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Evaluation of Traffic Impact of Tourism Attraction Development Gajah Mungkur Reservoir, Wonogiri Regency

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ABSTRACT

The Gajah Mungkur Reservoir is one of the popular destinations by the people of Wonogiri. The Regional Government of Wonogiri Regency plans to develop the Gajah Mungkur Reservoir in 2024. The development plan for the Gajah Mungkur Reservoir is predicted to have the potential to have potential impact on decreasing the performance of the road network and intersections in the surrounding area, so a study is needed regarding the current performance of parking, road networks and intersections, current generation and attraction, parking performance, road and intersection networks after development and handling traffic impacts due to development. The analysis method uses MKJI 1997. Based on the results of the analysis, it can be seen that the performance of Jalan Wonogiri - Manyaran - Blimbing/Bts. Province DIY (B-T) in the 2023 Existing condition has a saturation degree of DS=0.43 with a service level of "B", while for Jalan Wonogiri - Manyaran - Blimbing/Bts. Prov. DIY (T-B), degree of saturation DS=0.39 with service level "B". The performance of Simpang 4 Entrance on the 2023 Existing has a degree of saturation DS=0.407; Queue Opportunity is 19.14% and the intersection delay is 7.89 seconds/pcu with a service level of "B". Performance of Simpang 4 Exit in 2023 Existing has a degree of saturation DS=0.450; the Queue Opportunity is 21.59% and the intersection delay is 8.40 seconds/pcu with a service level of "B". In the existing conditions in 2023, the attraction of the Gajah Mungkur Reservoir is 155.38 pcu/hour and the generation is 116.88 pcu/hour. In 2024 construction period until 2027 after development, the performance of Jalan Wonogiri - Manyaran - Blimbing/Bts. DIY Province is still in good condition with a service level of "C". However, in 2028 after development, the performance of the Jalan Wonogiri - Manyaran - Blimbing/Bts. Province of Yogyakarta has a decrease in performance and an increase in the DS value where the performance of the Jalan Wonogiri - Manyaran - Blimbing/Bts. Province of Yogyakarta (B-T) has DS = 0.76 with a service level of "D" while for Jalan Wonogiri-Manyaran-Blimbing/Bts. Prov. DIY (T-B) has DS = 0.60 with a service level of "C". The performance of Simpang 4 Entrance in 2028 with development has a degree of saturation DS=0.583; the chance of queuing is 30.58% and the intersection delay is 9.76 seconds/pcu with a service level of "B". The performance of Simpang 4 Pintu Exit in 2028 with development has a degree of saturation DS=0.643; Queue Opportunity is 35.53% and the intersection delay is 10.44 seconds/pcu with a service level of "B". Parking performance, both existing and after development, is still able to accommodate all vehicles entering the Gajah Mungkur Reservoir. Recommendations for handling traffic impacts (Do Something) due to the Gajah Mungkur Reservoir Development consist of 2 alternatives, namely alternative 1 by reducing side obstacles by controlling street vendors on the road shoulder and prohibiting on-street parking while alternative 2 is by arranging separation of traffic directions on the Jalan Wonogiri - Manyaran - Blimbing/Bts. Prov. DIY. Of the two treatment alternatives, alternative 1 provides better results than alternative 2. Performance of the Jalan Wonogiri - Manyaran - Blimbing/Bts. Provinsi DIY experienced a decrease in the DS value for each direction from the previous DS=0.76 with a service level of "D" for the B-T direction to DS=0.74 with a service level of "C" while for the T-B direction from the previous DS=0.60 with service level "C" becomes DS=0.59 with the same service level, namely "C". The performance of Simpang 4 Pintu Masuk in the 2028 with Development & Do Something 1 shows good results, with a degree of saturation of 0.576; Queue Opportunity is 30.11% and the intersection delay is 9.69 seconds/pcu with a service level of "B". The performance of Simpang 4 Pintu Exit in 2028 with Development & Do Something 1 shows good results, with a degree of saturation of 0.637; the Queue Opportunity is 34.95% and the intersection delay is 10.37 seconds/pcu with a service level of "B". Apart from that, it is also recommended to put several road equipment both inside and outside the Gajah Mungkur Reservoir location.

Keywords: *Parking Performance, Road Performance, Intersection Performance, MKJI 1997, Degree of Saturation (DS), Queue Opportunities, Delays*

Introduction

Transportation is the process of moving or moving people or goods from one place to another [20][24][39], thus forming a journey [43]. Traffic impact analysis is a study of the construction of building facilities and other land use (land use) on the city's transportation system, especially the surrounding road network [10][43]. This analysis aims to determine the impact of traffic on the development plan of activity centers, settlements and

infrastructure that will cause disturbances in security, safety, order and smooth traffic and road transportation [32][33].

Wonogiri Regency is a district in Central Java Province which borders East Java Province and the Special Region of Yogyakarta [9]. The Gajah Mungkur Reservoir is located in Sendang Village, Wonogiri District, Wonogiri Regency. The Gajah Mungkur Reservoir was built from 1976 to 1981 [44]. The tourist attraction Gajah Mungkur Reservoir is one of the favorite destinations of the Wonogiri people. Visitors to the Gajah Mungkur Reservoir tourist attraction increased from 315,059 in 2018 to 325,868 in 2019 [11].

The location of the Mungkur Elephant Reservoir Tourist Attraction is on the Wonogiri - Manyaran - Blimbing/Bts. Prov. DIY (Section Number 227) which is a Provincial Road section with a V/C ratio of 0.60 and a service level of "C" [12]. The level of service of the road section is influenced by the rise and pull that burdens the road section. The rise and attraction of the Gajah Mungkur Reservoir tourist attraction is currently determined by the number of visitors and employees. Traffic flow conditions on the route to the Mungkur Elephant Reservoir on D+2 Eid 2023 are observed to be crowded and smooth and there is no congestion at the only access to the Mungkur Elephant Reservoir, which is on the Wonogiri - Manyaran - Blimbing/Bts. Prov. DIY. In the event of a traffic jam, traffic engineering is carried out in coordination with the Wonogiri Satlantas [14].

The Wonogiri Regency Regional Government plans to develop the Mungkur Elephant Reservoir as stated in Wonogiri Regency Regional Regulation Number 2 of 2020 concerning the Wonogiri Regency Regional Spatial Plan for 2020-2040. The development is planned to be carried out in 2024. The development concept is in the form of a recreation area for children and teenagers, by adding and improving attractive attractions and attractions. For area improvement, it is carried out by improving infrastructure and landscape of the area, while for building improvements/rehabilitation of less suitable buildings, demolition/demolition of buildings, and adding/infilling new buildings that can add to the attraction and tourist attractions [11].

The performance of the Karanganyar – Podo Road and Kedungwuni – Kutosari Road sections has decreased due to the Revitalization of the Kedungwuni Market, so it requires handling so that the traffic performance is optimal [37]. As a result of the operation of the Swiss Belinn Hotel Singkawang City, the degree of saturation (DS) in 2024 for Jalan Tani is 0.81>0.75. Therefore, handling is needed, namely alternative 1 with a 2-meter road widening and alternative 2, namely the implementation of a one-way road. Of the two handling alternatives, alternative 1 shows more effective results to reduce the value of saturation on the Jalan Tani section so that it was chosen to overcome the impact of traffic due to the operation of the Swiss Belinn Hotel Singkawang City [6].

Likewise, the plan for the Development of the Gajah Mungkur Reservoir Tourist Attraction is predicted to have the potential to have an impact on the decline in the performance of the road network and intersections in the surrounding area. With the rise and pull due to the Development of the Elephant Mungkur Reservoir Tourist Attraction, it is predicted that the condition of the Wonogiri - Manyaran - Blimbing/Bts. Prov. Yogyakarta, which previously had a V/C ratio of 0.60 and a service level of "C", will experience an increase in the value of the V/C ratio and a decrease in the level of road services. Therefore, it is necessary to handle the impact of traffic so that the performance of the road network can return to the way it was before, for example by reducing side obstacles by ordering street vendors on the shoulder of the road and prohibiting *on-street parking* and regulating the separation of traffic directions.

Based on the background description above, it is necessary to conduct a Traffic Impact Evaluation of the Development of the Gajah Mungkur Reservoir Tourist Attraction, Wonogiri Regency and recommend handling the traffic impact that occurs due to development.

Research Methodology

Research Location

This research is located at the Gajah Mungkur Reservoir, precisely on Jalan Wonogiri-Manyaran-Blimbing/Bts. Prov. DIY, Sendang Village, Wonogiri District, Wonogiri Regency, Central Java Province.

Research Time

The survey was carried out in conditions where there were no weather disturbances (sunny weather). The road and intersection inventory survey will be carried out on Saturday, March 4, 2023 at 09.00-10.00 WIB. The traffic counting survey was carried out on Sunday, March 5, 2023 and Monday, March 6, 2023 at 14.00-16.00 WIB. The survey of the turning movement at the intersection was carried out on Tuesday, March 7, 2023 at 14.00-16.00 WIB. The rise and pull survey will be held on Sunday, March 5, 2023 at 14.00-16.00 WIB.

Results And Discussion

Traffic Volume

Recapitulation of the results of the traffic volume survey on the Wonogiri - Manyaran - Blimbing/Bts. Prov. DIY on Sunday, March 5, 2023 during afternoon rush hours (15.00 WIB – 16.00 WIB) can be seen in Table 2.

Table 2. Traffic Volume of Wonogiri - Manyaran - Blimbing/Bts. Prov. DIY

Vehicle Type	Traffic Volume			
	West to East		East to West	
	(kend/hour)	(junior high school/hour)	(kend/hour)	(junior high school/hour)
LV	232	232	210	210
HV	56	73	50	65
MC	1093	437	985	394
Sum	**1381**	**742**	**1245**	**669**
UM	3	-	3	-

Road Section Capacity

A recap of the results of the calculation of the capacity of each road section can be seen in Table 3.

Table 3. Road Section Capacity

	Street Section Name	Effective Lane Width M	Road Type	Shoulder	Side Obstacle Type	Basic Capacity Junior High School/Hour	Bandwidth Adjustment Factor	Directional Separator Adjustment Factor	Side Resistance Adjustment Factor	City Size Adjustment Factors	Capacity (Total) Junior High School/Hour	Capacity (Per-Direction) Smp/ Hour
						Co.	Fcw	Fcsp	Fcsf	Fccs	C	C
1	Wonogiri - Manyaran - Blimbing/Bts. Prov. Diy	**9**	**2/2 Ud**	**1,5**	**M**	**2900**	**1,25**	**1,00**	**0,95**	**1,00**	**3444**	**1722**
2	Slendro II	**4**	**2/2 Ud**	**-**	**L**	**2900**	**0,45**	**1,00**	**0,92**	**1,00**	**1195**	**598**
3	Slendro III	**3**	**2/2 Ud**	**0,5**	**L**	**2900**	**0,34**	**1,00**	**0,92**	**1,00**	**896**	**448**

Source: Analysis Results, 2023

Performance Analysis of Existing Condition of Road Sections and Intersections

The performance analysis of roads and intersections was carried out to determine the condition of the service level of roads and intersections in accordance with the 1997 MKJI method. The parameter used for the performance analysis of road sections and intersections is the degree of saturation (DS). The degree of saturation is the comparison between traffic flow and capacity. In addition, the intersection performance analysis also uses delay parameters and queue opportunities.

Road Performance Existing Conditions

The performance of existing roads in 2023 based on the degree of saturation (DS) value can be seen in Table 4.

Table 4. Existing Road Performance in 2023

	Street Name	2023 Existing		Ds	Level Of Service
		CAPACITY (smp/h)	VOLUME (smp/h)		
1	Jalan Wonogiri - Manyaran - Blimbing/Bts. Prov. DIY 1 (B - T)	1722	742	0,43	B
2	Jalan Wonogiri - Manyaran - Blimbing/Bts. Prov. DIY 1 (T - B)	1722	669	0,39	B
3	Jalan Wonogiri - Manyaran - Blimbing/Bts. Prov. DIY 2 (B - T)	1722	690	0,40	B
4	Jalan Wonogiri - Manyaran - Blimbing/Bts. Prov. DIY 2 (T - B)	1722	740	0,43	B

5	Jalan Wonogiri - Manyaran - Blimbing/Bts. Prov. DIY 3 (B - T)	1722	666	0,39	B
6	Jalan Wonogiri - Manyaran - Blimbing/Bts. Prov. DIY 3 (T - B)	1722	731	0,42	B
7	Jalan Slendro II (U - S)	598	119	0,20	A
8	Jalan Slendro II (S - U)	598	104	0,17	A
9	Jalan Slendro III (U - S)	448	85	0,19	A
10	Slendro III Road (S - U)	448	74	0,17	A

Source: Analysis Results, 2023

Existing Non-Signalized Intersection Performance in 2023

The performance of the existing unsignalized intersections in 2023 can be seen in Table 5.

Table 5. Existing Non-Signalized Intersection Performance in 2023

It	Indicators	Junction 4 Entrance	Junction 4 Exit
1	Degree of Saturation (DS)	0,407	0,450
2	Delay Simpang (D) sec/junior high school	7,89	8,40
3	Queue Chance (QP%)	8-19	9-22

Source: Analysis Results, 2023

Existing Parking Performance in 2023

The need for parking space for the Gajah Mungkur Reservoir Tourist Object is analyzed based on the indicators of visitor vehicles and employee vehicles.

Table 6. Existing Parking Space Usage Levels in 2023

Description	Sum	Unit	Information
SRP Availability			
1. Car	192	SRP	
2. Motor	145	SRP	
3. Bus/Minibus	7	SRP	
SRP Needs			
1. Car	95	kend/hour	
2. Motor	141	kend/hour	
3. Bus/Minibus	3	kend/hour	
Turn Over (parking space utilization rate)			
1. Car	0,49	kend/hour/SRP	
2. Motor	0,97	kend/hour/SRP	
3. Bus/Minibus	0,43	kend/hour/SRP	
Information			
1. Car	$0.49 \leq 1$	kend/hour/SRP	**Meet**
2. Motor	$0.97 \leq 1$	kend/hour/SRP	**Meet**
3. Bus/Minibus	$0.43 \leq 1$	kend/hour/SRP	**Meet**

Source: Analysis Results, 2023

The Rise and Pull of Existing Conditions

In the analysis of rise and pull, the composition of traffic flows entering the Gajah Mungkur Reservoir Tourist Object is assumed based on the number of visitor vehicles and employees.

Table 7. Details of Employees of the Gajah Mungkur Reservoir Tourist Attraction

It	Job Classification	Sum		Total	Shift 1 (08.00-16.00)	Shift 2 (16.00-08.00)
		L	P			
1	Head of UPTD	1	-	1	1	-
2	Marketing	2	2	4	4	-
3	Animal Park Manager	8	-	8	8	-
4	Levy Collector	4	-	4	4	-

5	Revenue Administration	5	-	5	5	-
6	Sapras Manager	1	-	1	1	-
7	Security	8	-	8	6	2
8	Hygiene Manager	121	98	219	219	-
Sum		**150**	**100**	**250**	**248**	**2**

Source: UPTD Management of the Mungkur Elephant Reservoir, 2023

Table 8. Total Rise and Pull of 2023 Existing

No.	Indicators	Attraction (Junior High School/Hour)	Bangkitan (Junior High School/Hour)
1	Visitor Vehicles	125,18	116,08
2	Employee Vehicles	30,2	0,8
TOTAL		**155,38**	**116,88**

Source: Analysis Results, 2023

From Table 8, it can be seen that the magnitude of the rise and pull of the Gajah Mungkur Reservoir Tourist Object exists in its existing condition. The rise and pull have been included in the results of the survey of the existing traffic volume on the Wonogiri - Manyaran - Blimbing/Bts. Prov. DIY or on other roads around the location because the condition of the Gajah Mungkur Reservoir is currently operating.

Performance of Roads and Intersections After Development

Road Performance in 2024 Construction Period

The performance of road sections in the 2024 Construction Period based on the saturation degree (DS) value can be seen in Table 9.

Table 9. Road Performance in 2024 Construction Period

No	Street Name	2024 Construction Period		Ds	Level Of Service
		Capacity (Smp/H)	Volume (Smp/H)		
1	Jalan Wonogiri - Manyaran - Blimbing/Bts. Prov. Diy 1 (B - T)	1722	838	0,49	C
2	Jalan Wonogiri - Manyaran - Blimbing/Bts. Prov. Diy 1 (T - B)	1722	739	0,43	B
3	Jalan Wonogiri - Manyaran - Blimbing/Bts. Prov. Diy 2 (B - T)	1722	769	0,45	C
4	Jalan Wonogiri - Manyaran - Blimbing/Bts. Prov. Diy 2 (T - B)	1722	828	0,48	C
5	Jalan Wonogiri - Manyaran - Blimbing/Bts. Prov. Diy 3 (B - T)	1722	740	0,43	B
6	Jalan Wonogiri - Manyaran - Blimbing/Bts. Prov. Diy 3 (T - B)	1722	812	0,47	C
7	Jalan Slendro Ii (U - S)	598	132	0,22	B
8	Jalan Slendro Ii (S - U)	598	116	0,19	A
9	Jalan Slendro Iii (U - S)	448	100	0,22	B
10	Slendro Iii Road (S - U)	448	83	0,18	A

Source: Analysis Results, 2023

Simpang Performance in 2024 Construction Period

The performance of unsignalized intersections in 2024 during the construction period can be seen in Table 10.

Table 10. Performance of Unsignaled Intersections in 2024 Construction Period

It	Indicators	Junction 4 Entrance	Junction 4 Exit
1	Degree of Saturation (DS)	0,454	0,501
2	Delay Simpang (D) sec/junior high school	8,38	8,94
3	Queue Chance (QP%)	9-22	11-25

Source: Analysis Results, 2023

Rise and Pull After Development

Based on the survey data, it is known that the number of visitors to the Gajah Mungkur Reservoir Tourist Object in 2023 is 1,228 people per day. The number of visitors to the Gajah Mungkur Reservoir Tourist Object in the coming year or after development can be predicted to increase. The increase in the number of visitors after development can be predicted based on the results of *forecasting the* average percentage increase in the number of visitors.

Table 11. Prediction of an increase in the number of visitors compared to the number of existing visitors

Condition	Year	Visitors		Percentage	Visitor Increase	
		(Person/Year)	(Person/Day)	Increase (%)	(Person/Year)	(Person/Day)
Existing	2023	448.294	1.228	-	-	-
Construction	2024	482.695	1.322	**7,7%**	34.401	94
With Development	2025	519.736	1.424	**15,9%**	71.442	196
	2026	559.620	1.533	**24,8%**	111.326	305
	2027	602.564	1.651	**34,4%**	154.270	423
	2028	648.803	1.778	**44,7%**	200.509	549

Source: Analysis Results, 2023

Road Performance in 2025 with Development

The performance of road sections in 2025 with development based on the value of saturation degree (DS) can be seen in Table 12.

Table 12. Road Performance in 2025 with Development

NO	NAMA JALAN	2025 DENGAN PENGEMBANGAN		DS	TINGKAT PELAYANAN
		KAPASITAS (smp/jam)	VOLUME (smp/jam)		
1	Jalan Wonogiri - Manyaran - Blimbing/Bts. Prov. DIY 1 (B - T)	1722	922	0,54	C
2	Jalan Wonogiri - Manyaran - Blimbing/Bts. Prov. DIY 1 (T - B)	1722	814	0,47	C
3	Jalan Wonogiri - Manyaran - Blimbing/Bts. Prov. DIY 2 (B - T)	1722	850	0,49	C
4	Jalan Wonogiri - Manyaran - Blimbing/Bts. Prov. DIY 2 (T - B)	1722	912	0,53	C
5	Jalan Wonogiri - Manyaran - Blimbing/Bts. Prov. DIY 3 (B - T)	1722	816	0,47	C
6	Jalan Wonogiri - Manyaran - Blimbing/Bts. Prov. DIY 3 (T - B)	1722	895	0,52	C
7	Jalan Slendro II (U - S)	598	146	0,24	B
8	Jalan Slendro II (S - U)	598	127	0,21	B
9	Jalan Slendro III (U - S)	448	106	0,24	B
10	Jalan Slendro III (S - U)	448	91	0,20	B

Source: Analysis Results, 2023

Simpang's Performance in 2025 with the Development of

The performance of unsignalized intersections in 2025 with development can be seen in Table 13.

Table 13. Performance of Unsignalized Intersections in 2025 with the Development of

It	Indicators	Junction 4 Entrance	Junction 4 Exit
1	Degree of Saturation (DS)	0,486	0,537
2	Delay Simpang (D) sec/junior high school	8,73	9,32
3	Queue Chance (QP%)	10-24	12-27

Source: Analysis Results, 2023

Road Performance in 2026 with Development

The performance of road sections in 2026 with development based on the value of saturation degree (DS) can be seen in Table 14.

Table 14. Road Performance in 2026 with Development

NO	NAMA JALAN	2026 DENGAN PENGEMBANGAN		DS	TINGKAT PELAYANAN
		KAPASITAS (smp/jam)	VOLUME (smp/jam)		
1	Jalan Wonogiri - Manyaran - Blimbing/Bts. Prov. DIY 1 (B - T)	1722	1031	0,60	C
2	Jalan Wonogiri - Manyaran - Blimbing/Bts. Prov. DIY 1 (T - B)	1722	885	0,51	C
3	Jalan Wonogiri - Manyaran - Blimbing/Bts. Prov. DIY 2 (B - T)	1722	941	0,55	C
4	Jalan Wonogiri - Manyaran - Blimbing/Bts. Prov. DIY 2 (T - B)	1722	1010	0,59	C
5	Jalan Wonogiri - Manyaran - Blimbing/Bts. Prov. DIY 3 (B - T)	1722	896	0,52	C
6	Jalan Wonogiri - Manyaran - Blimbing/Bts. Prov. DIY 3 (T - B)	1722	981	0,57	C
7	Jalan Slendro II (U - S)	598	160	0,27	B
8	Jalan Slendro II (S - U)	598	140	0,23	B
9	Jalan Slendro III (U - S)	448	118	0,26	B
10	Jalan Slendro III (S - U)	448	101	0,23	B

Source: Analysis Results, 2023

Simpang Performance in 2026 with the development of

The performance of unsignalized intersections in 2026 With Development can be seen in Table 15.

Table 15. Performance of Unsignalized Junctions in 2026 with the Development of

It	Indicators	Junction 4 Entrance	Junction 4 Exit
1	Degree of Saturation (DS)	0,521	0,576
2	Delay Simpang (D) sec/junior high school	9,11	9,73
3	Queue Chance (QP%)	12-26	14-30

Source: Analysis Results, 2023

Road Performance in 2027 with Development

The performance of road sections in 2027 with development based on the degree of saturation (DS) value can be seen in Table 16.

Table 16. Road Performance in 2027 with Development

NO	NAMA JALAN	2027 DENGAN PENGEMBANGAN		DS	TINGKAT PELAYANAN
		KAPASITAS (smp/jam)	VOLUME (smp/jam)		
1	Jalan Wonogiri - Manyaran - Blimbing/Bts. Prov. DIY 1 (B - T)	1722	1157	0,67	C
2	Jalan Wonogiri - Manyaran - Blimbing/Bts. Prov. DIY 1 (T - B)	1722	957	0,56	C
3	Jalan Wonogiri - Manyaran - Blimbing/Bts. Prov. DIY 2 (B - T)	1722	1041	0,60	C
4	Jalan Wonogiri - Manyaran - Blimbing/Bts. Prov. DIY 2 (T - B)	1722	1118	0,65	C
5	Jalan Wonogiri - Manyaran - Blimbing/Bts. Prov. DIY 3 (B - T)	1722	982	0,57	C
6	Jalan Wonogiri - Manyaran - Blimbing/Bts. Prov. DIY 3 (T - B)	1722	1073	0,62	C
7	Jalan Slendro II (U - S)	598	175	0,29	B
8	Jalan Slendro II (S - U)	598	153	0,26	B
9	Jalan Slendro III (U - S)	448	130	0,29	B
10	Jalan Slendro III (S - U)	448	112	0,25	B

Source: Analysis Results, 2023

Simpang's Performance in 2027 With Development

The performance of unsignalized intersections in 2027 with development can be seen in Table 17.

Table 17. Performance of Unsignalized Junctions in 2027 with the Development

It	Indicators	Junction 4 Entrance	Junction 4 Exit
1	Degree of Saturation (DS)	0,553	0,611
2	Delay Simpang (D) sec/junior high school	9,44	10,10
3	Queue Chance (QP%)	13-28	16-33

Source: Analysis Results, 2023

Road Performance in 2028 with Development

The performance of road sections in 2028 with development based on the value of saturation degree (DS) can be seen in Table 18.

Table 18. Road Performance in 2028 with Development

NO	NAMA JALAN	2028 DENGAN PENGEMBANGAN		DS	TINGKAT PELAYANAN
		KAPASITAS (smp/jam)	VOLUME (smp/jam)		
1	Jalan Wonogiri - Manyaran - Blimbing/Bts. Prov. DIY 1 (B - T)	1722	1304	0,76	D
2	Jalan Wonogiri - Manyaran - Blimbing/Bts. Prov. DIY 1 (T - B)	1722	1035	0,60	C
3	Jalan Wonogiri - Manyaran - Blimbing/Bts. Prov. DIY 2 (B - T)	1722	1156	0,67	C
4	Jalan Wonogiri - Manyaran - Blimbing/Bts. Prov. DIY 2 (T - B)	1722	1243	0,72	C
5	Jalan Wonogiri - Manyaran - Blimbing/Bts. Prov. DIY 3 (B - T)	1722	1079	0,63	C
6	Jalan Wonogiri - Manyaran - Blimbing/Bts. Prov. DIY 3 (T - B)	1722	1176	0,68	C
7	Jalan Slendro II (U - S)	598	193	0,32	B
8	Jalan Slendro II (S - U)	598	168	0,28	B
9	Jalan Slendro III (U - S)	448	144	0,32	B
10	Jalan Slendro III (S - U)	448	124	0,28	B

Source: Analysis Results, 2023

Simpang's Performance in 2028 With Development

The performance of unsignalized intersections in 2028 With Development can be seen in Table 19.

Table 19. Performance of Unsignalized Intersections in 2028 with the Development of

It	Indicators	Junction 4 Entrance	Junction 4 Exit
1	Degree of Saturation (DS)	0,621	0,642
2	Delay Simpang (D) sec/junior high school	10,17	10,43
3	Queue Chance (QP%)	16-34	17-35

Source: Analysis Results, 2023

Parking Performance After Development

The need for parking spaces for visitor vehicles after development is obtained from *the results of forecasting* the percentage increase in the rise and pull of visitor vehicles in the next 5-year analysis year. After the development, the addition of parking SRP was carried out, namely for cars as many as 90 SRP and 224 SRP motorcycles so that the availability of parking spaces at the Gajah Mungkur Reservoir Tourist Attraction became 282 SRP Cars, 369 SRP Motorcycles and 7 SRP Buses.

Table 20. Parking Space Usage Rate Conditions After Development

Uraian	Jumlah	Satuan	Keterangan
Ketersediaan SRP			
1. Mobil	282	SRP	
2. Motor	369	SRP	
3. Bus/Minibus	7	SRP	
Kebutuhan SRP			
1. Mobil	132	kend/jam	
2. Motor	185	kend/jam	
3. Bus/Minibus	4	kend/jam	
Turn Over (tingkat penggunaan ruang parkir)			
1. Mobil	0,47	kend/jam/SRP	
2. Motor	0,50	kend/jam/SRP	
3. Bus/Minibus	0,57	kend/jam/SRP	
Keterangan			
1. Mobil	$0,47 \leq 1$	kend/jam/SRP	**memenuhi**
2. Motor	$0,50 \leq 1$	kend/jam/SRP	**memenuhi**
3. Bus/Minibus	$0,57 \leq 1$	kend/jam/SRP	**memenuhi**

Source: Analysis Results, 2023

Recommendations for Handling Traffic Impacts Due to Development (Traffic Engineering Management) in 2028 after Development

Alternative Traffic Impact Handling

1. Side Obstacle Reduction (Alternative 1)

   Traffic engineering management is carried out by reducing side obstacles from medium (M) to low (L) by ordering street vendors on the shoulder of the road and prohibiting *on-street parking*.

Table 21. Capacity of the Wonogiri - Manyaran - Blimbing/Bts. Prov. DIY With *Do Something* 1

NO	NAMA RUAS JALAN	LEBAR JALUR EFEKTIF m	TIPE JALAN	BAHU JALAN	TIPE HAMBATAN SAMPING	KAPASITAS DASAR Smp/Jam	FAKTOR PENYESUAIAN LEBAR JALUR	FAKTOR PENYESUAIAN PEMISAH ARAH	FAKTOR PENYESUAIAN HAMBATAN SAMPING	FAKTOR PENYESUAIAN UKURAN KOTA	KAPASITAS (TOTAL) Smp/Jam	KAPASITAS (PER-ARAH) Smp/Jam
						Co	FC_W	FCsp	FC_{sf}	FC_{cs}	C	C
1	Jalan Wonogiri - Manyaran - Blimbing/Bts. Prov. DIY	9	2/2 UD	1,5	L	2900	1,25	1,00	0,97	1,00	3516	1758

Source: Analysis Results, 2023

Table 22. Road Performance in 2028 with *Do Something* 1

NO	NAMA JALAN	2028 DENGAN PENGEMBANGAN & DO SOMETHING 1		DS	TINGKAT PELAYANAN
		KAPASITAS (smp/jam)	VOLUME (smp/jam)		
1	Jalan Wonogiri - Manyaran - Blimbing/Bts. Prov. DIY 1 (B - T)	1758	1304	0,74	C
2	Jalan Wonogiri - Manyaran - Blimbing/Bts. Prov. DIY 1 (T - B)	1758	1035	0,59	C
3	Jalan Wonogiri - Manyaran - Blimbing/Bts. Prov. DIY 2 (B - T)	1758	1156	0,66	C
4	Jalan Wonogiri - Manyaran - Blimbing/Bts. Prov. DIY 2 (T - B)	1758	1243	0,71	C
5	Jalan Wonogiri - Manyaran - Blimbing/Bts. Prov. DIY 3 (B - T)	1758	1079	0,61	C
6	Jalan Wonogiri - Manyaran - Blimbing/Bts. Prov. DIY 3 (T - B)	1758	1176	0,67	C

Source: Analysis Results, 2023

The performance of unsignalized intersections in 2028 With Development and *Do Something* 1 can be seen in Table 23.

Table 23. Performance of Unsignalized Intersections in 2028 With Development and *Do Something* 1

It	Indicators	Junction 4 Entrance	Junction 4 Exit
1	Degree of Saturation (DS)	0,576	0,637
2	Delay Simpang (D) sec/junior high school	9,69	10,37
3	Queue Chance (QP%)	14-30	17-35

Source: Analysis Results, 2023

2. Traffic Direction Separation (Alternative 2)

Traffic engineering management for alternative 2 is carried out by arranging the separation of traffic directions from the previous 50-50 to 55-45 where the West to East direction is wider because the traffic flow is higher.

Table 24. Capacity of the Wonogiri - Manyaran - Blimbing/Bts. Prov. DIY With *Do Something* 2

NO	NAMA RUAS JALAN	LEBAR JALUR EFEKTIF m	TIPE JALAN	BAHU JALAN	TIPE HAMBATAN SAMPING	KAPASITAS DASAR Smp/Jam	FAKTOR PENYESUAIAN LEBAR JALUR	FAKTOR PENYESUAIAN PEMISAH ARAH	FAKTOR PENYESUAIAN HAMBATAN SAMPING	FAKTOR PENYESUAIAN UKURAN KOTA	KAPASITAS (TOTAL) Smp/Jam	KAPASITAS (PER-ARAH) Smp/Jam	
						Co	FC_W	FCsp	FC_{sf}	FC_{CS}	C	C	
1	Jalan Wonogiri - Manyaran - Blimbing/Bts. Prov. DIY	9	2/2 UD	1,5	L	2900	1,25	0,97	0,97	1,00	3411	B	1876
												T	1535

Source: Analysis Results, 2023

Table 25. Road Performance in 2028 with *Do Something* 2

NO	NAMA JALAN	2028 DENGAN PENGEMBANGAN & DO SOMETHING 2		DS	TINGKAT PELAYANAN
		KAPASITAS (smp/jam)	VOLUME (smp/jam)		
1	Jalan Wonogiri - Manyaran - Blimbing/Bts. Prov. DIY 1 (B - T)	1705	1304	0,76	D
2	Jalan Wonogiri - Manyaran - Blimbing/Bts. Prov. DIY 1 (T - B)	1705	1035	0,61	C
3	Jalan Wonogiri - Manyaran - Blimbing/Bts. Prov. DIY 2 (B - T)	1705	1156	0,68	C
4	Jalan Wonogiri - Manyaran - Blimbing/Bts. Prov. DIY 2 (T - B)	1705	1243	0,73	C
5	Jalan Wonogiri - Manyaran - Blimbing/Bts. Prov. DIY 3 (B - T)	1705	1079	0,63	C
6	Jalan Wonogiri - Manyaran - Blimbing/Bts. Prov. DIY 3 (T - B)	1705	1176	0,69	C

Source: Analysis Results, 2023

Of the two treatment alternatives, alternative 1 gives better results when compared to alternative 2. Performance of the Wonogiri-Manyaran-Blimbing/Bts. Prov. DIY for the B-T direction has decreased from the previous DS=0.76 with the service level "D" to DS=0.74 with the service level "C", while for the T-B direction from the previous DS=0.60 with the service level "C" to DS=0.59 with the same service level, namely "C".

Recommendations for the Installation of Road Equipment

In addition to several alternatives for handling traffic impacts, it is also necessary to carry out traffic engineering management by installing several road equipment both inside and outside the location of the Mungkur Elephant Reservoir.

Conclusion

Based on the results of the analysis, the following can be concluded:

1. Road and Intersection Performance Existing Conditions in 2023
   a. Performance of the Wonogiri - Manyaran - Blimbing/Bts. Prov. DIY (B-T) has a saturation degree of 0.43 while for the east-west direction it has a saturation degree of 0.39 with a service level of "B".

b. The performance of the 4 Entrance Junction in 2023 existing conditions has a degree of saturation DS=0.407; the queue chance is 19.14% and the intersection delay is 7.89 seconds/junior high school with a service level of "B".
c. The performance of the existing 2023 Exit Junction 4 has a degree of saturation DS=0.450; the queue chance is 21.59% and the intersection delay is 8.40 seconds/junior high school with a service level of "B".

2. In the existing 2023 conditions, the attraction of the Gajah Mungkur Reservoir Tourist Object is 155.38 smp/h and the rise is 116.88 smp/h.
3. Road Performance and Junction Conditions After Development, both in 2024 Construction Period, in 2025 to 2027 After Development have a degree of saturation with a service level of "C". The performance of the 4 Entrance Junction and the 4 Exit Junction in the 2024 Conditions of the Construction Period until 2027 with the Development has a service level of "B".
   Then in 2028 After Development, the performance of the Wonogiri - Manyaran - Blimbing/Bts. Prov. DIY (B-T) has a degree of saturation of DS=0.76 with a service level of "D", while on the section of Jalan Wonogiri - Manyaran - Blimbing/Bts. Prov. DIY (T-B), degree of saturation DS=0.59 with service level "C". The performance of Junction 4 Entrance and Junction 4 Exit in 2028 conditions with development has the same level of service, namely "B".
4. Recommendations for handling traffic impacts (*Do Something*) due to the Development of the Mungkur Elephant Reservoir consist of 2 alternatives. Of the two treatment alternatives, alternative 1 gives better results than alternative 2. Another recommendation is the installation of several road equipment both inside and outside the location of the Mungkur Elephant Reservoir.

Suggestion

1. Other research is needed related to the economic impact or social impact of the development of the Mungkur Elephant Reservoir.
2. Evaluation of the performance of roads and intersections needs to be carried out periodically for the next 2-3 years due to an increase in vehicle volume due to the development of the Mungkur Elephant Reservoir.

Reference

[1] Adawiyah, R., Erpandi, M., & Surya, A. (2020). Evaluation of Road Performance at the Unsignaled Intersection of Jalan Padat Karya - Sungai Andai Banjarmasin City. *Proceedings of the 2020 National Engineering Seminar (SENASTIKA) of the Islamic University of Kalimantan MAB*, 148-154.
[2] Aji, T. K., Winarto, S., Ridwan, A., & Candra, A. I. (2019). Traffic Impact Analysis of the Construction of the Front One Hotel Tulungagung, Tulungagung Regency. *JURMATEKS*, Vol. 2 No. 2.
[3] Aldiansyah, M. (2022). Analysis Impact of Traffic (Andalalin) Transmart Mall Area, Jalan Tajur Bogor. *ASTONJADRO: CEAESJ*, Volume 11, pp. 263-274.
[4] Amijaya, J., & Soimun, A. (2022). The Impact of the Construction of Pertamina's Refrigerated LPG Terminal on Traffic Performance on the Surrounding Road Network. *Journal of Transportation Vol. 22 No. 2*, 143-154.
[5] Andoyo, H., & Yuniarti, S. (2020). Andadalin Construction of Shophouse 88 Berlian Commercial Estate in Tangerang City. *Journal of Civil Engineering - Architecture*, Volume 19, No. 1.
[6] Ardana, Y. E., Akhmadali, & Sumiyattinah. (2021). Analysis of Traffic Impact Due to the Operation of the Swiss Belinn Hotel, Singkawang City. *JeLAST : Journal of PWK, Sea, Civil, Mining*, Vol. 8, No. 1.
[7] Asy'ari, M. H., Ma'ruf, A., & Iskak, E. (2021). Performance Evaluation of Unsignalized Intersections (Case Study: Jalan Gatot Subroto Intersection – Jalan Panglima Sudirman – Jalan Trunojoyo – Jalan Untung Suropati, Malang City). *Student Journal GELAGAR Vol.3 No.2*, 73-81.
[8] Aulia, R. (2017). Performance Analysis of Signalized Junction Five (Case Study of Jalan Soekarno Hatta Tlogosari Semarang). Unissula Institutional Repository.
[9] Central Statistics Agency. (2022). *Retrieved* from Wonogiri Regency in Numbers.
[10] Dikun, S., & Arief, D. (1993). *Building and Traffic Area Problem Solving Strategy.* Jakarta: Seminar Materials on the Impact of Land Intensity Utilization of High-Rise Buildings/Superblocks in Jakarta.
[11] Wonogiri Regency Youth and Sports and Tourism Office. (2021). *AMDAL Framework of Reference Form for the Development of the Elephant Mungkur Reservoir Tourism Object.* Wonogiri.
[12] Public Works Office of Highways and Cipta Karya of Central Java Province. (2022). *Traffic Summary Report*.
[13] Transportation Office. Decree of the Director General of Land Transportation Number 272/HK.105/DRJD/96 concerning Technical Guidelines for the Implementation of Parking Facilities. Jakarta: Transportation Agency.
[14] Wonogiri Regency Transportation Office. (2023). https://dishub.wonogirikab.go.id/

[15] Hariyanto, Suraji, A., & Cakrawala, M. (2022). Performance Evaluation of Unsignaled Junction Three Jl. Muharto - Jl. Mayjen Sungkono - Jl. Raya Ki Ageng Gribig, Malang City. *CYCLE: Journal of Civil Engineering Vol 8, No. 1, April 2022*, 70-85.
[16] Hidayat, A. (2021). Analysis of the Traffic Impact Due to the Construction of the North Sumatra Sport Center on the Performance of the Sultan Serdang Road Section (Case Study). *Scientific Journal of Engineering Students*, Vol. 1 No. 3.
[17] Hobbs, F. D. (1995). *Traffic Engineering Planning.* Yogyakarta: Gajahmada University Press.
[18] Hudoyo, C. P., Purwono, N. A., & Hidayat, Z. I. (2021). Forecast and Handling of Traffic Impacts of Pangandaran Special Housing Development, West Java. *TECHNO*, Vol. 22, No. 1, p. 27-34.
[19] Juwita, F. (2021). Performance Evaluation of Unsignalized Intersections Using PTV VISSIM 9.0 (Case Study of Jalan AH Nasution – Jalan Way Pangabuan – Jalan Tanggamus). Journal of Science Engineering Volume 06, *Number 01*, 44-50.
[20] Kamaluddin, R. (1986). *Transportation Economics.* Jakarta: Ghalia Indonesia.
[21] Kumita, & Reza, M. H. (2022). Performance Evaluation of Unsignalized Intersections Based on the 2014 PKJI Method. *Journal of Engineering and Technology (Rekatek) 6(1)*, 1-7.
[22] Maulana, Q. (2016). Simulation of Road Grid Modeling to Predict the Decomposition of CO, NOx, PM10, and SO2 Emissions from the Rapid Transit Bus Development Plan in Tangerang City. *Journal of Engineering*, Volume 22 Number 1.
[23] MKJI. (1997). *Department of Public Works.* Jakarta: Directorate General of Highways.
[24] Morlok, E. K. (1978). *Introduction to Transportation Engineering and Planning.* Jakarta: Erlangga.
[25] Morlok, E. K. (1988). *Introduction to Transportation Engineering and Planning.* Jakarta: Erlangga.
[26] Morlok, E. K. (1995). *Introduction to Transportation Engineering and Planning*. Jakartra: Erlangga.
[27] Muharyanto, E. A., & Talessy, B. (2021). Performance evaluation of marked intersection at the RH-Mart intersection. *Uniqbu Journal of Exact Sciences (UJES)*, 14-19.
[28] Munawar. (2005). *Visual Modeling with UML.* Yogyakarta: Graha Ilmu.
[29] Murwono, D. (2003). Transportation Environment Planning. In *Lecture Materials.* Yogyakarta: Master of Transportation Systems and Engineering, UGM.
[30] Nasution. (1996). *Transportation Management.* Jakarta: Ghalia Indonesia.
[31] Pedo, K. S. (2022). Performance Evaluation of Road Sections and Three Unsignaled Intersections on Jl. Piet A. Tallo (Liliba Bridge). *Journal of Civil Engineering Volume 16, No. 4, April 2022*, 261-268.
[32] Government of the Republic of Indonesia. (2009). *Law of the Republic of Indonesia Number 22.* Jakarta.
[33] Government of the Republic of Indonesia. (2011). *Government Regulation of the Republic of Indonesia Number 30 of 2011 concerning the Implementation of the Traffic and Road Transportation Sector.* Jakarta.
[34] Government of the Republic of Indonesia. (2021). *Regulation of the Minister of Transportation of the Republic of Indonesia Number PM 17 of 2021 concerning the Implementation of Traffic Impact Analysis*. Jakarta.
[35] Robot, A. M., Rompis, S. Y., & Kumaat, M. M. (2023). Performance Analysis of Unsignaled Junction (Case Study: Unsignaled Intersection in Front of SMA Negeri 7 Manado Between Jl. Tololiu Supit and Jl. W. Z. Yohanes). *TEKNO Volume 21, No. 84*, 445-456.
[36] Rodomora, A., Firdausiyah, N., & Kurniawan, E. B. (2022). Evaluation of the Performance of Unsignalized Intersections on Jalan Patimura and Jalan Trunojoyo – Cokroaminoto, Malang City. *Planning for Urban Region and Environment Volume 11, Number 3*, 187-196.
[37] Rusmandani, P., Nisa, M. C., & Setiawan, R. S. (2019). Traffic Impact Analysis of the Construction of Kedungwuni-Karangdadap Market, Pekalongan Regency. *Journal of Road Transportation Safety*, ISSN 2338-4247.
[38] Salim, A. (1993). *Transportation Management.* Jakarta: Rajagrafindo Perkasa.
[39] Saputra, A. R., Sebayang, N., & Ma'ruf, A. (2020). Performance Evaluation of Unsignalized Intersections (Case Study: Simpang Tiga Jl. Raya Dadaprejo – Jl. Ir. Soekarno, Batu City). *Student Journal GELAGAR Vol. 2 No. 2*, 67-76.
[40] Sutabri, T. (2012). *Transportation System Analysis.* Yogyakarta: Andi Yogyakarta.
[41] Styawan, A., Cahyo, Y., & Ridwan, A. (2019). Analysis of the Traffic Impact of the Revitalization of the Sumbergempol Market, Tulungagung Regency. *JURMATEKS*, Vol. 2, No. 2.
[42] Tamin, O. Z. (1994). Application of the 4-Stage Transportation Planning Model in Solving Transportation Problems in Developing Countries. *Journal of Civil Engineering*.
[43] Tamin, O. Z. (1997). *Transportation Planning and Modeling.* Bandung: ITB.
[44] Utami, S. (2015). Construction of the Mungkur Elephant Reservoir in 1976-1986. *Avatara e-Journal*, Vol 3, No 1.Wardani, L. K. (2022). Performance Evaluation of 3 Feet Unsignaled Junction Jl. Mulyorejo - Jl. Tebo Selatan (Simpang Mulyorejo). *Journal of Science - Engineering Sciences - Systems Vol. 18 No. 1*, 41-46.