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Special Sections on

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A SPECIAL SECTION

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Guest Editors: Supriyono, Waluyo Adi Siswanto, Agung Setyo Darmawan, Wahyu Mulyo Utomo, Heru Supriyono, Wisnu Setiawan, Mochamad Solikin, Agus Ulinuha, Hari Prasetyo, and Herry Purnama
Adv. Sci. Lett. 24, 9023–9025 (2018)
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RESEARCH ARTICLES

ASL

Pre-Feasibility Study Yogyakarta City – Kulonprogo (Aerotropolis City) using Hyperloop One Technology

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Synergies with the improved readiness for the mobility of travel demand modeling of the new Kulon Progo airport, Hyperloop is present as a future mode of innovation that pushes the pod through low-pressure tube pipes potentially beyond the speed of the aircraft, using passive magnetic levitation and air cushioning. Aerotropolis Concept New Yogyakarta International Airport 2019 according to National Medium Term Development Plan (RPJMN) 2015-2019. The pre-feasibility study method is observed based on open-source data available from Hyperloop with Kulonprogo Regency statistics comparative data. The short range 38 km Kulon Progo - Yogyakarta is needed by the Hyperloop only in 2 minutes show the inefficiency.

Keywords: Hyperloop, Airport, Aerotropolis, Feasibility

1. Introduction

Not only as the mobility of passengers or freights, is the progress of development strongly influenced by the role of transportation. The role including the political, economic, social, cultural, and others. Transportation network system can be seen in terms of effectiveness, in the sense of safety, accessibility, alignment, capacity, regularity, fluency, accuracy, speed, and ease. The efficiency of low public load and high utility in a single network transportation system. Transportation serves as a catalyst in supporting economic growth and regional development[1].

In accordance to the National Medium Term Development Plan 2015 - 2019, 2019 becomes the deadline of the development agenda of the Special Region of Yogyakarta in the realization of New Yogyakarta International Airport, Kulon Progo Regency. Decree of the Minister of Transportation KP. 1163 / 2003 11 November 2013 stated the location of the new airport is in Temon sub-district Kulon Progo Regency, covers some of 5 (five) villages ie Glagah, Palihan, Sindutan, Jangkaran, and Kebonrejo Village[2].

The Planning of Regional Area Services *(PKW*) for the development of Wates City, Kulon Progo becomes an area supporting the existence of airport and the development of airport city, aerotropolis, and green city (Sekda DIY, 2017). Main connectivity support as a "backbone" of accessibility between airports - tourist destinations and airport - Yogyakarta City as the National Service Area *(PKN)* in DIY with high service standards, travel time, and the certainty of mode transfer.

In 2012 the fascinating idea of Elon Musk, businessman, inventor and industrialist of the United States, who is CEO of Tesla Motors, CEO and CTO of SpaceX, one of Founder of PayPal and Chairman of Solar City thrived for the revolution of mass transit transportation system with vacuum tubes exceeding the speed of the airline called Hyperloop[3]. Fast moving pods are electrically powered and glide over passive levitated magnetic trajectories or air cushions. A concept of energy-efficient, noisy, and autonomous systems. Year 2020 Abu Dhabi will soon realize it in the realization of technology ease of transportation of passengers and goods.

2. Literature Review

Transportation Modes

Transportation modes are an essential component of transport systems since they are the means by which mobility is supported. A wide range of modes that may be grouped into three broad categories based on the medium they exploit: land, water and air. Each mode has its own requirements and features, and is adapted to serve the specific demands of freight and passenger traffic. This gives rise to marked differences in the ways the modes are deployed and utilized in different parts of the world. More recently, there is a trend towards integrating the modes through intermodality and linking the modes ever more closely into production and distribution activities. At the same time, however, passenger and freight activity is becoming increasingly separated across most modes[4].

Public Transport

Public transport is a public transport passenger and is carried out under a rent or pay system. In the case of mass transit, transport costs become a burden of shared responsibility, so that public transport systems become more efficient because transport costs become cheaper. The existence of public transport, let alone mass, means a reduction in the number of vehicles passing by on the road. This is very important in relation to traffic control[5].

Sustainable Transportation

Sustainable transportation involves taking many dimensions of transportation and land-use planning into account simultaneously, as well as public visioning processes aimed at describing the future we desire, and the taking the steps necessary to attain that vision. It is essentially a societal, rather than strictly technical, process depends upon planning, policy, economics, and citizen involvement.

Sustainable transportation aims at lowering financial costs to society and to the individual through lessening dependence upon automobiles as the main mode of individual mobility[6].

Transport Demand Management (TDM)

TDM encourages convenient alternatives to driving. It reduces travel demand by changing behaviors, particularly at peak commute hours. TDM creates strategic ways to get cars off the road, to create work-life balance, and to reduce stress. But that is not all. Communities benefit from improved health and a cleaner environment. Everyone benefits by the economic stimulus of empowering people to live and play in their own communities. The urban development approach that adopts mixed spatial layout provides maximum ease of access to public transport and encourages the development of transit points for feeder transportation. The concept of urban development that focuses on mass transport nodes, vertical development directions, has mixed activities, prioritizes pedestrian movements, reduces the use of private vehicles both cars and motorcycles, and increases the use of mass public transport. Three main points in the development of TOD system: density, diversity, design.

Hyperloop

Hyperloop is a mode of transportation of passengers and freights using an air vacuum tube system that exceeds the speed of aircraft capable of reaching 700 mph (1.127 km / h). The technology uses maglev, a linear induction motor located along the tube to accelerate and slow down the capsule with the appropriate speed of each tube route. Rolling resistance is eliminated and air resistance is reduced, capsules can be sailed with high-pressure air transfer to low[3]. Several companies and academic groups professionally developing the Hyperloop concept:

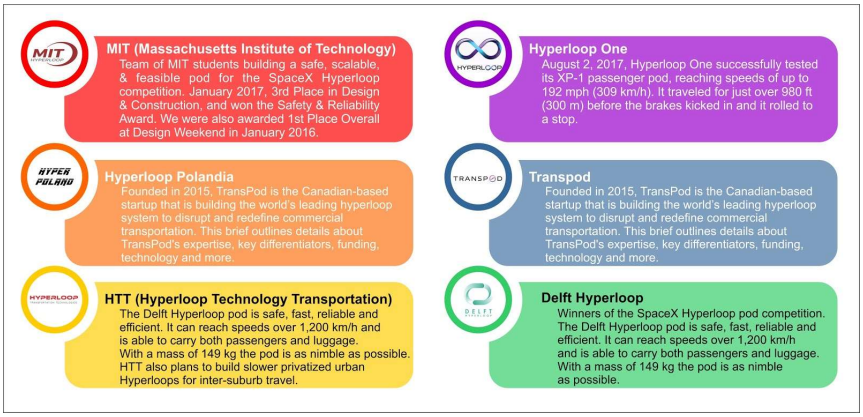


Figure 1. Hyperloop by Companies and Academic Groups

The company that will be developed in Indonesia by HTT, but the researchers will focus on Hyperloop One as the observation, just hit blazing fast new records speeds, on early August 2017:

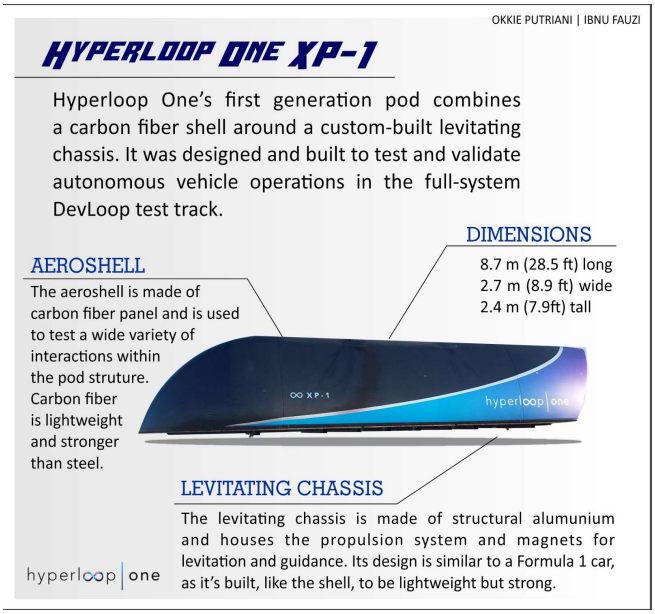


Figure 2. Hyperloop One XP-1

Feasibility Study

The feasibility study is an important early stage of a series of physical activities, in which the outcome of a feasibility study is a recommendation on whether or not a project should be reviewed to proceed to the next stage. Today, feasibility studies are felt to be very important because resources of time, man and fund are increasingly difficult to obtain. The aspects studied in this feasibility study are not only limited to the financial aspects but also the technical, environmental, managerial and administrative aspects, organizational, economic, and social aspects[7].

3. Methodology

The type of research that will be used in this research is descriptive research type, that is trying to describe a symptom, event, occurrence happening. This research is using qualitative research method. According Creswell in Noor[8] qualitative research is a descriptive analysis, theoretical basis used as a guide to focus the research according to fact in the field. The path of the research phase in this study is shown in Figure 3.

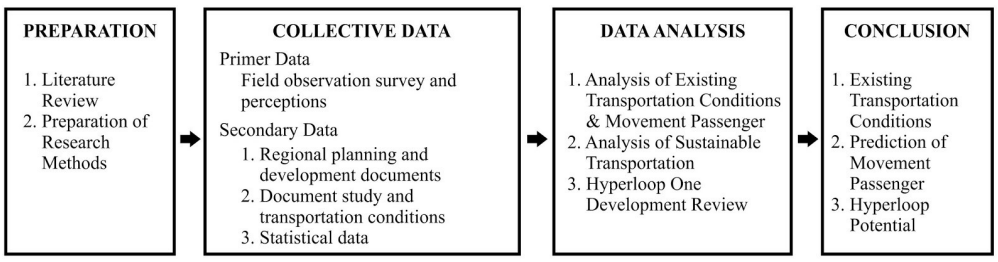


Figure 3. Research Process Flow Chart

4. Result

The Existing Access of Yogyakarta City – Kulon Progo

The location of New Yogyakarta International Airport is located in Temon District Kulon Progo Regency which is ± 5 km from Wates City (Kulon Progo Regency Capital) and ± 40 km from the center of Yogyakarta City. Wates City becomes the closest city to NYIA which is the center of economic activity in Kulon Progo. Currently the available public transportation serve Yogyakarta - Wates are only 2 (two) modes of bus and train. For the number buses serving the Yogyakarta - Wates 44 active buses, this is presented in Table 1 below:

Table 1. The Recapitulation of Bus Route
Yogyakarta - Wates 2016

Bus	Route	Fleet	Active	
			Unit	%
KUKUH	YK-GODEAN/WATES	10	6	60%
PRAYOGO	YK-GODEAN/WATES	17	9	53%
MENOREH	YK-GODEAN/WATES	17	14	82%
Total		44	29	66%

Source: UPT Yogyakarta Passanger Terminal

The data of local train that serves relation station Lempuyangan (Yogyakarta) - Wates Station obtained from DAOP 6 Yogyakarata PT. Kereta Api Indonesia (Persero) showed in table 2.

Table 2. Related Train Yogyakarta - Wates

Train	Travel Time	
	Yogyakarta	Wates
Prambanan Express	6.24	6.55
Prambanan Express	13.32	14.02
Prambanan Express	17.24	17.54
Joglokerto	6.58	7.36

Source: PT. Kereta Api Indonesia (Persero) DAOP 6 Yogyakarta

Aerotropolis NYIA

Quoting from Public Relation of NYIA, NYIA was built with the concept of Airport City which is an integrated airport development with self-contained city equipped with various facilities needed by the community and airport service users, so systematically awakened synergy and symbiosis, utilises between airports with city self-supporting airport support, radius Airport City covers an area of 5 km square of designed airport built in such a way to achieve synergy with the airport and the development of the city will be more controllable.

The concept of an airport city in NYIA in the future will be developed into a new Aerotropolis in thesouthern region of Java, as it is conveyed in the district diagram that has been planned by PT. Angkasa Pura I (Persero) in Figure 4. below.

Source : PT. Angkasa Pura I (Persero)

Figure 4. District Diagram

New Yogyakarta International Airport

Supply and Demand NYIA

New Yogyakarta International Airport (NYIA) is planned in 3 stages by the government, in the decision of the Minister of Transportation. KP. 1164 of the year 2013 on the establishment of the new airport location mentioned that the NYIA will be built in 3 stages as described in Table 5. on the operation of phase III (2031-2041) is expected to be able to sustain up to 20 million passengers per year and during rush hour can serve up to 39 aircraft per hour. With the movement of 20 million pax / year or nearly close to 55 thousand / day, it is necessary a transportation planning concept that is able to serve the movement of air passenger passengers both from downtown Yogyakarta and access left NYIA.

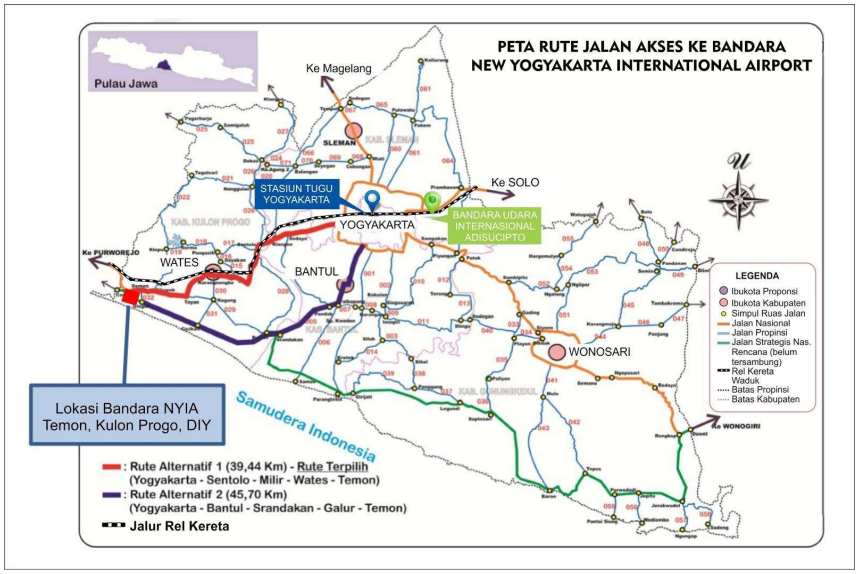
Table 3. Estimated Air Transport Service

NO	DETAILS	STEP I 2016 - 2021	STEP II 2021 - 2031	STEP III 2031 - 2041
I	PASSANGER (annually)			
1	Domestic	9,132,000	12,251,600	16,475,200
2	International	868,000	1,748,400	3,524,800
	Total	10,000,000	14,000,000	20,000,000
II	PLANE MOBILITY (annually)			
1	Domestic	67,200	87,000	112,100
2	International	5,460	10,350	19,730
	Total	72,660	97,350	131,830
III	PASSANGER PEAK HOUR (per hour)			
1	Domestic	3,222	3,842	5,006
2	International	632	910	1,345
	Total	3,547	4,332	6,010
IV	PLANE PEAK HOUR (per hour)			
1	Domestic	21	26	32
2	International	4	5	7
	Total	25	31	39

Source: The Minister of Transportation Number: KP.1164 Year 2013

Transportation Planning NYIA

With the prediction of demand for air transport services reaching 20 million pax / year, the DIY government made the Road Network System Design: access connecting the Airport - KSPN Borobudur (Sentolo - Dekso - Klangon), Development of South Cross Road Network (JJLS), National Road Access to Airport Integrated Development of NYIA in planning document RPJMD DIY 2017 - 2020 and document RTRW DIY and Kulon Progo Regency. Including the construction of railway and revitalization station PT. Kereta Api Indonesia (Persero). Kulon Progo Regency Spatial Plan Perda 1/2012, The transportation network system in articles 10, 11, and 18 consists of: land, railway and air transport networks. Located in Temon Sub-district, Wates Sub-district, Panjatan Sub-district, and District of Galur and Land Transport Concept proposed by Organda DIY include taxis, airport buses, cross-shuttles, and special transport within the airport. The fourth transportation is expected to be a complimentary airport of travel glamor, flash-packer, and backpacker, and the surrounding community. The design of the road network system by the DIY government is described in Figure 5 below



Source : BAPPEDA DIY & PT. Angkasa Pura I (Persero)

Figure 5. NYIA Road Access Plan

Review of Hyperloop Development Opportunities:

In the concept of sustainable transportation by the World Commission on Environment and Development (WCED) is implicitly covered 3 (three) dimensions, namely:

1. Economic sustainability (economic efficiency), ie in development, then the aspect of economic efficiency should be the goal. In the transport sector, the efficiency, smoothness, safety, and effectiveness of transport should be considered.

2. Environmental sustainability (ecological stability): that is, in the development of transportation, the environmental balance is not disturbed, either by emission or the use of infrastructure, so that the existing ecosystem remains stable according to its ecological function.

3. Social sustainability (distributional / social equity); Namely social needs and fairness must be guaranteed in the long-term development of transportation. All stakeholders should be an inseparable consideration of other objectives.

These three dimensions have been met in the Hyperloop development criteria contained in the Report "Hyperloop Commercial Feasibility Analysis: High Level Overview" issued by the US. Department of Transportation and further investigated by National Aeronautics and Space Administration (NASA). Factor speed and energy consumption into two Hyperloop flagship factors, with an average speed of 600 mph is able to cut travel time between the city of Yogyakarta-Kulonprogo which originally 30 minutes if using Railway mode to 120 seconds. Hyperloop fuels that

use electricity and solar power make this mode of transportation zero emission in the operation phase, it is conveyed in the following table.

Table 4. *Hyperloop Commercial Feasibility Analysis: High Level Overview*

Indicator	Specification
Travel Time	Max Speed
	Avg. Speed
Frequence	30 - 120 per hour with 30 sec. - 2 min. headway
Fare	Los Angeles - San
	Francisco
Amenities	Vomit Comet Petentially
Reliability	Protected from rain and snow
Energy Consumption	
Fuel	Electric
Power Source	Solar powered with backup batteries
Energy Consumption	Short route: 5-6x more fuel efficient than air
Emissions-Operating Phase	Zero
Emissions-Construction Phase	Not zero due to manufacturing of vehicles
	and construction of airport facilites
Capacity	
Capacity-Passengers per Vehicle	28 per vehicle (this may be flexible)
Capacity-Passenger per Hour	840 - 3.360 per hour
Passengers per Year	15 million per year (maximumn capacity)
Resiliency	Unless multiple tubes are stacked
	in each direction, maintenance,
	or repair in one section of tube
	would require entire route to shut
	down. Presentation mention
	building 3 tubes.
System Interoperability	Not interoperable, cannot provide
	local transit
Capital Cost	$25-27 million (minus land)
	$64 million (underwater)
	It estimate excludes land acquisition

Source: Source: Volpe, Hyperloop Commercial Feasibility Report, 2016

Hyperloop energy consumption is designed to save 5-6 times the fuel for short air transport routes and 2-3 times more efficient when compared to trains. And here are the Cost Estimate Guidelines for Hyperloop listed in Table 5.

Table 5. Estimation Cost

Component	**Cost (Million USD)**	**Note**
Tube Construction	650	709.2 miles of Tube
Pylon Construction	2550	25k pylons
Tunnel Construction	600	15.2 miles of tunnel
Propulsion	140	Linear induction motors
Solar Panels & Batteries	210	Panels cover both tubes
Station & Vacuum Pumps	260	2 stations @ $125 m each
Permits & Land	1000	2 stations @ $125 m each
Total	5410	

Sumber : US. Departement of Transportation

Table 5. shows the component cost of 354.6 miles or the equivalent of 570.67 km of routes on Hyperloop Alpha used for passenger mobilization. This calculation does not include the cost of pods. This distance is almost the same as Bandung - Surabaya through air transportation.

5. Conclusion

Hyperloop, a futuristic transportation using maglev technology and air tube system, described as the first major change in transportation technology in this century has been piloted. The readiness of Kulonprogo, Yogyakarta as the next aerotropolis city for receiving this innovation needs a extra adjustment in all aspects area of feasibility study. The bureaucracy, the geographic, the economy, and the socialization are the considerable situation that has to be arranged. The sustainability goals for the transportation can be delivered within Hyperloop would work by propelling pods through a large tube at speeds of 750 mph using magnets. It is seen as a solution to long distance travel, but also alleviating congestion in many cities.

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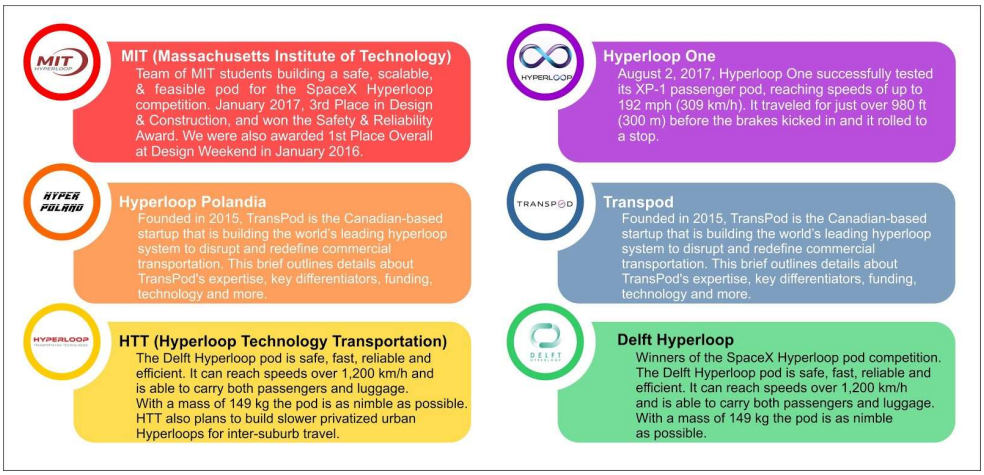

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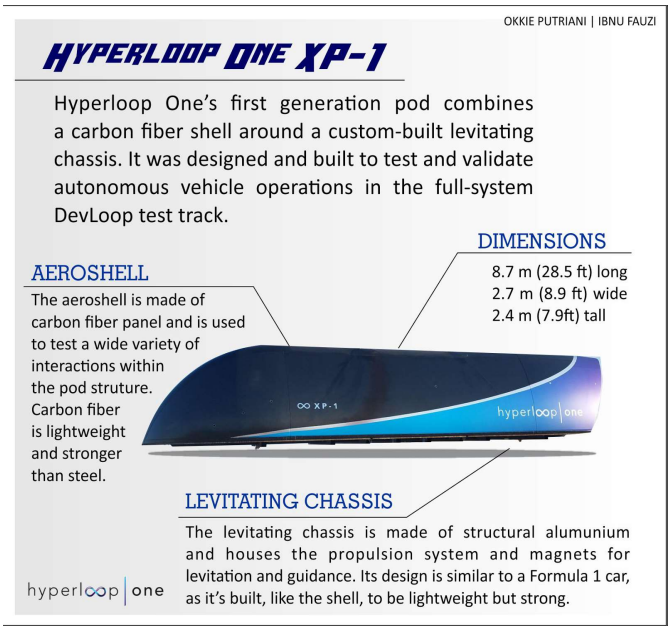

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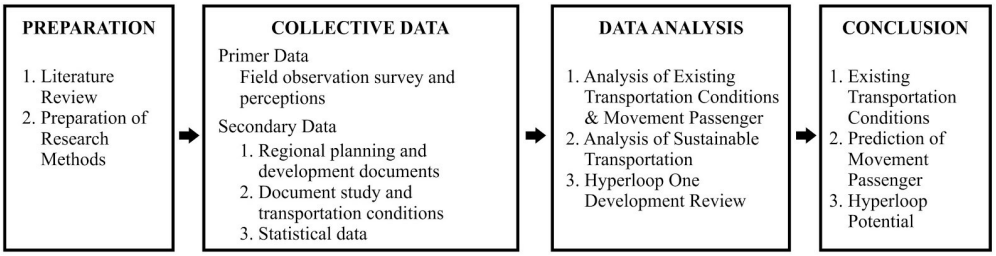

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Figure 4. District Diagram

New Yogyakarta International Airport

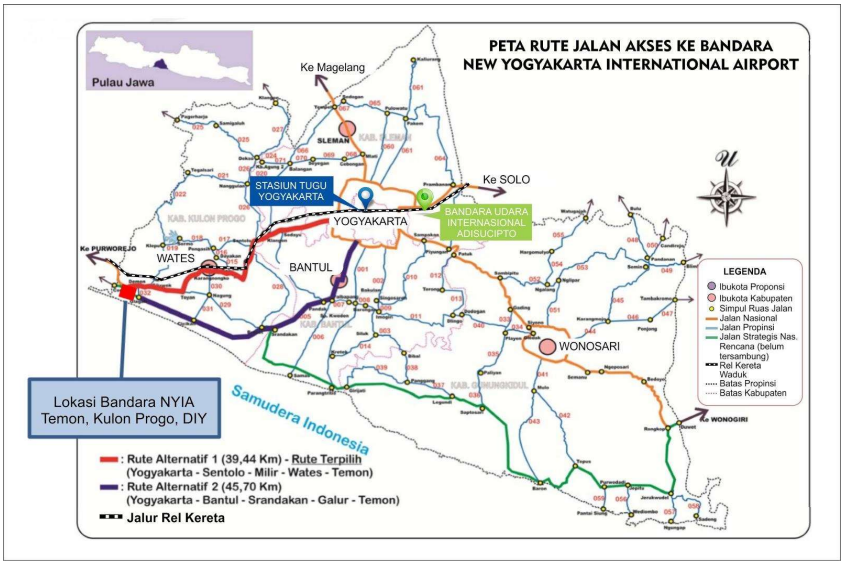

Figure 5. NYIA Road Access Plan