations using Geovia Minex 6.5 software to measure the area of redisturbance.
(3) Collecting data on cycle time, hauling distance, and overburden volume capacity. Calculating estimated operating costs and evaluating the comparison and differences in costs and economics between the use of J Void Dump and Brazil Dump.

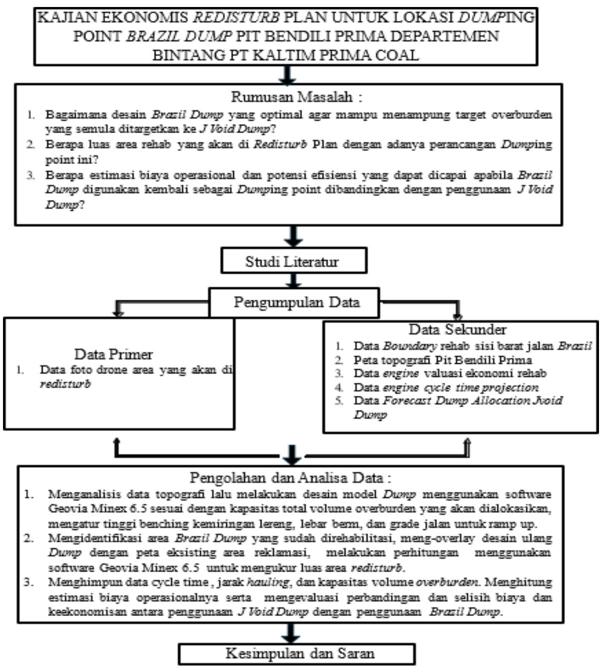

Figure 2 Research Flowchart

3 Result and Discussion

3.1 Brazil Dump Design Plan

The Brazil Dump design in this study was created using Geovia Minex 6.5 software to ensure the accuracy of topographic modeling and systematic planning of the backfilling stage. Geovia Minex is a computer-based geological and mining software developed by Dassault Systems, specifically designed for coal mining and stratified deposits, such as coal, bauxite, and limestone. Minex integrates various important functions such as geological modeling, mine planning, pit and dump design, reserve calculation, and topographic data management in a single integrated grid- and point-based modeling platform [3].

The design was created in stages from elevation RL +50 to RL +150, with a bench height of 10 meters at each level as the basis for the filling stages. In the design of the dumping geometry, several technical parameters were applied to ensure the stability of the fill and the smooth running of operations. The slope angle is set at 1:1.5, equivalent to 33.69 degrees, which is considered safe for the overburden material conditions at the site. Each bench is equipped with a 40-meter-wide berm that serves as an inspection path, a maneuvering area for heavy equipment, and a safeguard against potential landslides.

3.2 Current Condition of Brazil Road in Pit Bendili

Figure 3 Top View of the Actual Condition of the Planned Dumping Sit

Brazil Road is located on the southernmost side of Pit Bendili Prima. Based on drone documentation (Figure 3), the condition of the road leading to the Brazil Dump area currently shows that the existing mining road infrastructure is still connected and functional. The main hauling road appears to have been built with adequate width and uses standard pavement materials for mining roads. This road is the same road that leads to the J Void Dump.

The topography surrounding the road consists of hilly contours and dense vegetation, indicating that the Brazil Dump area had previously been reclaimed and will now be reopened for dumping activities. On the east side, this dumping point borders a bus route, while the west side borders a pit, and the south side borders a coal haul road. Furthermore, there is an intersection on the east side of Brazil Road and the coal haul road, so boundaries need to be established for the dumping point design. Brazil Road will remain an active road, so it must be designed in accordance with applicable geometry and regulations.

The next step is mapping using topographic maps and the April 2025 star string design to check the elevation and then adjust the elevation at which dumping will begin. See (Figure 4) for an illustration comparing the hauling distances in Brazil and Jvoid.

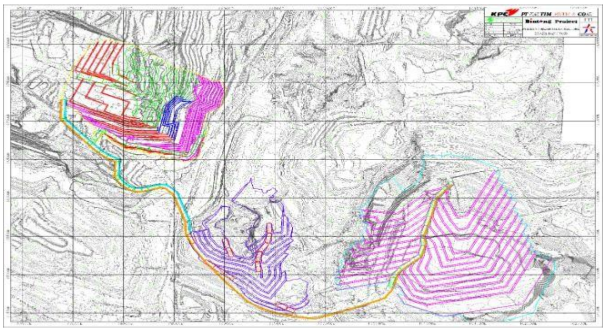

Figure 4. Illustration of Comparison between Distance Hauling in Brazil and Jvoid

The dumping design plan in (Figure 5) was created from elevation +50 in accordance with the actual condition of the road at present. At this elevation, the total capacity is only 2827 BCM, as it is only for filling the road, then creating a road that rises to elevation +60 (ramp up) and then following the contour of elevation +60 to obtain a flat dumping area.

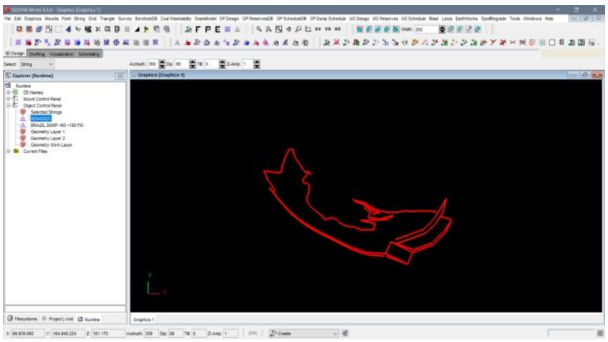

Figure 5 Elevation String Design +60

Then, road access to the area with an elevation of +70 meters is required. Therefore, a ramp up to an elevation of +70 will be constructed. After reaching this elevation, the road will be designed to follow the topographical contours to maximize the available flat area. Elevation +70 was chosen because it has a large enough area, so that in accordance with the project requirements, this area will be used not only as a dumping zone, but also as a shift change area for heavy equipment operators to replace the Tamaka shift change. At elevation +70, a maintenance area and heavy equipment service area will also be built. For these purposes, a special 300 x 200 meter area at elevation +70 will be designated as a rest zone, equipment service area, and operator shift change area. Look at (Figure 6).

In addition, at elevation +70, a main road will be constructed leading to the east. This road will also be designed to directly connect the Harapan pit road to the dumping site at this elevation and to subsequent elevations. The road width is set at 45 meters, referring to the existing road standards that have been previously applied in the Brazil Dump area. At this elevation, the overburden capacity is 1,007,309 BCM.

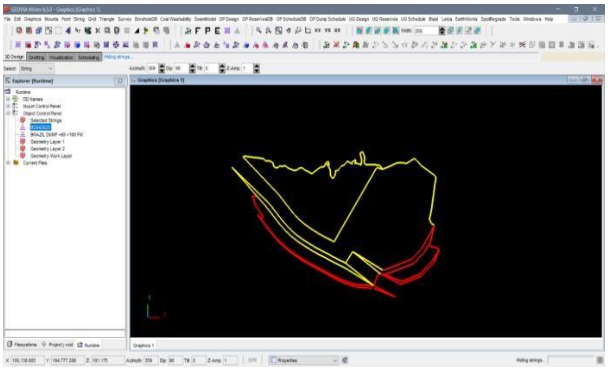

Figure 6 Elevation String Design +70

Furthermore, road access to the area with an elevation of +80 meters is also required. Therefore, a road (ramp) will be built to reach an elevation of +80. After reaching this elevation, the road will be designed to follow the topographical contours to maximize the available flat area. The road to this elevation will be formed from the end of the previous elevation road so that it remains connected to the route from the pit later on. Look at (Figure 7). At this elevation, the overburden capacity that can be dumped is 802,078 BCM.

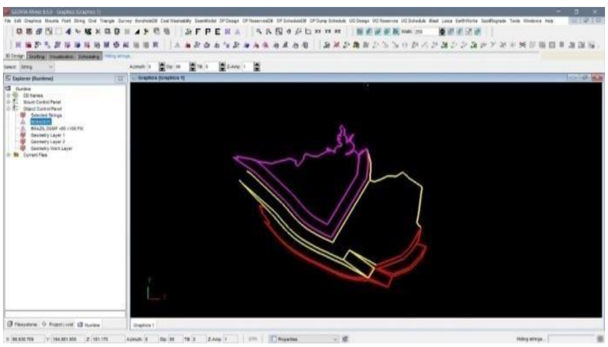

Figure 7 Elevation String Design +80

After that, as with the next stage (Figure 8), road access is needed to reach the next area, so an uphill ramp will be built to reach an elevation of +90. The road will then be designed to follow the topographical contours to maximize the available flat area. At this elevation, the topographic contours begin to head north due to a valley, so the flat area must be adjusted. The overburden that can be dumped at this elevation is 899,546 BCM.

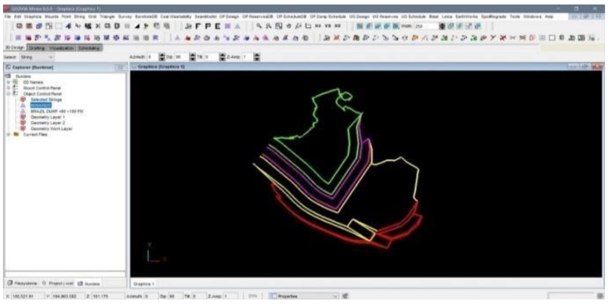

Figure 8 Elevation String Design +90

Furthermore, the road from the pit is also at an elevation of +90, so an uphill road (ramp up) will be built from the pit to an elevation of +100 (Figure 9). There will be two uphill roads, one from the west (pit) and one from the east (J Void). At this elevation, the overburden capacity that can be dumped is 1,419,114 BCM.

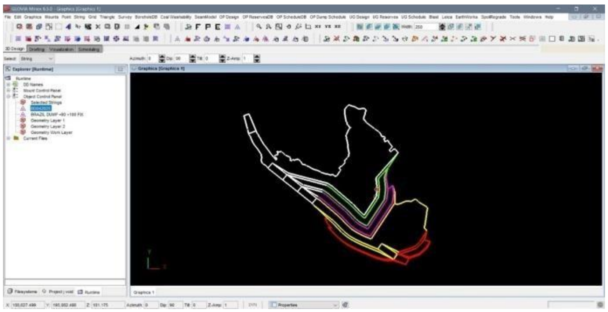

Figure 9 Elevation String Design +100

Then, to ascend to an elevation of +110 (Figure 10), an access ramp is also required. At this stage, an attempt must be made to construct an access ramp in the flat area at +100 because the main route cannot be used. Therefore, the most suitable location for the access ramp must be engineered. The overburden capacity that can be dumped at this elevation is 1,710,043 BCM.

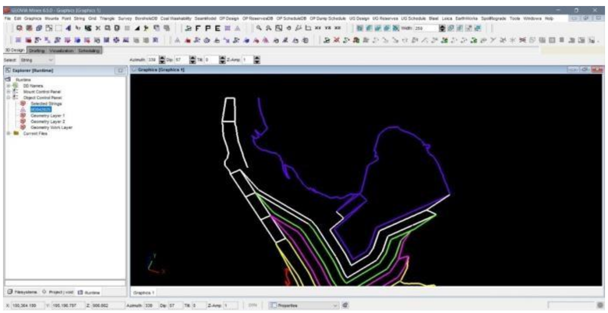

Figure 10 Elevation String Design +110

Next, to reach an elevation of +120, an uphill road (ramp up) is also required, and as before, this stage will follow the topographic contour of elevation +120. See (Figure 11), with the aim of maximizing the available flat area. The achievable overburden capacity is 1,655,586 BCM.

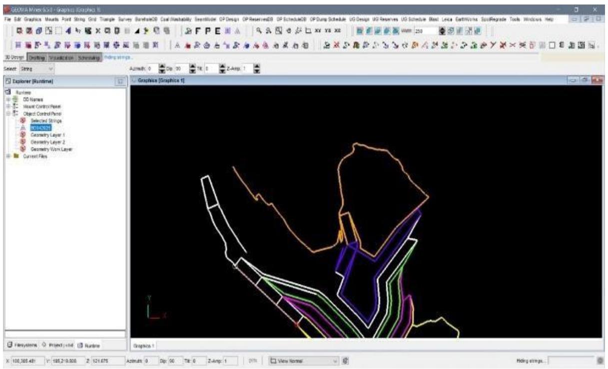

Figure 11 Elevation String Design +120

Then (Figure 12) this elevation needs to be shifted to the ramp up path starting from elevation +100, then another ramp up path is created from elevation +120 to elevation +130 so that the area on the west side that can be dumped can be maximized. At elevation +130, it will follow the topographic contour to maximize the available flat area. The overburden capacity that can be dumped at this elevation is 1,737,238 BCM.

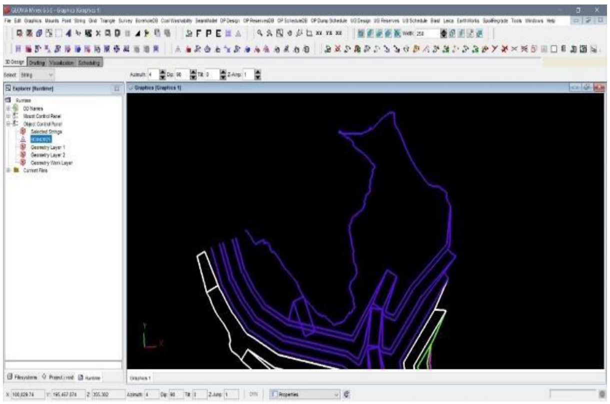

Figure 12 Elevation String Design +130

The next stage is to build an upward ramp from elevation +130 to elevation +140. There are two ramp-up paths: one to the west to maximize capacity of overburden material that can be dumped and another to the north following the topographic contour of elevation +140 to obtain the available flat area. Can be seen in (Figure 13), This area is the largest of all dumping designs because its contour surrounds the hills to maximize the overburden material that can be dumped. The overburden capacity that can be obtained in this elevation design is 2,140,667 BCM.

This design is only designed from elevation +50 to elevation +150 because it is not possible to go up to the next elevation due to the undulating contours on the west side and the proximity to the pit. Furthermore, the north side is also further away in terms of distance. The capacity is 1,707,044 BCM. (Figure 13) shows the final design of this disposal plan.

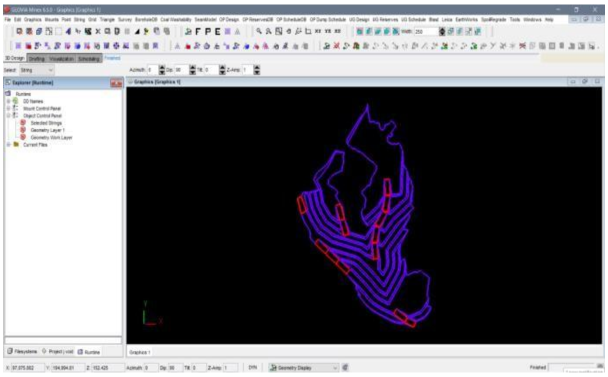

Figure 13 Elevation String Design +150

After all designs and geometric adjustments are complete, the final design is formed. This final design will be converted into a triangle (.tr5) format to determine the total overall volume capacity or the volume per bench. This design has been approved and received approval from the midterm department. If the operational costs are low and potentially profitable, then all design plans will be submitted to the geotechnical department and await approval to determine whether the design is feasible and complies with regulations, thereby passing in terms of safety factors.

Below are the details of the geometry of this dumping area design. Here is the explanation:

a.	*Angle Slope*	:	34 %
b.	*GradeRoad*	:	8%
c.	*Crossfall*	:	1-2 %
d.	*BenchHeight*	:	10 M
e.	*WidthBerm*	:	40 M
f.	*Haul Road*	:	45 M

Sumber: MOD Continuous Improvement (2017) [4]

After complying with the provisions from the geotechnical section and passing the safety factors, the purpose is to avoid undesirable events such as landslides and so on. Next step after obtaining the final design is to calculate the total amount of overburden that can be stockpiled from all designs per elevation in order to determine the capacity of overburden material that can be dumped in this dumping area. Volume overburden per bench looks at (Table 1).

Table 1 Overburden Volume per Bench

=======================================	
TriangleVolume	
======================================	
Bench NameVolume	
======================================	
RL +150	1707044,13
RL +140	2140667,00
RL +130	173723,00
RL +120	1655586,00
RL +110	1710043,25
RL +100	1419114,38
RL +90	899546,00
RL +80	802078,81
RL +70	1007309,00
RL +60	353846,31
RL +50	2826,72
==============*BrazilDump*==============	
TOTAL	13435299,59 BCM

The table above presents the results of calculations of the volume of material to be filled in the Brazil Dump area based on the Triangle Volume method for each elevation (bench level), ranging from RL +50 to RL +150. These calculations are used to determine the total capacity of the dump designed in the redisturbance plan.

The largest volume is at the RL +140 bench, which is 2,140,667 m³, followed by RL +150 with 1,707,044.13 BCM and RL +110 with 1,710,043.25 BCM. This shows that the most massive filling occurs in the upper and middle elevation areas, which technically also supports the stability of the stepped dump geometry. Meanwhile, the smallest volume is found at RL +50, which is only 2,826.72 BCM, indicating that the bench is likely only used as a base layer or complementary fill.

Bench RL +70, which is also planned as a strategic area for shift changes and the main hauling route, has a fill volume of 1,007,309.00 BCM. Overall, the total volume planned to be filled at the Brazil Dump is 13,435,299.59 BCM.

3.3 Area of Redisturbance at the Brazil Dump

In order to optimize the reuse of the Brazil Dump area as an active dumping point, an in-depth study was conducted on the previously rehabilitated area. The results of mapping and interpretation of the latest topographic data show that there are many areas that require redisturbance, namely the demolition of areas that have been revegetated and stabilized, in order to convert them into overburden storage sites.

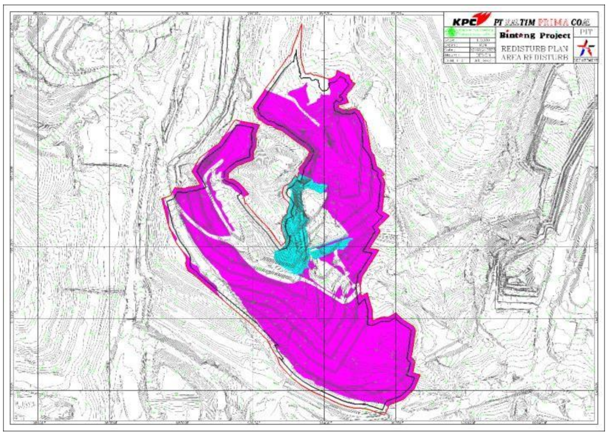

Figure 14 Redisturb Area Brazil Dump

(Figure 14) clearly shows the boundaries of the areas included in the redisturbance plan. These areas are scattered throughout all parts of the Brazil Dump design and are marked with different overlays indicating the existing rehabilitation status. Purple indicates areas where rehabilitation involves planting crops or trees, while blue indicates rehabilitation techniques using the method of planting seeds by spraying a mixture of seeds, fertilizer, soil conditioners, and mulch in the form of slurry to be planted (hydroseeding). The mapping and overlay were created based on the rehabilitation boundary data available at KPC. The total area of redisturbed land identified reached ±82.26 hectares.

Table 2 Economic Value of Reclaimed Areas

Lokasi *Redisturbed*	Luas (ha)	Tahun Reklamasi	Nilai Ekonomi Area Reklamasi (USD)			
			Valuasi Ekonomi	Biaya Reklamasi yang Lalu	Biaya Reklamasi Kembali	Total Nilai Ekonomi
(b)	(c)	(d)	(f)	(g)	(h)	(i = f + g + h)
Brazil Dump	9.85	2009	889.109	260.171	315.731	1.465.012
Brazil Dump	52.40	2011	4.729.883	1.384.056	1.679.625	7.793.566
Brazil Dump	20.01	2012	1.806.201	528.530	641.399	2.976.130
TOTAL	82.26		7.425.195	2.172.758	2.636.755	12.234.709

The data in Table 2 shows that the plan to reactivate Brazil Dump as an active dumping point has a very significant economic impact. Although technically and operationally, the estimated reuse of Brazil Dump provides benefits in the form of hauling efficiency and operational cost savings, it should be noted that the economic value of the previous reclamation that will be disrupted is also very large.

This is important as part of a comprehensive consideration for risk management and strategic decision-making by PT Kaltim Prima Coal (KPC), so that the plan to reuse the land remains in line with the principles of good mining practice and environmental sustainability.

3.4 Estimated Operational Costs and Benefits Redisturb

In this study, cycle time projections were made to compare the hauling efficiency from the J Void and Brazil dumping point areas to the BPR-HRP target panel. The process began by determining the centroid point of the Brazil and J Void dumping point area designs. This centroid point represents the center point of the dumping point's stockpiling activities as the initial reference point for material transportation.

Next, a route or string was created from this point leading to the loading point at the BPR-HRP panel. This route was then used as the basis for the hauling cycle time simulation. The simulation was carried out using a 2026 grid, where all string data was fitted into the grid. After that, all hauling strings were interpolated to produce a more accurate projection. This process produces a visualization of the hauling route along with an estimate of the travel time. The results are then in the form of coordinates per point, which are compiled in a detailed report and formulated in a Midterm Cycle Time Projection format for comparison and future operational planning.

This analysis begins by inputting technical data into an Excel calculation format, including an overburden volume of 13,434,250 bcm, transport distance (6.80 km without redisturb and 4.66 km with redisturb), and transport cycle time (50.94 minutes without redisturb and 38.27 minutes with redisturb). This data forms the basis for calculating more accurate estimates of hauling costs and haul road maintenance.

In the first scenario, without redisturbance, the overburden is transported to the J Void Dump with a longer hauling distance and longer transport time. Transportation costs are calculated using a rate of USD 2.44 per bcm per hour, while road maintenance costs are calculated using a rate of USD 0.03 per bcm per km. The calculation results show that the total production cost for this scenario reaches USD 30,327,050, consisting of USD 27,829,855 for transportation costs and USD 2,497,195 for road maintenance costs.

In the second scenario, which involves reactivating the Brazil Dump through a redisturbance plan, there is a significant reduction in hauling distance and transport cycle time. This has a direct impact on reducing operational costs. The cost calculation in this scenario results in a total production cost of USD 22,619,216, consisting of USD 20,907,902 for transportation and USD 1,711,313 for road maintenance.

The difference between the two scenarios shows a cost efficiency of USD 7,707,835. This figure represents very significant potential savings and can be used as a strong basis for considering the implementation of a redisturbance plan at the Brazil Dump.

The results of the calculation show that:

(1) The total economic value of reclamation for the entire area affected by redisturbment reached USD 12,234,709.35.

(2) The efficiency value or revenue from the reuse of Brazil Dump based on savings in hauling operational costs was USD 7,707,835.

(3) The total benefit value of redisturb is USD 4,526,874.79, which means that economically, there is a net loss from the reclamation investment aspect of more than USD 4.5 million if the entire area is reclaimed.

According to the Mining, Minerals and Sustainable Development Project (MMSD, 2002), redisturbance can only be carried out if the economic benefits outweigh the environmental impact or additional costs incurred, and it also emphasizes that redisturbance must adhere to the principles of good mining practice and sustainability [5]. It should be noted that these negative results indicate that the economic value embedded in the previous reclamation is greater than the operational efficiency gained from redisturbance. This means that although the reuse of the Brazil Dump is more operationally efficient, in terms of environmental investment value and reclamation costs, this redisturbance plan requires extra consideration.

Thus, this study highlights the importance of balancing operational cost efficiency and preservation of reclamation investment value, so that decisions related to redisturbance can be made comprehensively by PT Kaltim Prima Coal.

5 Conclusions and Recommendations

Based on the design results, Brazil Dump is technically feasible to be reused as an active dumping site. The tiered design from elevation RL +50 to RL +150 can accommodate an overburden volume of ±13.4 million BCM. The total reclamation area that will be affected by redisturbance activities reaches 82.26 hectares. It is not economical to plan for redisturbance at the Brazil Dump site because the rehabilitation costs are greater than the efficiency gains.

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