

ROUTE DETERMINATION REPORT FOR ROUTE K29

BETWEEN km 12,0 AND km 34,4

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1.1 End points and length

Viewed in its entirety route K29 links Johannesburg with the Atomic Energy Board's installations at Pelindaba and with the Hartbeespoort Dam area. The section under review, however, commences at km 12,0 just south of the interchange between P103-2 and the Pretoria - Krugersdorp freeway P158-2 (refer to plan W/K29/1Sp). The route then follows the reasonably direct alignment of P103-2 northwards and ends at a T-intersection with road P31-1 (Route K26) not far west of Pelindaba and the Crocodile River. The end point (km 34,4) is approximately 4 km south of the Crocodile River's point of entry into the Hartbeespoort Dam. The total length of the section is therefore 22,4 km and is strongly influenced by the length of the existing road P103-2 which is followed closely throughout.

1.2 Purpose of the route

The main purpose of secondary roads in the PWV system is to complement the network of freeways by means of feeder roads. Route K29 fulfils this function in that it gives direct access to the Provincial freeway P158-2 at km 12,2 and to planned freeway PWV3/P161-2 at km 30,5. Indirect access by means of other PWV secondary road connections is, furthermore, provided to the latter at three points and to planned freeway PWV1/P160-1 at one point (refer to plan W/K29/1Sp). The route will also have the specific and important function of acting as a collector/distributor road to freeway PWV3/P161-2, because it in effect duplicates the route of this freeway for the greater part of this section, and will furnish more convenient access to many properties in the vicinity of the freeway than may otherwise have been possible.

As mentioned previously, K29, as presently planned, constitutes a very important alternative link between Johannesburg, on the one hand, and Pelindaba and the recreational facilities of the Hartbeespoort Dam area on the other, and, despite its other functions, this fact remains one of the primary reasons for its inclusion in the PWV system (refer to 1.1).

1.3 Existing Provincial roads affected1.3.1 P103-2

With the exception of a few insignificant deviations in alignment only, K29 follows the present location of road P103-2 so closely that the proposed new facility will ultimately replace the existing road completely along the whole of this section.

1.3.2 P158-2

At the start of this section route K29 affects the newly constructed interchange between the Pretoria-Krugersdorp freeway P158-2 and road P103-2. The present three lane bridge by which P103-2 passes over the freeway will have to be widened to accommodate the proposed dual carriageway

road./ ...

road. The ramps of the diamond interchange will also have to be adapted where necessary (refer to plan W/K29/1Ls)

#### 1.3.3 Road 1027

At present road 1027 crosses K29/P103-2 with a staggered intersection at about km 13,8 (refer to plan W/K29/1Ls). This crossing is to be replaced by a fourway intersection when route K33 is built (refer to the route location report for K33). In view of this, the junction of K29 and road 1027 should preferably be completely rebuilt to the intended design at the time of the implementation of either of routes K29 or K33, whichever is undertaken first.

#### 1.3.4 Road 2339

This newly constructed two lane black-top access road to Lanseria airport, joins existing road P103-2 with a T-intersection at km 16,9 (refer to plan W/K29/2Ls). Since the second carriageway of K29 is to the west of P103-2, this junction will not be seriously affected by the new route.

#### 1.3.5 Road 540

The T-junction which road 540 currently makes with P103-2 at km 18,9, is situated just north of the point where PWV3/P161-2 is to cross over route K29 (refer to plan W/K29/2Ls). Because of its close proximity to the future overpass bridges, this intersection has been relocated to join K29 slightly further to the north, as indicated on plan W/K29/2Ls. An additional advantage of this realignment is that road 540 will now join K29 vertically instead of at an obtuse angle as would otherwise have been the case.

#### 1.3.6 P31-1

Route K29 ends at road P31-1 (K26) with a T-intersection. Because K29 is a dual carriageway road, this will necessitate the reconstruction of the present intersection. Incidentally, a similar situation will again arise when route K26 replaces P31-1. In consequence, it would be preferable, other factors being equal, to build the intersection to its ultimate requirements at the time of the implementation of either of routes K29 or K26, whichever is undertaken first.

### 1.4 Planned major routes affected

Planned freeway PWV3/P161-2 crosses over route P103-2 at km 18,6 near the Crocodile River (refer to plan W/K29/2Ls). The present planning of the freeway at this point is thus affected to the

extent that the planned structures will now have to be increased in length for the crossing of a dual instead of a single carriage-way road. A similar situation arises at km 30,5 where the planned interchange between PWV3/P161-2 and P103-2 will need to be adjusted for the proposed dual carriageway road (K29). The necessary alterations in this case may pose certain problems due to the location of the interchange between the Kalkheuwel and the Jukskei Stream (refer to 7.1 and to plan W/K29/5Ls).

## 2. ALTERNATIVE ROUTES CONSIDERED

### 2.1 Alternatives investigated by Consortium member

Although the possibility of alternative routes was looked into, none, apart from the minor amendment referred to in 5.1, was found to be worthwhile - primarily for the following reasons:

- (i) From the start the existing road P103-2 was followed as closely as possible with the object of replacing it with the new dual facility and of thus avoiding three major parallel roads within one and the same corridor.
- (ii) Crossings of the planned freeway PWV3/P161-2 would be expensive and are therefore not worth considering unless some major advantage is to be gained.
- (iii) Deviations from the existing road P103-2 will more often than not encroach on costly development adjacent to the road (refer to 5.2.3).
- (iv) The rugged nature of the terrain which in any case limits the possibility of improving on the present alignment of P103-2 (refer to 5.2.2).

### 2.2 Alternatives investigated at request of interested parties at a preliminary stage

No requests of this nature were received.

## 3. COMMENTS RECEIVED REGARDING THE PUBLISHED ROUTE

Comment was received from Messrs. Haacke, Sher and Aab concerning the affect that the PWV road network and the new Lanseria airport could have on future traffic patterns in this region. After due consideration the Consortium decided that the network was adequate to handle the anticipated traffic needs of the future and that, in particular, no change in the location or status of route K29 could be justified (refer to the Addendum A under separate cover).

## 4. DISCUSSIONS WITH INTERESTED BODIES REGARDING THE ROUTE

Apart from discussions with officials of the Transvaal Roads Department and the consultants concerned, no other discussions were found

to be necessary.

## 5. DESCRIPTION OF RECOMMENDED ROUTE

### 5.1 Amendments to route since publication

Since final publication the alignment of K29 has been changed between km 30,5 and the end of the route at km 34,4 so as to follow the existing road, P103-2, more closely (refer to plan W/K29/5Ls). This change is included in the set of 1 in 10 000 orthophoto transparencies subsequently submitted to the Roads Department and has been approved by EXCO. In addition to adhering to the existing road, the revised alignment minimizes earthworks, and hence environmental impact, and avoids certain improvements.

### 5.2 Description

#### 5.2.1 General

A general, but abbreviated, description of the route is contained in item 1.1. In addition to this description, some miscellaneous aspects, which are not referred to elsewhere in this report, are considered of sufficient relevance to merit mentioning separately under this heading. Into this category falls the following aspects of the route:

- (a) In order to adhere to applicable geometric standards, the existing bridges across the Crocodile River at km 18,2, a tributary of the Crocodile River at km 20,6 and the Rhenoster Stream at km 24,7, will have to be demolished to make way for new double bridges (refer to 6.1 and plans W/K29/2Ls and 3Ls). The position of the centre line of K29 has, however, been so located at each of these bridge sites that the existing structure can still be utilized for the accommodation of traffic while one of the two new bridges is being constructed.
- (b) Between km 22,6 and km 23,9 approximately, routes K29 and PWV3/P161-2 share a common road reserve boundary (refer to plan W/K29/3Ls).
- (c) At km 32,9, where the route crosses a tributary of the Crocodile River at its junction with the latter, it has been possible to align K29 such that the existing bridge on P103-2 can be retained (refer to 6.1 and to plan W/K29/5Ls). This bridge can also be used for the accommodation of traffic while the second bridge for northbound traffic is being constructed on the western side.

### 5.2.2 Topography and vegetation

The topography rolls throughout the length of this section and, as a consequence, natural grades are relatively steep. The northern portion of the route, in particular, winds down a scenic gorge which dissects the hills known locally as the Kalkheuvel and which is occupied firstly by the Jukskei Stream and then by the Crocodile River (refer to 6.1 and plan W/K29/1Sp). In all, five major watercourses requiring bridges are crossed.

The natural vegetation, where this has not been destroyed by cultivation and other cultural pursuits, consists largely of grassland and a few scattered trees. However, along the slopes of the Kalkheuvel in the north, as well as adjacent to watercourses, the growth of indigenous trees and shrubs tends to be fairly dense.

### 5.2.3 Land use and township applications

#### (a) km 12,0 to km 20,9

The land adjacent to the portion of the route from km 12,0 up to the Krugersdorp/Pretoria district boundary at approximately km 20,9, is currently subdivided into smallholdings, some of which are intensively developed. The nature of the activities pursued on these small holdings is varied as can be seen from the following few examples:

- (i) Approximately 1,0 km south of the beginning of this section at km 12,0 is a Lion Park which is open to the public and which is being run as a commercial venture (refer to plan W/K29/1Ls).
- (ii) A reasonably large poultry farm is being operated on a battery system just east of km 13,8 (refer to plan W/29/1Ls).
- (iii) The new Lanseria airport is situated east of the route and approximately opposite km 17,0 (refer to plans W/K29/1Sp and 2Ls). This airport can easily be extended to accommodate the largest aircraft in service in South Africa at present.
- (iv) West of km 18,3 and on the northern bank of the Crocodile River, certain recreational facilities are being provided by the Wilderness Pleasure Resort which is privately run. This undertaking will, however, have to be terminated or transferred to an alternative locality when PWV/3/P161-2 is built (refer to plan W/K29/2Ls).

- (v) Immediately south of road 540 and near its junction with route K29/P103-2, an organic compost is produced for the market on the property known as Malabar Farm (refer to plan W/K29/2Ls).
- (vi) The area adjacent to and on both sides of the route between the Crocodile River at km 18,2 and one of its tributaries at km 20,6, is intensively cultivated for the production of vegetables (refer to plans W/K29/2Ls and 3Ls). Much of this land is under permanent irrigation.
- (vii) The breeding of pedigree cattle is being undertaken on the Green Giant farm immediately north-east of the intersection between routes K29 and K31 (refer to plan W/K29/3Ls). This enterprise is seriously jeopardised by the proposed alignments of routes K29, K31 and PWV3/P161-2 and by the proposed interchange between the latter two.

In regard to the long term development prospects of this area, these are likely to be influenced by both the recently established Lanseria airport and the Department of Planning's "proposed medium term urban development boundary" which runs not far to the south of this section of route K29 (refer to plan W/K29/1Sp). Despite this proposed boundary, however, it may be mentioned that one township application to the north of it, namely that of Lanseria No. 4603, has already been received and others could follow (refer to plan W/K29/2Ls). This township straddles the route at km 15,5 but, inspite of this, it may not be possible to give direct access to the township from K29 due to the steep natural cross fall of the terrain which will necessitate heavy earthworks if a limiting grade of 3½% for the access road is to be adhered to. Access may therefore have to be provided by means of service roads with points of exit and entrance outside the township boundaries. A possible locality for such an access point is indicated at km 15,15 on plan W/K29/2Ls. This problem of direct access between the township and route K29 has already been noted on the prescribed township application forms.

(b) km 20,9 to km 34,4

North of km 20,9 the pattern of land usage becomes less intensive due, in part, to the more rugged nature of the terrain (refer to 5.2.2). A certain amount of development, apart from that associated with extensive agricultural exploitation, has nevertheless taken place, the more significant of

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which is as follows:

- (i) The Rhenosterspruit Centre, comprising a garage and a supermarket, among other facilities has recently been erected to the west of the route at km 22,4 (refer to plan W/K29/3Ls)
- (ii) A gravel landing strip for light aircraft is in use to the west of the route at km 26,0 (refer to plan W/K29/4Ls).
- (iii) A small European cemetery is located adjacent to the route at km 27,75 (refer to plan W/K29/4Ls).
- (iv) A small nursery, which will be adversely affected by the proposed alignment of K29, is established on the farm "Hills Beyond" at approximately km 28,0 (refer to plan W/K29/4Ls).
- (v) The Magaliesburg Spa Hotel holiday resort (Santa Barbara) is situated east of the route at km 29,5 (refer to plan W/K29/4Ls).
- (vi) Between the nursery at km 28,0 and the Magaliesburg Spa Hotel at km 29,5 a number of houses are dispersed in the area bordered by the route and the Jukskei Stream; but, by adhering to the existing road P103-2 closely, the route infringes very little, if at all, on these developed properties (refer to plan W/K29/4Ls).

It is considered unlikely that the region through which this portion of K29 passes, will undergo particularly rapid change in the short to medium term. Two primary reasons are responsible for this contention. Firstly, the Department of Planning and the Environment has not ear-marked the region for any specific use, according to their July 1975 publication entitled "Amended proposals for a guide plan for the PWV complex"; and, secondly, the northern part of the area concerned falls within an 8 km radius of Pelindaba and, as such, may be subject to certain strictures of the Atomic Energy Board.

#### 5.2.4 Undermining

The route does not cross any undermined areas or mine properties.



#### 5.2.5 Subsidiary roads, access points and service roads

The realignment of subsidiary roads, the siting of access points and the necessity for service roads will all require attention at the basic planning stage. Important accesses which will have to be taken into consideration, among others, are those of the proposed township Lanseria No. 4603 and the newly established Lanseria airport, both in the more intensively developed area between km 12,0 and km 20,9; the Rhenoster-spruit Centre and the Magaliesburg Spa Hotel holiday resort on the portion of the route between km 20,9 and km 34,4; as well as all other traffic generating enterprises which happen to have been developed in the interim (refer to 5.2.3(a) and (b)). In addition, provision will have to be made for the other activities in and residents of the region, probably by means of service roads in some instances.

#### 5.2.6 Present and future traffic

The positions of the latest traffic counts taken on P103-2 are shown diagrammatically on plan W/K29/1 and the relevant data obtained are given in Table 1. This information indicates that the volume of traffic decreases in a northerly direction, the volume at the end point of the route in the north (km 34,4) being of the order of 30% of that at the starting point of this section in the south (km 12,0). This trend corresponds with that of the relative intensity of development and land usage along the route and is therefore to be expected (refer to 5.2.3). The counts also illustrate that the volume of traffic on Sundays is of the order of 10% to 35% greater than on week-days. This is also to be expected because of the attractions of the Hartbeespoort Dam and of other pleasure resorts on the way to Rustenburg and elsewhere in this area.

A traffic study of the whole PWV region is currently being undertaken and meaningful predictions of future traffic trends in this area will have to await the results of this study which is scheduled for completion towards the end of 1977 (refer to the Introduction). However, in view of the relatively low present day counts and of the fact that route K29 virtually duplicates planned freeway PWV3/P161-2 over this 22,4 km section, it seems safe to conclude that, provided the freeway is constructed as planned, K29 will not be required as a dual carriageway road for many years to come.

TABLE 1

Station	Date	Av. 24 hour count	Sunday count (24 hours)	% Heavy vehicles
A	Thur. 7 - Wed. 13 June, 1973	475	641	14,0
B	Thur. 14 - Fri. 15 June, 1973	541	-	16,8
C	Thur. 21 - Wed. 27 June, 1973	1 603	1 753	12,8
D	Mon. 8 - Fri. 12 Sept. 1975	2 450	-	-

## 6. MAJOR STRUCTURES AND SERVICES

### 6.1 Major Structures

Apart from the bridges connected with the interchange at km 30,5, the following structures, and extensions for structures, are regarded as being important:

- (a) Widening of the existing bridge across the freeway P158-2 at km 12,2
- (b) A double bridge across the Crocodile River at km 18,2.
- (c) A double bridge across a tributary of the Crocodile River at km 20,6.
- (d) A double bridge across the Rhenoster Stream at km 24,7.
- (e) A double bridge across the Jukskei Stream at km 28,1.
- (f) A single bridge adjoining existing bridge No. 3029 of 1973 on a tributary of the Crocodile River at km 32,9 (the existing bridge is to be retained for the southbound carriageway).

### 6.2 Services

Escom power lines cross the route at km 19,8 and km 31,3 and these lines may require relocation and/or protection when K29 is built (refer to plans W/K29/2Ls and 5Ls). The possibility of certain underground services also being affected by the route, cannot be excluded at this stage. This aspect will require further attention during basic planning.

## 7. INTERCHANGES AND AT GRADE INTERSECTIONS.

### 7.1 Interchanges

Two interchanges are required on this section of route K29 in order to provide access to the existing freeway P158-2 at km 12,2 and to the planned freeway PWV3/P161-2 at km 30,5 (refer to plan W/K29/1Sp). In regard to the former, the existing diamond interchange between P158-2 and P103-2 will have to be adapted slightly to accommodate the proposed dual carriageway road K29 (refer to plan W/K29/1Ls). The changes required include the widening of the existing bridge across the freeway (refer to 1.3.2 and 6.1(a)). The type of interchange presently planned for the intersection of route K29 and PWV3/P161-2 at km 30,5, is a parclo AB (refer to plan W/K29/5Ls). The adoption of this particular type of interchange is dictated by topography. The loops of the parclo, which are planned on the eastern side of K29/P103-2 and are in fill, will nevertheless necessitate the diversion of a short length of the Jukskei Stream.

### 7.2 At grade intersections

At grade intersections will have to be provided at the junctions of K29 and the following secondary routes:

- (a) K33/1027 at km 14,1 (refer to plan W/K29/1Ls).
- (b) K31 at km 20,2 (refer to plan W/K29/3Ls). The geometry of this intersection is fixed within narrow limits by the grade level and grade of route PWV3/P161-2 and by the geometry of its access interchange with K31.
- (c) K44 at km 26,18 (refer to plan W/K29/4Ls). The geometry of this intersection is likewise fixed within narrow limits by the level and grade of route PRW3/P161-2 and by the geometry of its access interchange with K44.
- (d) K26/P31-1 at km 34,4 (refer to plan W/K29/5Ls).

In between these intersections a limited number of approved access points will also be necessary in order to cater for existing and future development along the route (refer to 5.2.5).

## 8. ESTIMATE OF COST.

The cost being used in the PWV study for the construction of a double carriageway secondary road in flat terrain, is R250 000-00 per kilometre. This figure includes normal structures, but excludes major structures and interchanges, and is based on average ruling prices. However, due to the rolling nature of the terrain and to the five rivers (or streams) which have to be traversed, the earthworks along this section of K29 will be relatively heavy (refer to 5.2.2). For this reason a cost of R400 00-00 per kilometre is being adopted in this particular estimate.

In regard to major structures, their cost of construction has been

estimated/ ...

estimated by applying a price of R280-00 per square metre of bridge deck to an approximation of the size of the structure.

On this basis, then, the estimated cost of building this section of route K29 is as follows:

(i)	22,4 km of dual carriageway road at R400 000 per km	R8 960 000-00
(ii)	Widening of bridge across P158-2 at km 12,2 (+ 90 m span)	R 300 000-00
(iii)	Double bridge at km 18,2 (+ 130 m span)	R 950 000-00
(iv)	Double bridge at km 20,6 (+ 170 m span)	R1 240 000-00
(v)	Double bridge at km 24,7 (+ 100 m span)	R 730 000-00
(vi)	Double bridge at km 28,1 (+ 60 m span)	R 440 000-00
(vii)	Single bridge at km 32,9 (+ 110 m span)	R 400 000-00
	Total estimated cost	<u>R13 020 000-00</u>

It should be noted that the above estimate does not include the cost of the interchange with planned freeway PWV3/P161-2 at km 30,5 together with the cost of any associated drainage structures at the interchange (refer to 7.1). In the PWV study the cost of interchanges between proposed secondary roads and freeways is normally covered by the inclusive figure used for the estimate of the cost of construction of the freeway concerned (in this case PWV3/P161-2).

## 9. DESIGN STANDARDS

The desirable standards, as well as those actually applied in the design, are given in Table 2. It will be seen from this information that a design speed of either 100 km/h or 110 km/h has been used throughout. This was found to be necessary in order to limit the amount of earthworks through the very hilly terrain encountered along most of the route (refer to 5.2.2). Moreover, it should be noted that the minimum radius of curvature of 300 m recorded in the Table has been used only at the approach to the T-junction with route K26/P31-1 where running speeds will in any case be well below the design speed (refer to plan W/K29/5Ls). The minimum radius used elsewhere is 450 m.

TABLE 2/ .....

TABLE 2

Item	Standard	
	Desirable	Actually applied
<u>Horizontal alignment</u>		
(a) Design speed	120 km/h	100 & 110 km/h
(b) Min. curve radius	500 m	300 m
<u>Vertical alignment</u>		
(a) Design speed	120 km/h	100 & 110 km/h
(b) Max. grade	6 %	6 %
(c) Min. grade (in cut)	0,5 %	0,5 %
(d) Min. curve length	-	300 m
(e) Min. k-value		
(i) Crest	110	62
(ii) Sag	50	39

10. CONCLUSIONS

Although the construction of K29 is unlikely to be of high priority if planned freeway PWV3/P161-2 is constructed in the foreseeable future, expensive development along the route, and especially along the portion between km 12,0 and km 20,9 is nevertheless taking place at an ever increasing rate (refer to 5.2.3 and 5.2.6). It is considered advisable, therefore, to widen the present road reserve of P103-2 to that required to accommodate the proposed dual road Carriageway road (K29) as soon as is feasibly possible; or, alternatively, to protect a sufficiently wide strip of land on each side of the present road reserve against all further encroachment.