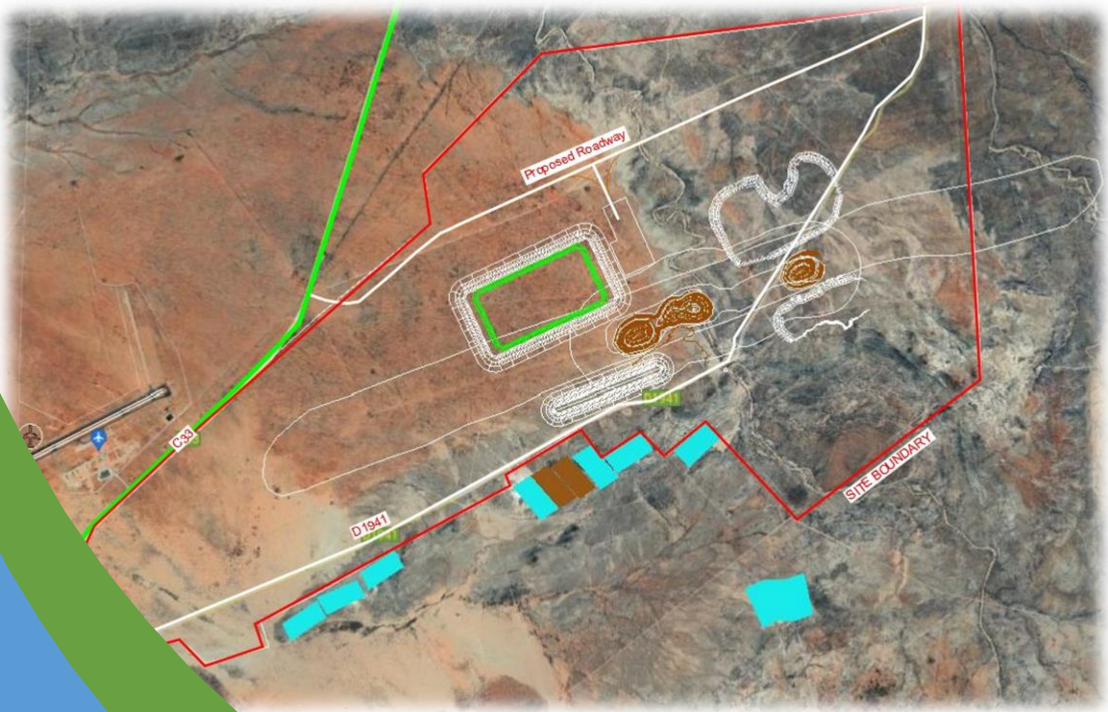
Twin Hills Mine Project

Transport Impact Assessment (TIA)

Erongo Region, Namibia

Report Status – Revision 2
November 2021



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SUMMARY SHEET

Report Type	Transport Impact Assessment (TIA)
Title	Twin Hills Mine Project
Location	Erongo Region, Namibia
Client	Environmental Compliance Consultancy
Reference Number	ITS 4377
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Report Status	Revision 2
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ANNEXURE

Transport Impact Assessment

Twin Hills Mine Project, Erongo Region, Namibia

1 Purpose of Study	This report summaries an investigation of the transport related impacts, expected as part of the planned Twin Hill Mine Project, during both the construction and operational phases. The purpose of this assessment is to identify constraints within the road network and recommend appropriate mitigation measures.
2 Locality	The Twin Hill Project is located approximately 135km outside of Windhoek, in the Erongo Region of Namibia, just northeast of the town Karibib. The site is bounded by C33, C36 and B2 roadways. See **Figure 1** for a Locality Plan and **Figure 2** for a Site Boundary Plan.
3 Land Use & Extent	**Existing land use** – currently undeveloped. Based on aerial photography. **Proposed use / extent** – Mine for Gold Ore and to process the ore to bars. The extent of the site is about 6 277 hectares. See **Figure 2** the Site Boundary Plan.
4 Development	Construction is planned to start in late 2022. Construction to last about 18 months. Operational phase of the mine to commence in 2024 The Twin Hill Mine is planned to mine about 14 million tonnes per year for the first two years of operation. Production would then increase to about 25 million tonnes per year until closure (approximately 14 years of mining, including waste). The processing of the ore is capped at 3.5 million tonnes per year and thus will keep the mine in operation for an additional 2 years (2038 to 2040). No trips are planned for transporting of waste material off site. All waste material is stored / used on site. Closure of the mine – around 2040.
5 Existing Access	Currently the D1941 Road runs through the site which could potentially provide access for the site. However, a new site access and roadway is proposed for the development.

	Due to the mine, the existing D1941 is planned to be closed and relocated to a new position to the north by the development. The proposed new roadway to the site would be located about 7km north of the existing C33 Road / D1941 Road intersection. The proposed access is discussed further in **Section 17** of the report.
6 Existing Roadways	The major roadways in the site vicinity include: **B2 Road (T0106)** – a typical Class 1 principal arterial, with a surfaced lane (approx. 3,7 meters wide) per direction. Speed limit of 120km/h. **C33 Road (T0203)** – a typical Class 2 major arterial, with a surfaced lane (approx. 3,5 meters wide) per direction. Gravel shoulders and a speed limit of 120km/h. **C36 Road (M0080)** – a typical Class 3 minor arterial, with gravel lanes. Speed limit of 100km/h. **D1941 Road** – a typical Class 4 distributor, with gravel lanes. See **Figure 1** for the location of the roads, relative to the development.
7 Study Intersections & Existing Control	Int. 1: B2 Road / C33 Road — Unsignalised control Int. 2: C33 Road / D1941 Road — Unsignalised control Int. 3: C33 Road / B2 Road — Unsignalised control Int. 3: C36 Road / B2 Road — Unsignalised control
8 Analyses Hours	The 30th highest peak hour traffic volumes were used to determine the impact for this development on the surrounding road network. This peak hour traffic volumes means that the volumes will only be exceed 29 times through the year and are therefore typically higher than the weekday AM and PM peak hour traffic volumes.
9 Scenarios Analysed	**Scenario 1**: 2021 Existing Traffic conditions. (Based on 2018 - 30th highest hourly volumes, escalated with a 2% growth rate per year, to determine a calculated existing 2021 traffic volume scenario.) See **Section 10** for more details. **Scenario 2**: 2022 Background Traffic conditions – *before development* is constructed (Based on **Scenario 1** traffic volumes, escalated with a 2% growth rate per year.) See **Section 11** for more details. **Scenario 3**: 2024 Total Traffic conditions (Based on **Scenario 2** traffic volumes, *PLUS* the **construction phas**e trips from the proposed Twin Hill project). See **Section 15** for more details.

	Scenario 4: 2040 Total Traffic conditions (Based on **Scenario 2** traffic volumes, *PLUS* the **operational phase** trips from the proposed Twin Hill mine development). Intersection analyses were done with Traffix version 8.0 Software, which is based on the Highway Capacity Manual (HCM).
10 Existing Traffic – Scenario 1	The calculated 2021 existing traffic volumes are based on the 30th highest hourly volumes. These traffic volumes were calculated by escalating 2018 volumes with a growth rate of 2% per year over three years. 2021 Traffic volumes were also surveyed, but it was approximately 50% (i.e. 30 vehicles) less that the 2018 volumes (probably due to Covid 19 impacts). The 2021 traffic volumes were therefore not used in the capacity analyses calculations. Both the 2018 and 2021 traffic volumes were however, used to determine the distributional split of new development trips. The current total two-way peak hour volumes along C33 are approximately 170 vehicles about 30% (i.e. 53 vehicles) of this current total peak hour volumes are heavy vehicles. Based on the capacity analyses results, all the intersections are operating with an acceptable Level-Of-Service (LOS) A, very short delays and sufficient capacity. Hence, no upgrades are proposed. See **Figure 3** in annexure A for the Existing Traffic Conditions.
11 Background Traffic – Scenario 2	The 2022 Background Traffic volumes were calculated by escalating the *calculated* 2021 traffic volumes. This analysis is based on the existing intersection geometry / control. All traffic volumes were escalated with a 2% growth rate per year (over 2 years). This increase in traffic volumes could result in zero or one additional heavy vehicles trip along the C33. Based on the capacity analyses results, all the intersections would continue to operate at acceptable LOS A / B, with very short delays and sufficient capacity. Hence, no upgrades are proposed. See **Figure 4** in annexure A for the Background Traffic Conditions.
12 Trip Generation Rates	No trip generation rates are available in COTO or the ITE manuals for mines, since there are various factors that affects the number of development trips (i.e. size, process and procedures of what is being mined). Because this is a gold mine, information on the transport of the gold bars is classified and it is therefore not accounted for in the trip generation. However, this is expected to be very low volumes (i.e. one trip per day / week).

<table>
<tr><td></td><td>The trip generation for this development is based on person trips of the number of people working on site during each shift.

The development demand:
• Construction: 333 people per shift (3, 8-hour shifts)
• Operational: 257 people per shift (3, 8-hour shifts)

Truck development demand:
• Construction: 10 -20 trucks a day (based on B2Gold info)
• Operation: 5 - 10 trucks a day (max. assumed demand)

See Table 1 and Table 2 in Annexure B for the expected development trips during construction and operational phases respectively.</td></tr>
<tr><td>13 Development Trips</td><td>The demand for the person trips was split 10% and 90% for light and heavy vehicles respectively. Based on this split, the development is expected to generate the following peak hour trips:

Construction:
• Peak Hour: 74 Total trips (37 In and 37 Out)

Operations:
• Peak Hour: 52 Total trips (26 In and 26 Out)

See Table 3 and Table 4 for the expected driveways trips during construction and operational phases respectively. See Figure 5 in annexure A for the construction development trips and Figure 7 in annexure A for the operational development trips.</td></tr>
<tr><td>14 Trip Distribution</td><td>The following trip distribution was used for the proposed mine development, based on current trip patterns in the area:

• 40% of trips to/from Omaruru along C33
• 5% of trips to/from Omaruru along C36
• 45% of trips to/from Karibib along B2
• 10% of trips to/from Okahanja along B2

See Figure 5 and Figure 7 in annexure A for the distribution of trips.</td></tr>
<tr><td>15 Total Traffic – Scenario 3 Construction Phase</td><td>The 2024 Total Traffic volumes were calculated by adding the Twin Hill mine construction development trips onto the 2022 Background Traffic volumes. The 2022 traffic volumes were escalated with a 2% growth rate per year over 2 years. The geometry used in this scenario is based on the existing geometry and control. The proposed new C33/D1941 intersection is based on the current intersection geometry and control. The expected truck trips during the construction phase would be spread out across the full day and not only the peak hours. The expected truck trips would only be about 3 new</td></tr>
</table>

	heavy vehicles during the peak hours. Approximately 50% of the total traffic demand along the C33 is expected to be heavy vehicles in this scenario. However, since the total traffic volumes along the C33 would be low, the impact thereof would be low for this road environment. Based on the capacity analyses results, the intersections would continue to operate at acceptable LOS A/B, with short delays and sufficient capacity. Hence, no upgrades are required, *from a capacity analysis point of view.* See **Figure 6** in annexure A for the Total Traffic Conditions.
16 Total Traffic – Scenario 4 *Operational Phase*	The 2040 Total Traffic volumes were calculated by adding the operational development trips onto the 2022 Background Traffic volumes. The 2022 background traffic volumes were escalated by 2% per year up till 2040 (design life of the mine). The geometry used in this scenario is based on the existing geometry and control. The proposed new C33/D1941 intersection is based on the current intersection geometry and control. The operational phase of the development would generate fewer truck trips on the surrounding road network compared to the construction phase. As mentioned in Scenario 3 the development trips for trucks are spread out across the full day. Hence, only about 2 truck trips are expected during the peak hours. Approximately 40% of the total traffic demand along the C33 is expected to be heavy vehicles in this scenario. However, since the total traffic volumes along the C33 would be low, the impact thereof would be low for this road environment. Based on the capacity analyses results, the intersections are expected to continue to operate acceptably with a LOS A/B, with short delays and sufficient capacity. Hence, no upgrades are proposed, *from a capacity analysis point of view.* See **Figure 8** in annexure A for the Total Traffic Conditions.
17 Site Access	Access to the Twin Hill mine development is proposed from the re-aligned D1941. The mine entrance access along this re-aligned D1941, should have a minimum shoulder sight distance of 200m for a speed limited of 60km/h. The width of the roadway should be a minimum of 7m wide to allow heavy vehicles to safely pass one another. Sufficient bell-mouth radii (of at least 15 meters) are recommended at this development access.
18 Re-aligned D1941	As part of the proposed mine development, it is proposed to re-align D1941. The current road alignment goes across the proposed mine site. The proposed re-aligned D1941 is north of the development. See **Figure 2** for the site boundary as well as the proposed D1941 road re-alignment.

	This re-aligned D1941 would link up to the existing (lower order) access along C33 Road, just north of Karibib air force base (approx. 3.8 km's). The access road is currently surfaced (with asphalt) for about 17m from the C33 roadway and it is gravel thereafter. The width of the existing asphalt road is about 3m wide. It is recommended to increase this road width to at least 7 meters. This should allow trucks and busses to pass one another safely. *Based on the capacity analysis*, no intersection upgrades are required at the study intersections. However, it is recommended to implement a separate northbound right-turn lane at the C33/D1941 intersection, *from a safety point of view*. The required shoulder sight distance with the current traveling speed of 120km/h along C33 Road is: • Passenger car – 220m • Single unit – 340m • Single unit & Trailer – 455m Sufficient shoulder sight distance is available for the minor road. See **Photos 1** and **2** and **Figure 9** in annexure A. However, it is recommended to reduce the speed along the C33 to 80 km/h on the approaches of this D1941 intersection, *from a safety point of view.* If the travelling speed is reduced to 80km/h, then the required shoulder sight distance would be: • Passenger car – 155m • Single unit – 245m • Single unit & Trailer – 300m Approximately 285 daily trips are expected along the D1941 Road. From a maintenance and safety point of view, the re-aligned D1941 road should be surfaced. Any damages after the construction phase along the proposed re-aligned D1941, between the development access and the C33 road, should be repaired by the developed to an acceptable standard.
19 Surrounding Roads (Site observation)	**C36 Road** A gravel road from the B2 intersection till C33 Road. The speed limit along the road is 100km/h. There is signage along the road which indicate the alignment of the road, beware of animals and delineator plate (W401 and W402) signs. See **Photo 3** in Annexure C. Fencing along the road is suggested as this can protect the driver and the animals.

	B2 Road The road is surfaced with asphalt and is in good condition. Signages are present along the B2 Road. See **Photo 4** in Annexure C. **C33 Road** The road is surfaced with asphalt and is in very good condition from the B2 intersection till about halfway to Omaruru. From that point on the road is in fair conditions and is currently undergoing maintenance. There is signage along the road indicating minor side roads and speed limits. See **Photo 5** in Annexure C. **D1941 Road** A gravel road, with some warning signage closer to the Farmhouses. See **Photo 6 and 7** in Annexure C.
20 Public Transport	Most trips to and from this development will make use of public transport (i.e. buses) and therefore appropriate infrastructure should be in place. It is recommended that bus embayments with sufficient circulating radii (minimum 15 meters), lighting and shelter be provided on-site at the development entrance.
21 Fuel and Supply Deliveries	Approximately 20 trucks per day (Based on B2gold) will travel in and out of the site during the construction phase and it was assumed that there would be 5-10 trucks per day during the operation phase. Based on the primary mining equipment list an average of 85 litres per hour of fuel is required and an average of 35 litres per hour is required for the secondary mining equipment list (based on Qubeka Mining Consultants Twin Hill Mining Study). Based on an average fuel tanker size of 45 000 litres, as well as the assumed fuel storage capacity of 30 cubic meters / 30 000 litres on site (ECC report), this could equate to about one fuel truck every 10 days.
22 Conclusion & Recommendations	This report summaries an investigation of the transport impacts expected as part of the Twin Hills gold mine development, in the Erongo region of Namibia. The following can be concluded, based on this investigation: **2021 Existing Traffic**: All intersections currently operate acceptably and have sufficient capacity. Hence, no upgrades are proposed. **2024 Background Traffic**: All intersections would continue to operate acceptably and would have sufficient capacity. Hence, no upgrades are proposed.

	Trip Generation: This development is expected to generate the following peak hour trips, during the construction and operational phases. • Construction - 74 Total trips (37 In and 37 Out) • Operational - 52 Total trips (26 In and 26 Out) The additional (10-20) trucks in the construction/operational period of the development does not significantly increase the truck usage on the surrounding road network *during the peak hour*. **2024 Total Traffic**: All intersections would continue to operate acceptably and would have sufficient capacity. **2040 Total Traffic**: All intersections would continue to operate acceptably and would have sufficient capacity. **Site Access**: Recommended from the proposed re-aligned D1941. **Re-alignment D1941**: As part of the proposed mine development, it is proposed to re-align D1941. The current road alignment goes across the proposed mine site. The proposed re-aligned D1941 is to the north of the development. It is recommended to implement a separate northbound right-turn lane at the C33/D1941 intersection, *from a safety point of view*. It is also recommended to reduce the speed along the C33 to 80 km/h on the approaches of this D1941 intersection, *from a safety point of view.* From a maintenance and safety point of view, the re-aligned D1941 road should be surfaced. Any damages after the construction phase along the proposed re-aligned D1941, between the development access and the C33 road, should be repaired by the developed to an acceptable standard. **Public Transport**: It is recommended that bus embayments with sufficient circulating radii (minimum 15 meters), lighting and shelter be provided on-site at the development entrance. Based on the findings in this investigation, it is evident that the impact of this development would be minimal on the external road networks. Hence, it is recommended that the Twin Hills gold mine development be considered for approval, *from a transport point of view.*

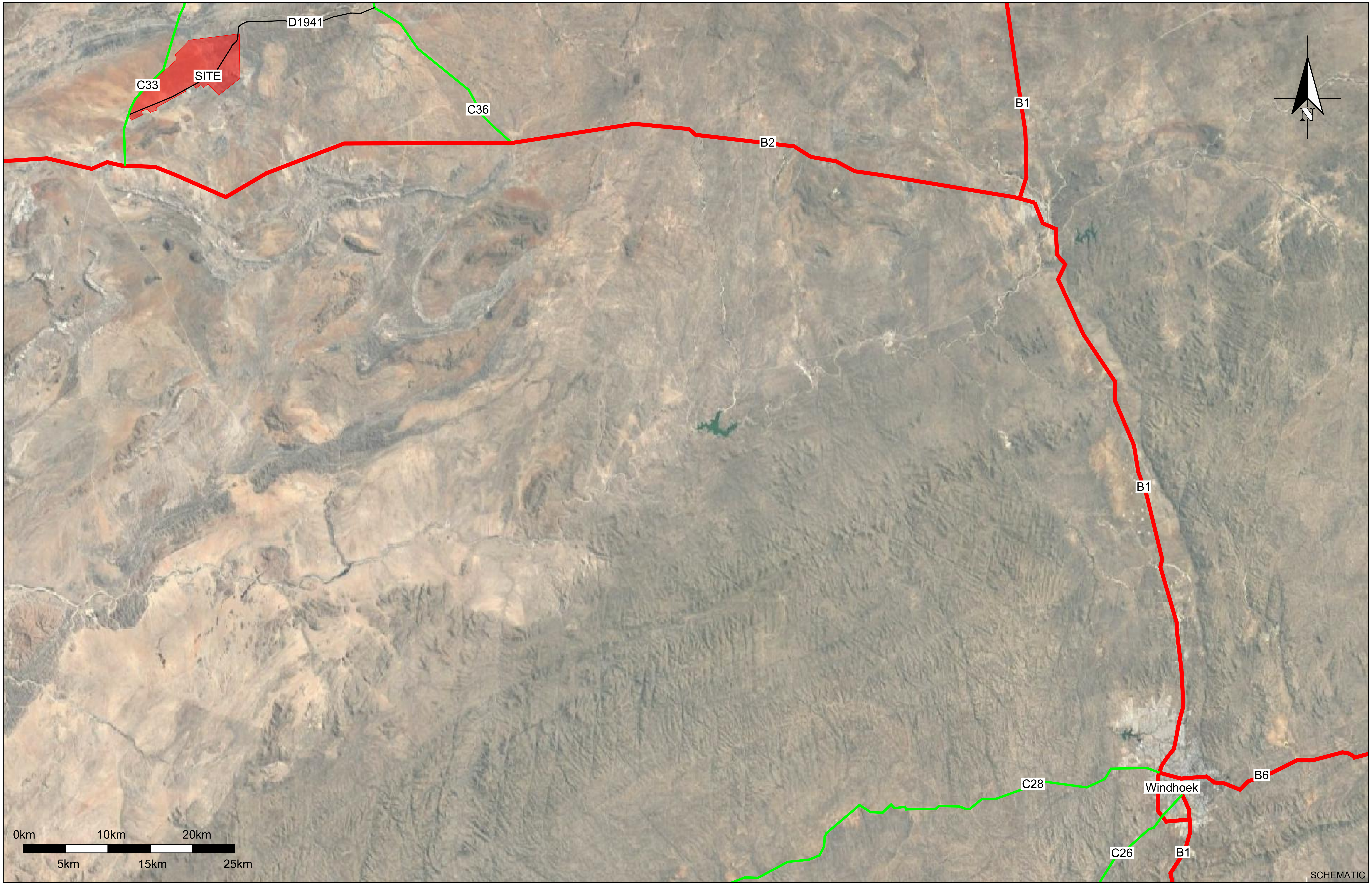
REFERENCES

1. Committee of Transport Officials. South African Traffic Impact and Site Traffic Assessment Standards and Requirements Manual. TMH 16 vol 2. 2014
2. South African Trip Data Manual, TMH17, Version 1.1, COTO, September 2013
3. Western Cape Government, Access Management Guidelines, November 2019
4. Qubeka Mining Consultants. Osino Resources: Twin Hill Gold Project Preliminary Economic Assessment (PEA) – Mining Study. Project number-LYC/OSI/PEA/2021/018/01. 15 June 2021.
5. Environmental Compliance Consultancy. Preliminary Environmental And Social Scoping Report. ECC-103-332-REP-19-A. August 2021
6. B2Gold Corp. NI 43-101 Technical Report Feasibility Study. Provice of Otjozondjupa, Republic of Namibia. February 2013

Annexure A

Figures

List of Figures



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TWIN HILLS PROJECT	LOCALITY PLAN	1A

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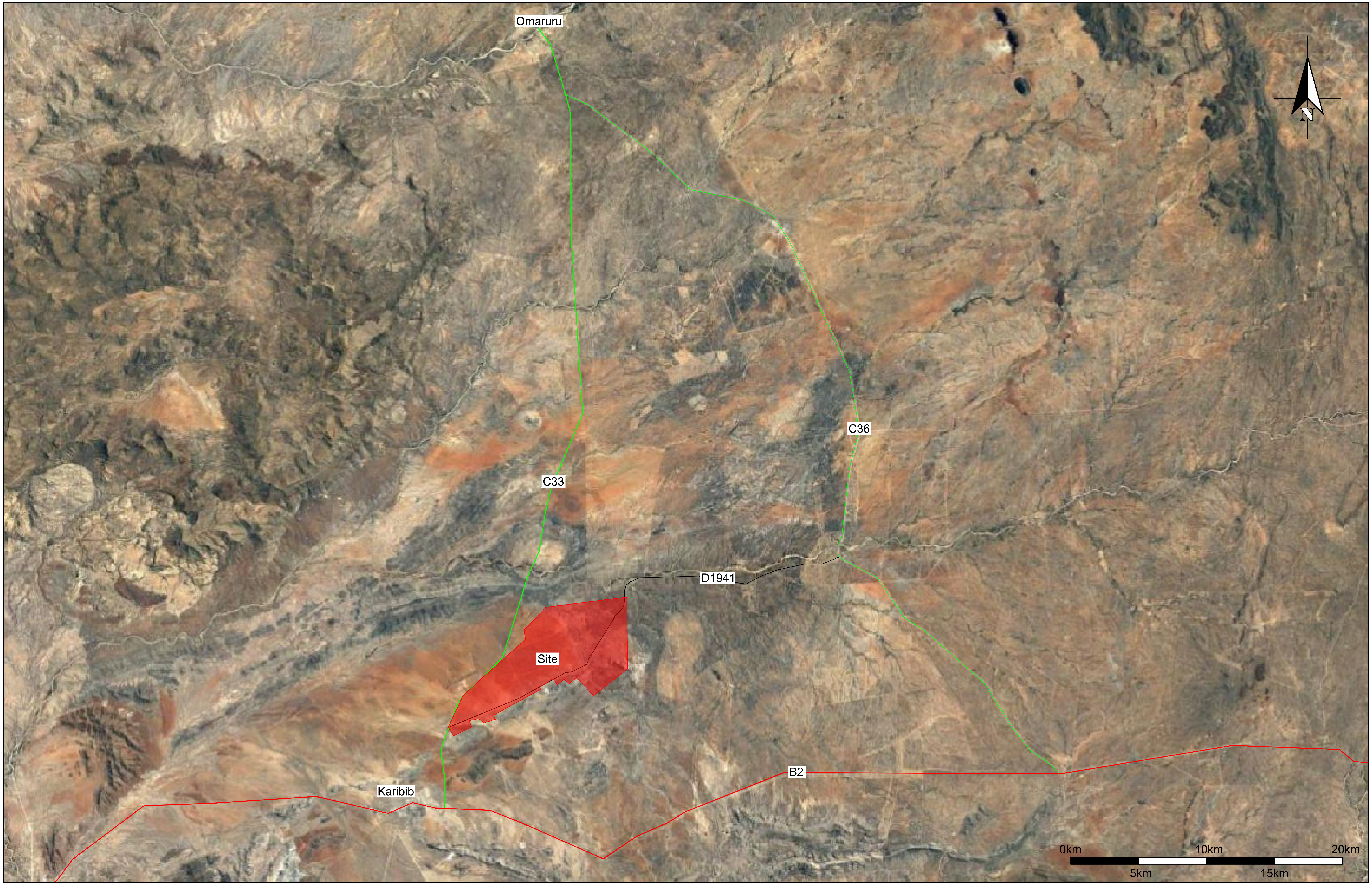

PROJECT:	FIGURE:	NUMBER:
TWIN HILLS PROJECT	LOCALITY PLAN (ZOOMED)	1B

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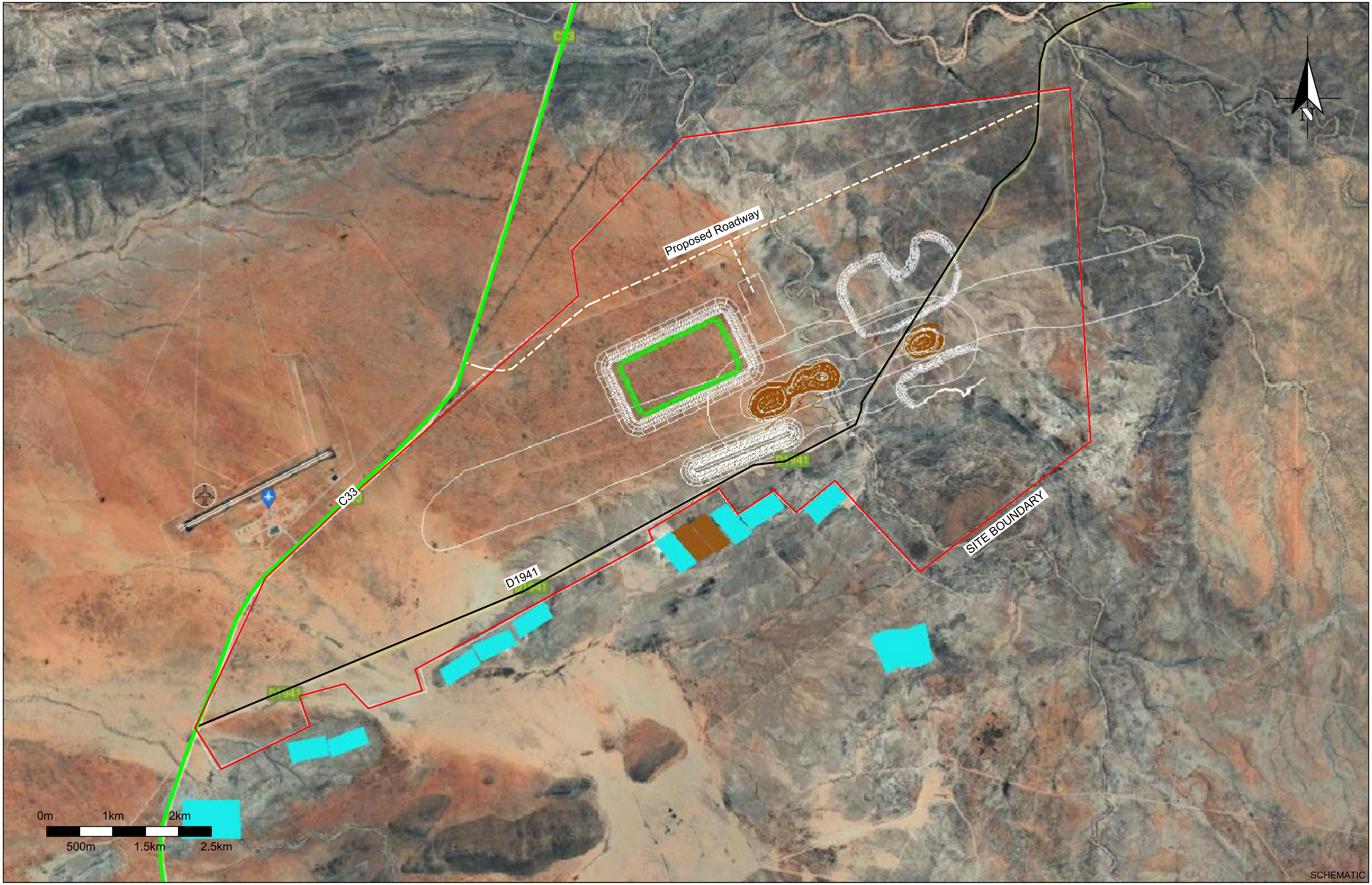

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PROJECT:	FIGURE:	NUMBER:
TWIN HILLS PROJECT	SITE BOUNDARY PLAN	2

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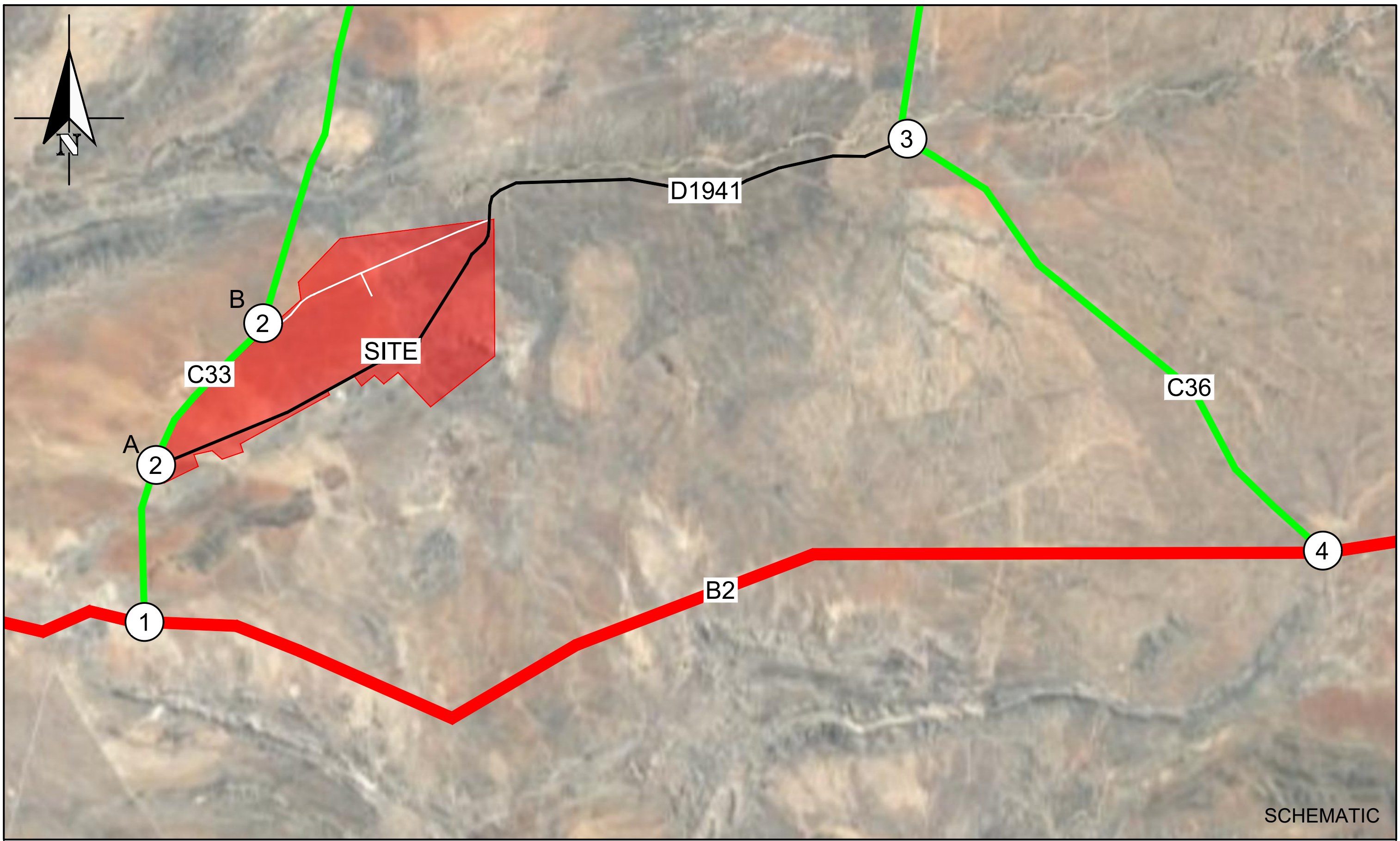
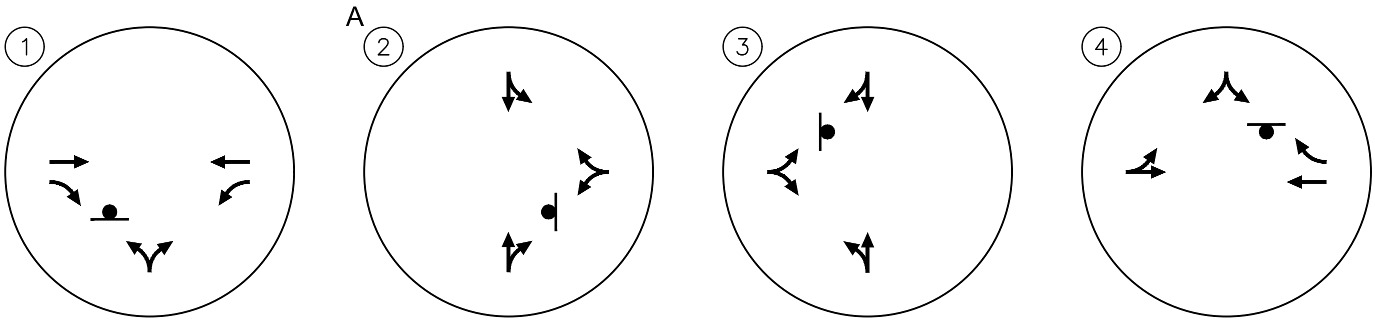
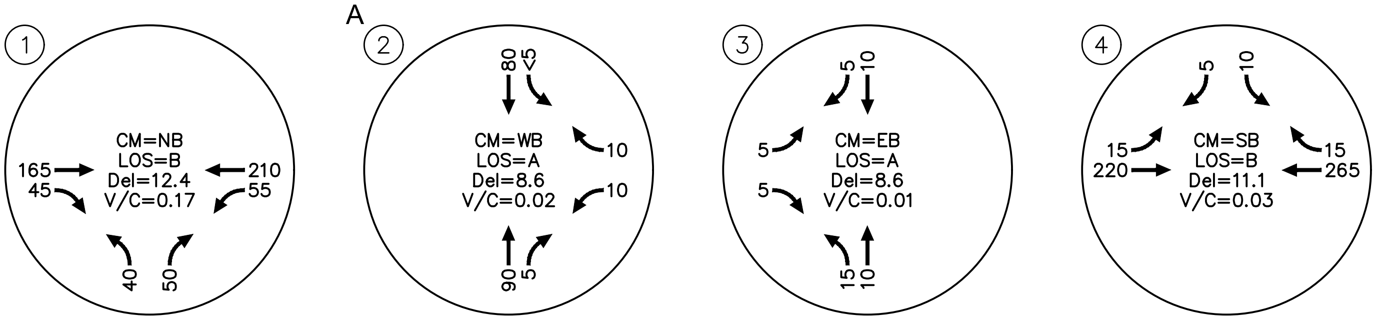


EXISTING LANE CONFIGURATION AND TRAFFIC CONTROL DEVICES



2021 EXISTING TRAFFIC CONDITIONS - 30th HIGHEST HOURLY VOLUME



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NOTE:
TRAFFIC COUNTS: BASED ON 2018 TRAFFIC COUNTS ESCALATED WITH A 2% GROWTH RATE PER YEAR
TRAFFIC COUNTS: ROUNDED TO THE NEAREST 5 veh/h

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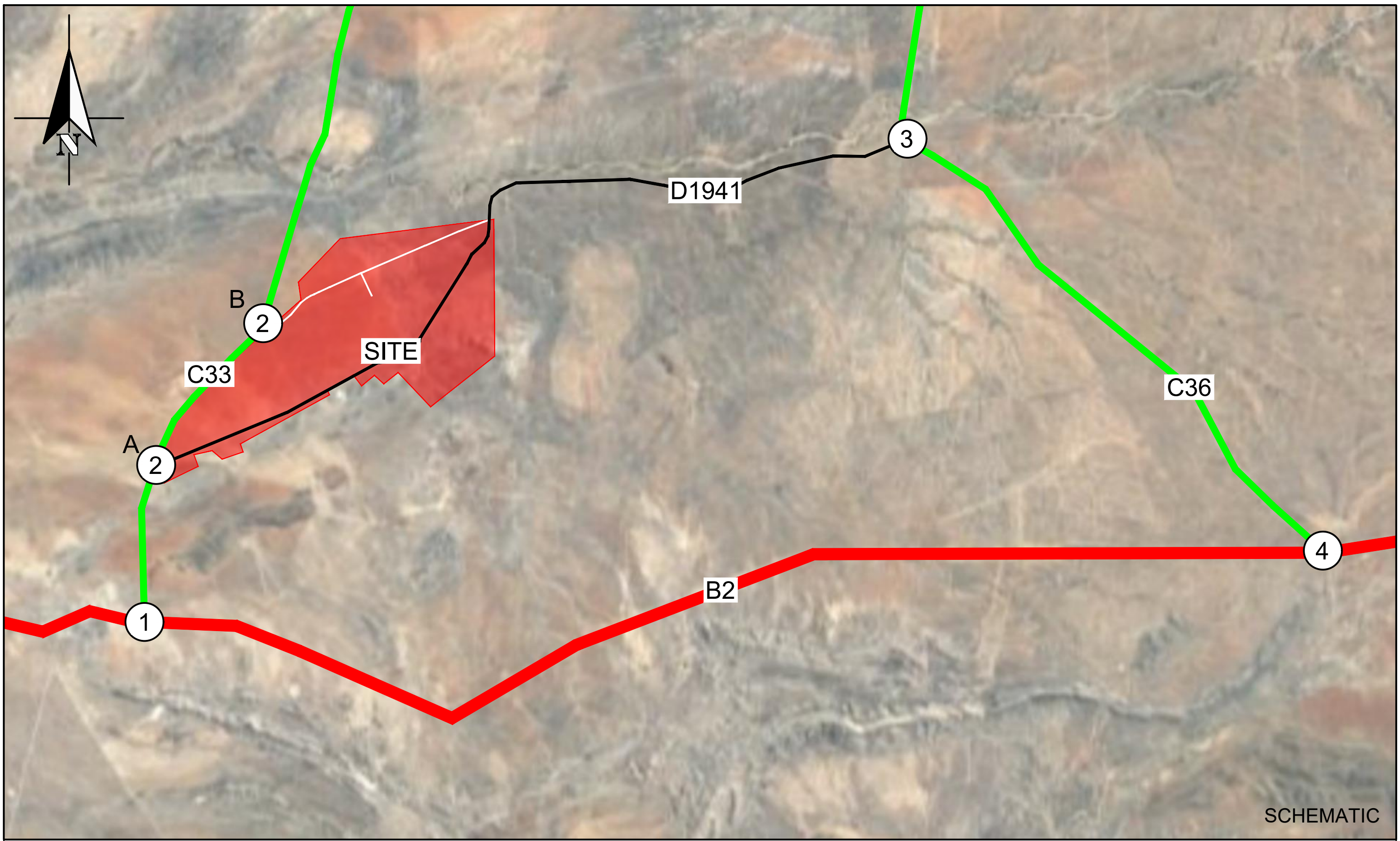
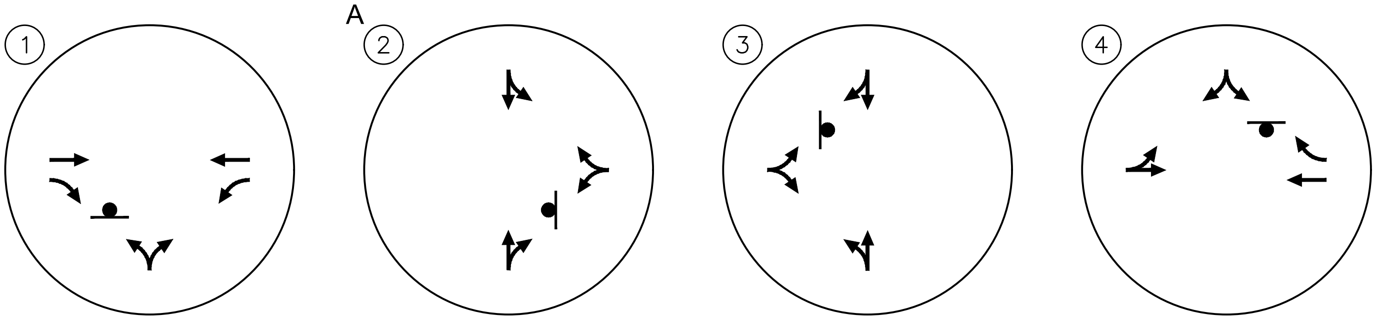
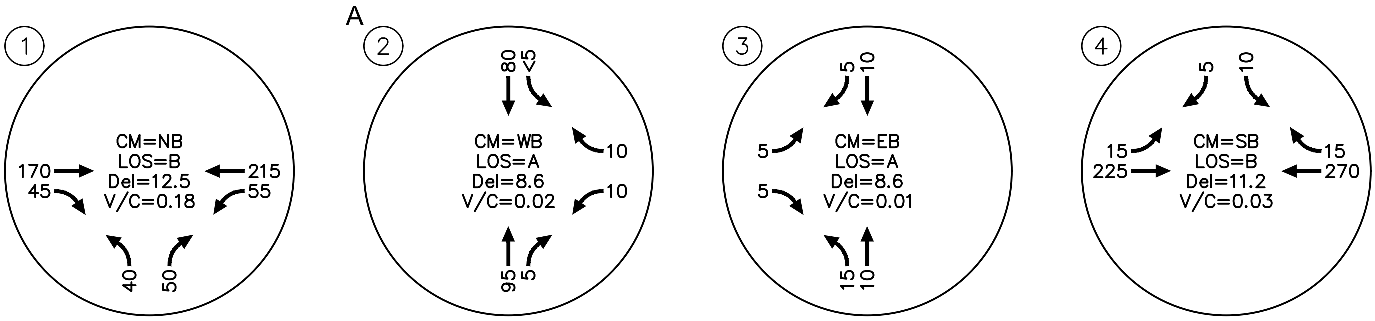
TWIN HILLS PROJECT	2021 EXISTING CONDITIONS	3



LANE CONFIGURATION AND TRAFFIC CONTROL DEVICES



2022 BACKGROUND TRAFFIC CONDITIONS



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NOTE:
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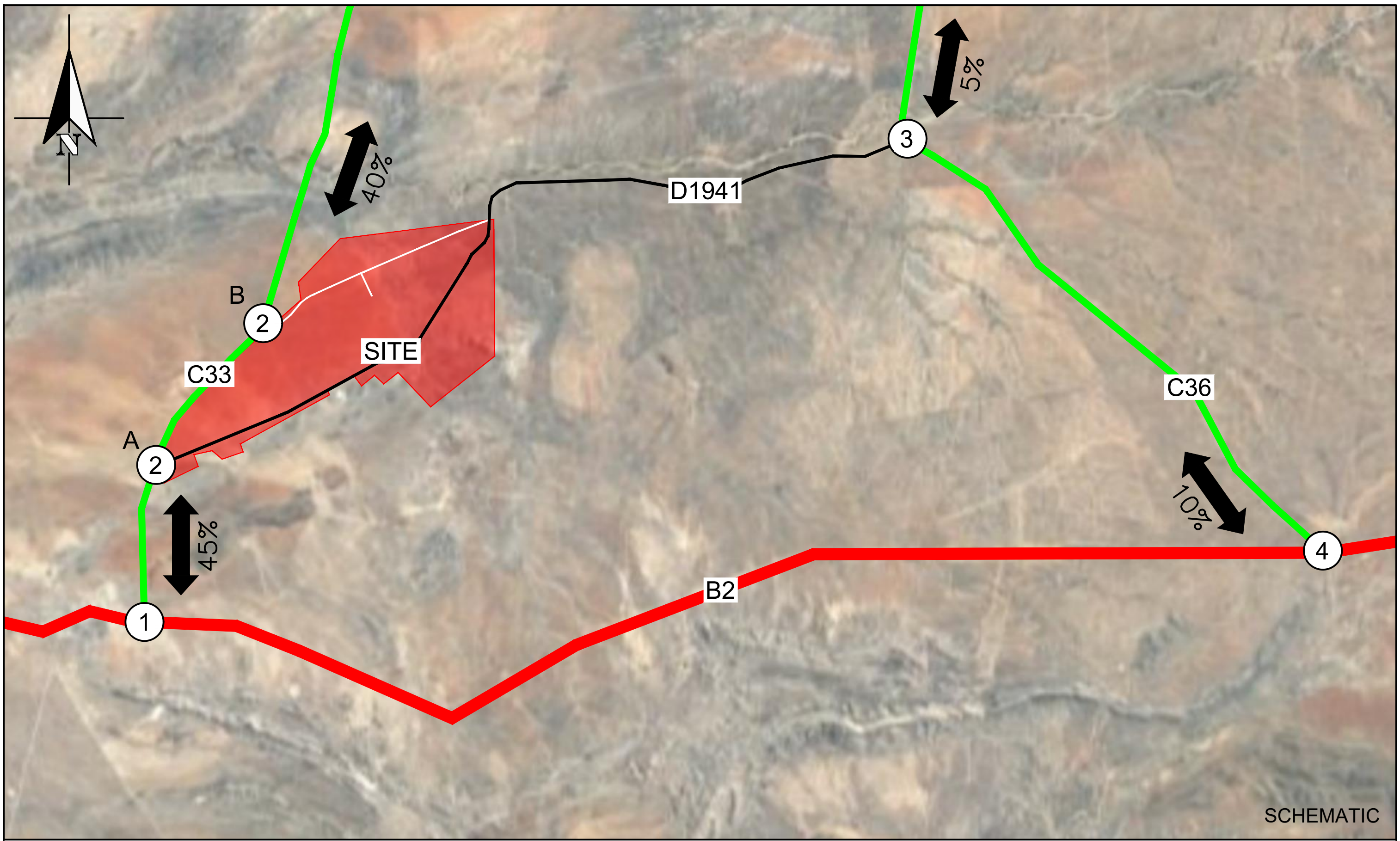
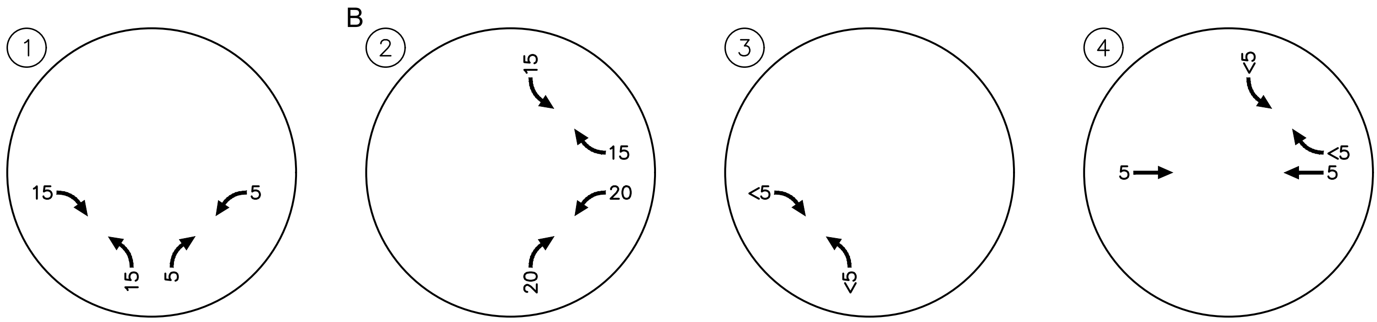


CONSTRUCTION PEAK HOUR



TRIP GENERATION			
	PEAK HOUR		
TRIP TYPE	IN	OUT	TOTAL
TOTAL DRIVEWAY TRIPS	37	37	74

NOTE:
TRAFFIC COUNTS: ROUNDED TO THE NEAREST 5 veh/h

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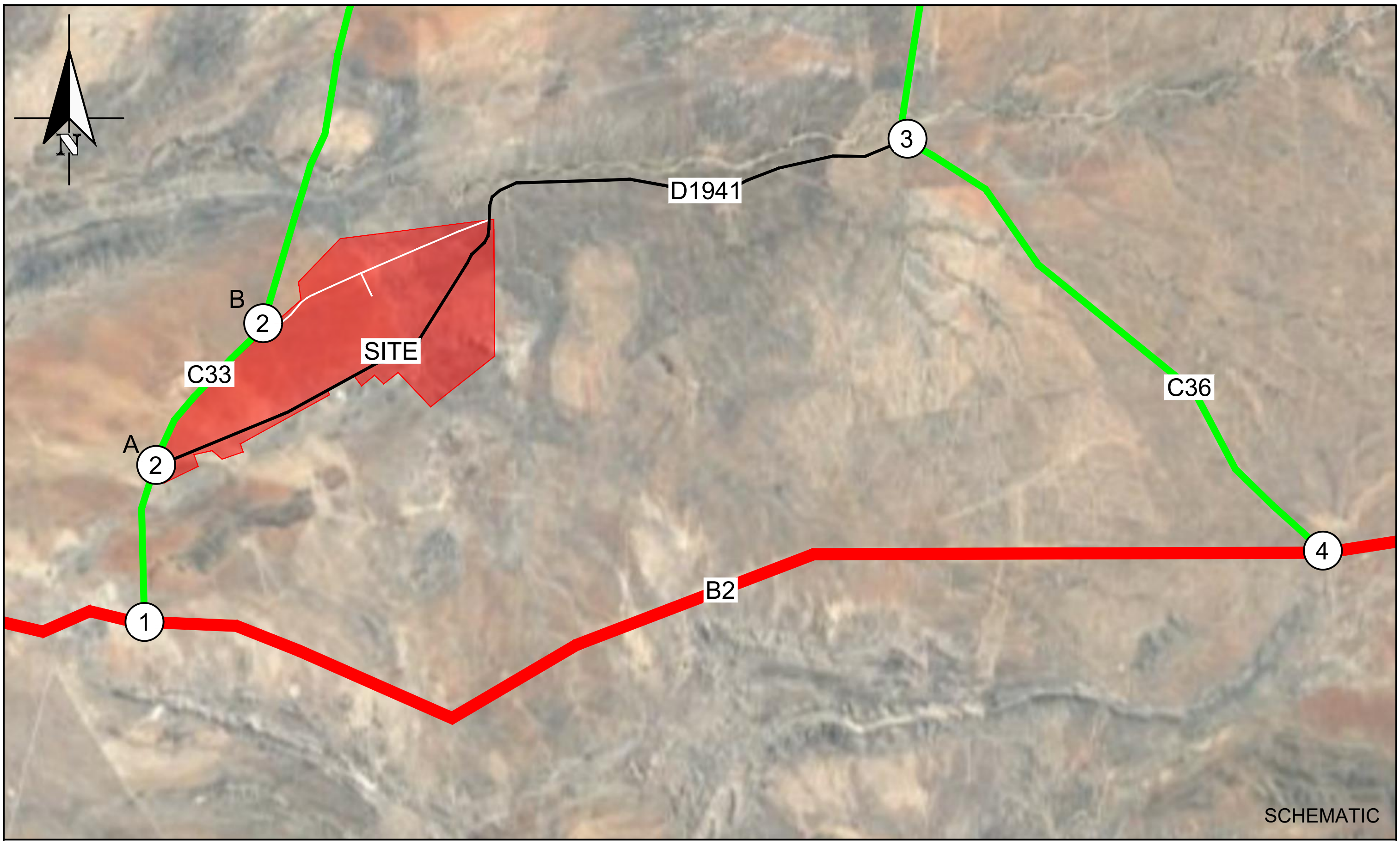
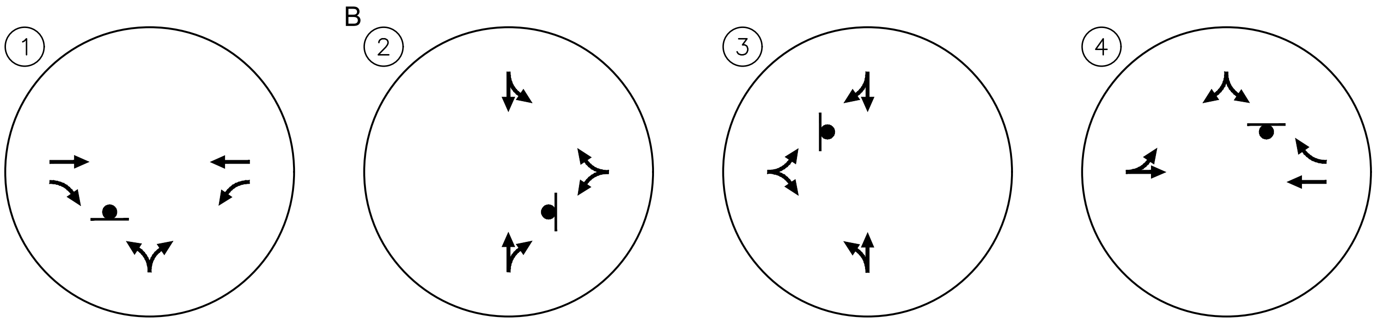
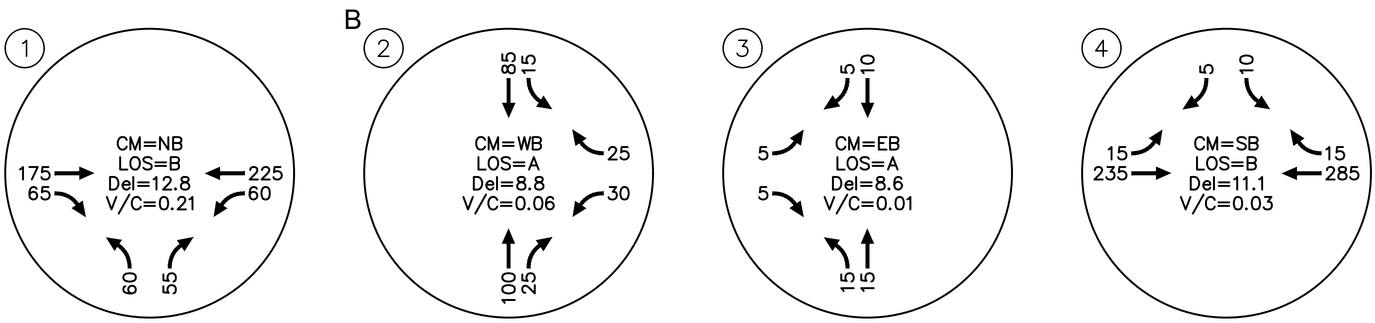
PROJECT:	FIGURE:	NUMBER:
TWIN HILLS PROJECT	CONSTRUCTION DEVELOPMENT TRIPS	5



LANE CONFIGURATION AND TRAFFIC CONTROL DEVICES



2024 TOTAL TRAFFIC CONDITIONS



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NOTE:
TRAFFIC COUNTS: ROUNDED TO THE NEAREST 5 veh/h

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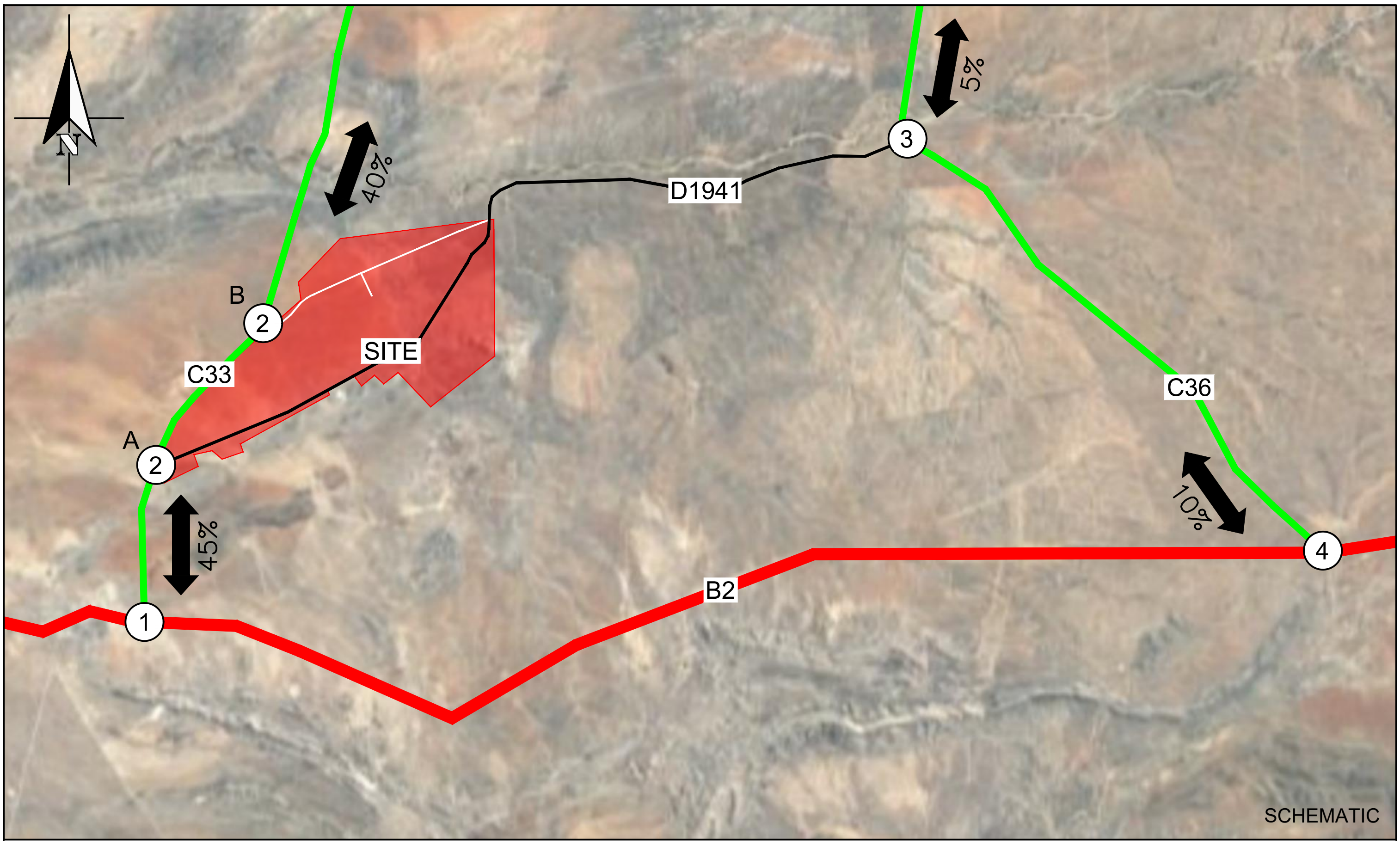
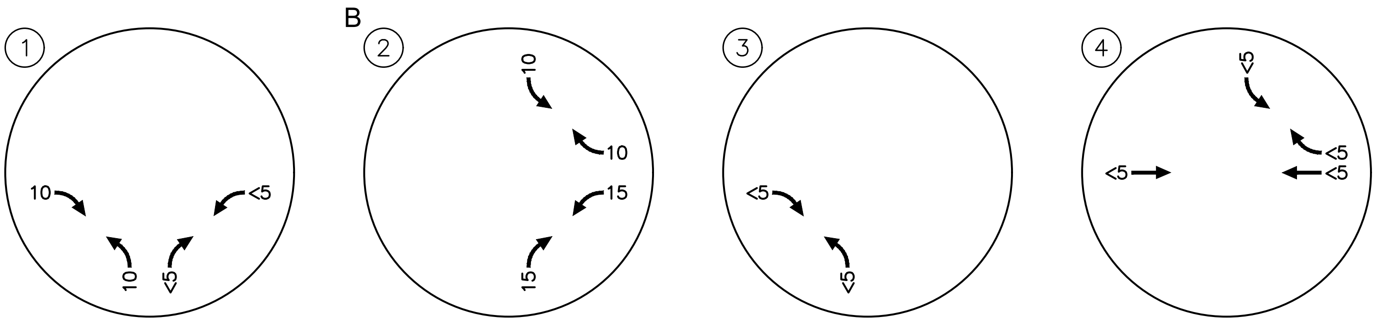
PROJECT:	FIGURE:	NUMBER:
TWIN HILLS PROJECT	2024 TOTAL CONDITIONS CONSTRUCTION PHASE	6



OPERATIONAL PEAK HOUR



TRIP GENERATION			
	PEAK HOUR		
TRIP TYPE	IN	OUT	TOTAL
TOTAL DRIVEWAY TRIPS	26	26	52

NOTE:
TRAFFIC COUNTS: ROUNDED TO THE NEAREST 5 veh/h

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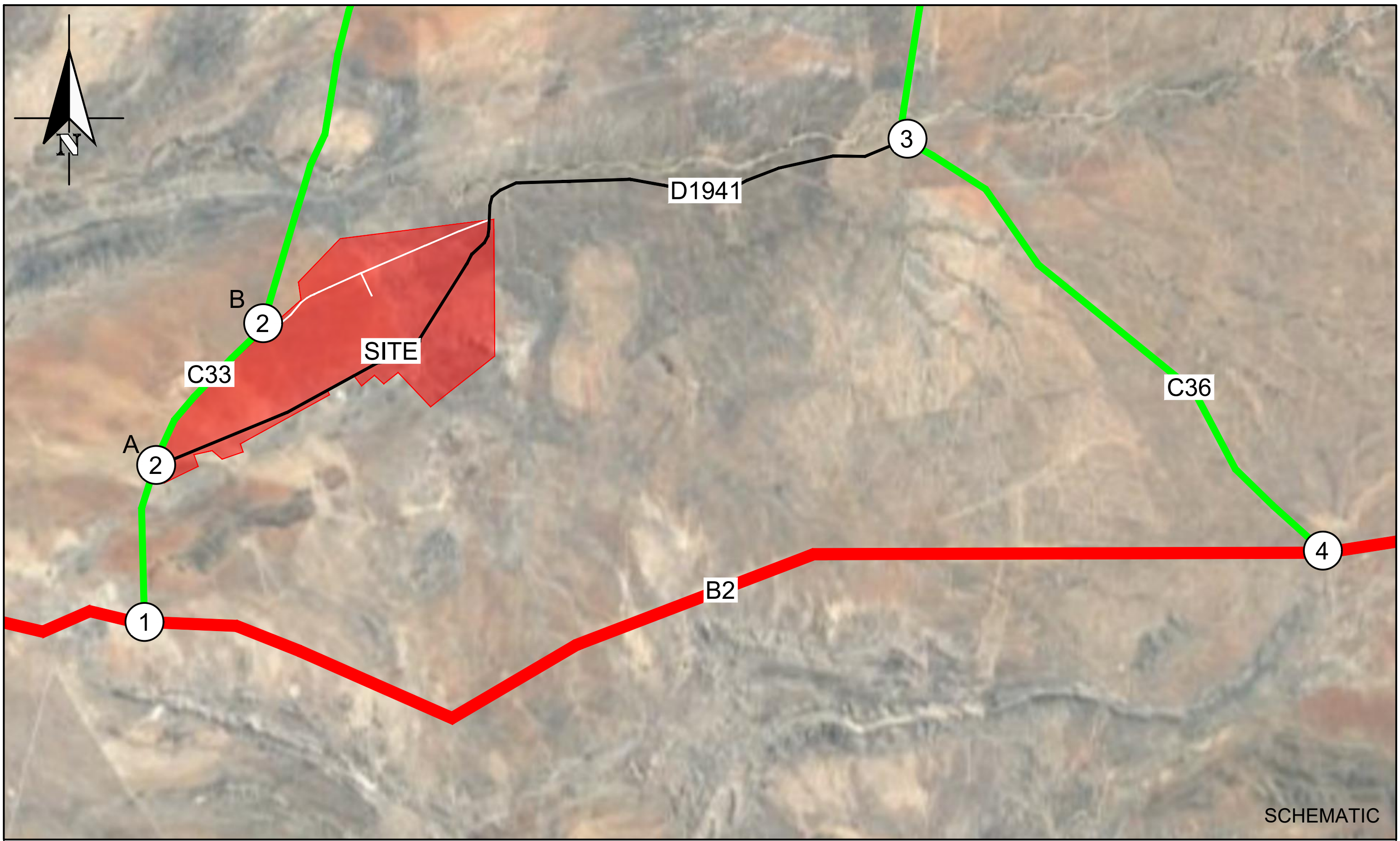
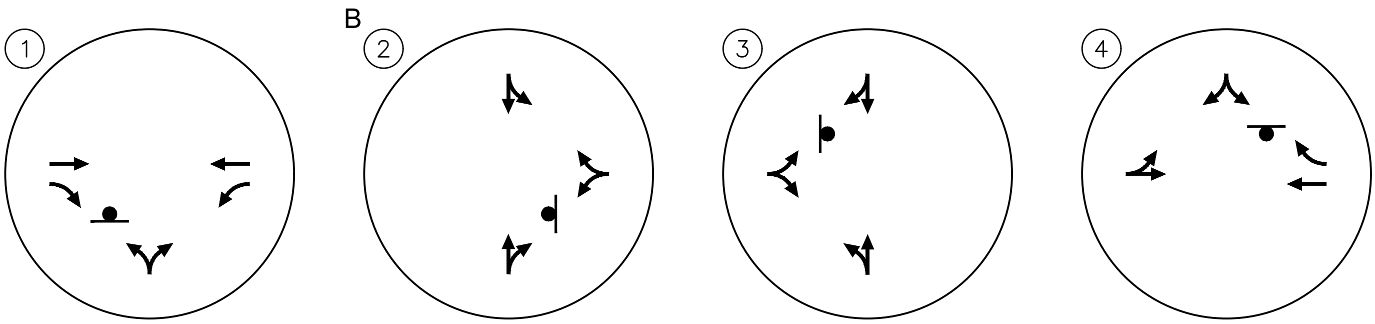
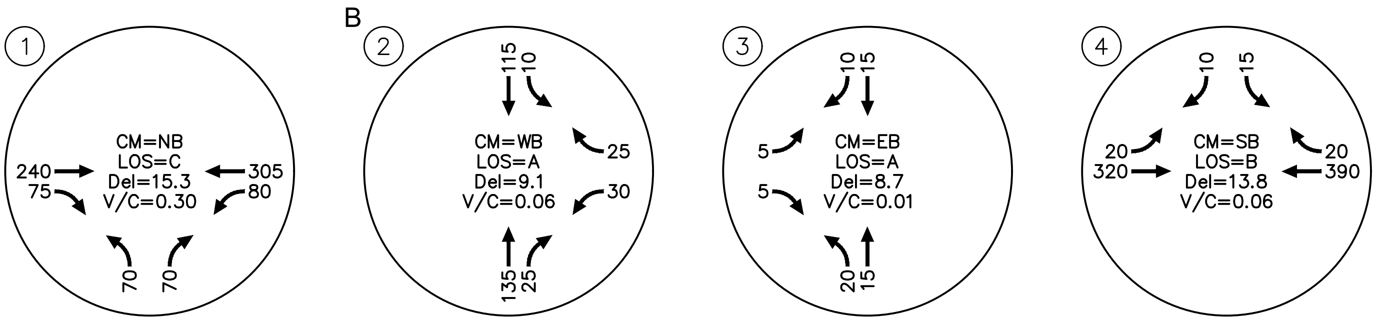
PROJECT:	FIGURE:	NUMBER:
TWIN HILLS PROJECT	OPERATIONAL DEVELOPMENT TRIPS	7



LANE CONFIGURATION AND TRAFFIC CONTROL DEVICES



2024 TOTAL TRAFFIC CONDITIONS



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NOTE:
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PROJECT:	FIGURE:	NUMBER:
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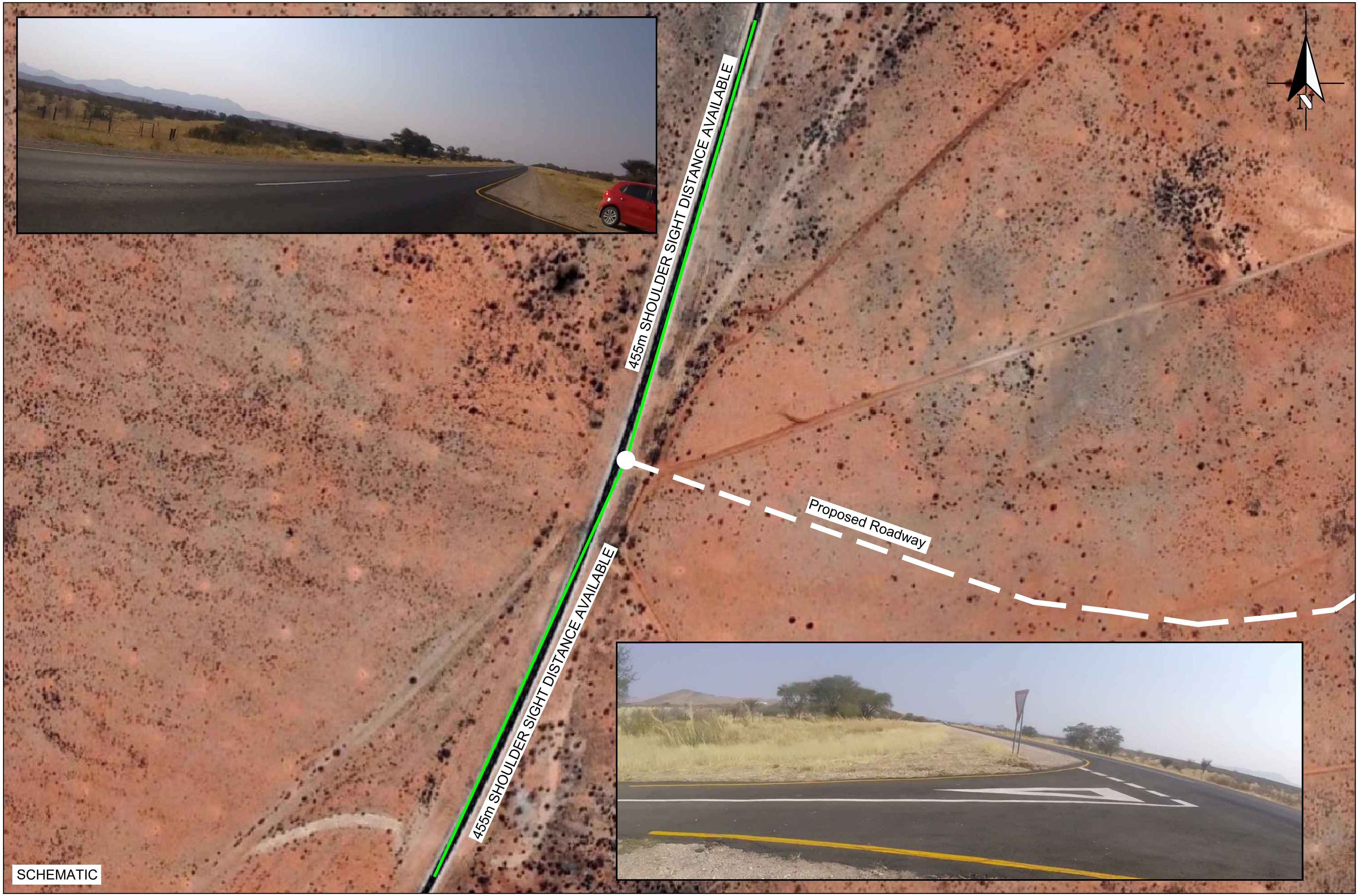

PROJECT:	FIGURE:	NUMBER:
TWIN HILLS PROJECT	SHOULDER SIGHT DISTANCE	9

Annexure B

Tables

Table 1: Construction - Trip Generation and Development Trips

PROPOSED DEVELOPMENTS	
Construction phase	
SIZE OF DEVELOPMENTS	1000
Landuse	**Mine**
Number of employees per shift	333
PERSON TRIP GENERATION RATES	
Person/worker trip generation rate per household	1
DEMAND DURING PEAK HOUR	
Proportion of person trips during the peak period	100%
Person trips during peak hour	
Demand	333
PRIMARY MODAL SPLIT (PUBLIC TRANSPORT, INCLUDING WALKING, VS PRIVATE TRANSPORT)	
Modal split (public transport share)	90%
Number of public transport passengers and pedestrians	300
SECONDARY MODAL SPLIT	
Public transport modal split	
Bus	100%
No of people using public transport	
Bus	300
Private Motor Vehicles	33
Bus Trips	
Bus capacity (pax)	80
% of bus trips In	100%
% of bus trips Out	100%
No of bus pax In	300
No of bus pax Out	300
Total no of bus trips In	**4**
Total no of bus trips Out	**4**
NUMBER OF PRIVATE VEHICLE TRIPS	
Motor vehicle capacity (pax)	1
% of Motor Vehicle trips In	100%
% of Motor Vehicle trips Out	100%
No of Motor Vehicle pax In	33
No of Motor Vehicle pax Out	33
Total no of Motor Vehicle trips In	**33**
Total no of Motor Vehicle trips Out	**33**

Table 2: Operational - Trip Generation and Development Trips

PROPOSED DEVELOPMENTS	
Operation phase	
SIZE OF DEVELOPMENTS	771
Landuse	**Mine**
Number of employees per shift	257
PERSON TRIP GENERATION RATES	
Person/worker trip generation rate per household	1
DEMAND DURING PEAK HOUR	
Proportion of person trips during the peak period	100%
Person trips during peak hour	
Demand	257
PRIMARY MODAL SPLIT (PUBLIC TRANSPORT, INCLUDING WALKING, VS PRIVATE TRANSPORT)	
Modal split (public transport share, including walking)	91%
Number of public transport passengers and pedestrians	234
SECONDARY MODAL SPLIT	
Public transport modal split	
Bus	100%
No of people using public transport	
Bus	234
Private Motor Vehicles	23
Bus Trips	
Bus capacity (pax)	80
% of bus trips In	100%
% of bus trips Out	100%
No of bus pax In	234
No of bus pax Out	234
Total no of bus trips In	**3**
Total no of bus trips Out	**3**
NUMBER OF PRIVATE VEHICLE TRIPS	
Motor vehicle capacity (pax)	1
% of Motor Vehicle trips In	100%
% of Motor Vehicle trips Out	100%
No of Motor Vehicle pax In	23
No of Motor Vehicle pax Out	23
Total no of Motor Vehicle trips In	**23**
Total no of Motor Vehicle trips Out	**23**

Table 3: Construction Drive Way Trips

Transport Mode	Trips		
	In	Out	Total
Busses	4	4	8
Private Vehicles	33	33	67
AM PEAK	37	37	74
PM PEAK	37	37	74

Table 4: Operational Drive Way Trips

Transport Mode	Trips		
	In	Out	Total
Busses	3	3	6
Private Vehicles	23	23	46
AM PEAK	26	26	52
PM PEAK	26	26	52

Annexure C

Photo’s

Photo 1: Access about 3.8km north of Karibib Air Force base sight distance towards Karibib

Photo 2: Access about 3.8km north of Karibib Air Force base access sight distance towards Omararu

Photo 3: C36 Road heading north to C36 / D1941 intersection

Photo 4: B2 Road heading east towards B2 / C36 intersection

Photo 5: C33 Road heading north towards C33 / D1941 intersection

Photo 6: D1941 Road heading east towards C36 / D1941 intersection

Photo 7: D1941 Road heading east towards C36 / D1941 intersection