

## Study of Alternative Alignments

At present, the most preferred road connectivity between Kozhikode to northern areas like Kalpetta, Meppadi, Meenangadi, Sulthan Bathery etc. is through the NH- 766. However, in a 11.5 km stretch between Adivaram and Lakkidi in Wayanad District, the road rises steeply by 700 m in the circuitous hill Road called Thamarasary Churam. Vehicle efficiency on hilly terrain reduces by about 30%. This Ghat road which is already saturated due to high volume of traffic is slide-prone during the monsoons causing accidents and congestions. It is not feasible to improve the width of this stretch of NH-766 which is passing through forest land. Therefore, in view of the rising demand for movement of passengers and freight in this corridor and the hue and cry of road users for decades, the Government of Kerala got conducted several Studies for alternate measures and decided to implement the Anakkampoyil-Kalladi-Meppadi Tunnel Road Project to augment the capacity of the Thamarassery Ghat road.

Based on Desktop Studies, site inspections, field survey best possible routes were explored. The main focus is to provide a reliable, safe, all-weather road connectivity. Four technically feasible alignment alternatives were studied.

### Methodology Adopted for the Study

Possible alternative road alignments between Anakkampoyil and Meppadi were prepared based on the nature of topography, land use, geological information and primary data by several reconnaissance surveys. Design parameters like horizontal geometry, vertical geometry, design speed, etc. were considered and detailed study for each alternatives. In order to minimize impact to the environment, diversion of forest land is maximum avoided wherever possible. Social impacts due to land acquisition is considered minimum while freezing the alignment. Following techno - economic parameters were also been taken in the study.

**Route Length:** It is desired to connect origin and destination with minimum route length complying IRC design standards.

**Minimum tunnel length:** Since the project alignment is passing through the part of hilly and mountainous terrain of Western Ghat, alignment alternative with minimum length of tunnel stretch is favoured while selecting the alignment.

**Forest Area to be affected:** While developing infrastructure there should be endeavour to minimize utilization of forestland to minimum extent.

**Geological features:** It will be prudent to align the tunnel and its portal locations on stable geological strata.

**Connectivity to important villages**

**Land requirement**

**Project Cost.**

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Based on desktop studies, site inspection, aforesaid mentioned parameters, best possible routes were envisaged. The four possible alignment alternatives were considered and the details of each alternatives are briefed as follows:

### Alt-1 Maripuzha (South) to Vellarimala (North)

With a view to arrive at a feasible alternative with the shortest length of tunnel and a minimum length, the Maripuzha –Vellarimala route has been envisaged. On south side of proposed tunnel, the present road connectivity is upto Maripuzha village from which south take-off has been proposed. Thus the utilization of the available road connectivity is maximized.

A major bridge at km 0+425m with a length of 130 m was proposed across Iravanjipuzha on the southern approach road. Iravanjipuzha flows in forest area and narrow strips of land adjoining banks of either side of the river area belongs to private owners. Immediately after crossing Iravanjipuzha, the south portal of the tunnel was proposed at km 0+580 m from where the proposed road takes a right turn to emerge out at the north portal at km 7+45. At km 7+642 the proposed project road joins the Meppadi- Chooralmala road. All locations on the Meppadi-Chooralmala road further south of the proposed junction are at much lower elevations and the existing road has several sharp curves and steep gradients that would render the drive from and to Meppadi as a more tortuous experience. Hence junction / take-off points at locations further south on the Chooralmala road i.e. at Mundakkai, etc, were not explored. Approach roads having length of 580 m and 192 m were envisaged on the south and the north sides respectively of the proposed tunnel with a length 6870 m.

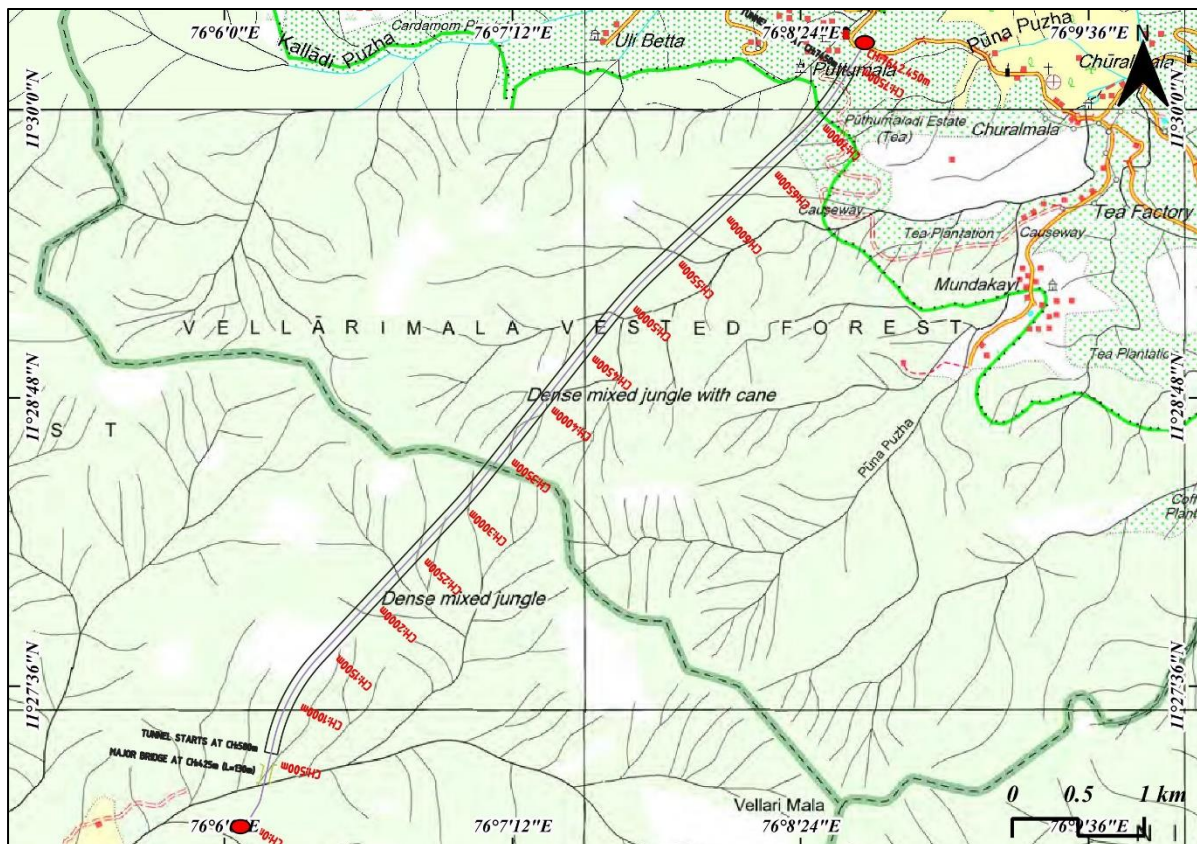


Figure 1: Alt-1 Maripuzha (South) to Vellarimala (North)



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Thus the total route length from Maripuzha to Vellarimala is 7642m. The gradient in Tunnel stretch of this alternative is 2.89%.

The present connectivity of Meppadi town from this proposed north end is very poor and partially passing through forest area as well. Hence, it's widening and improvement will be a complex task.

North end and further 2.0 km is in landslide prone areas where a massive landslide disaster had occurred on 8th August 2019. Around 20 people were killed and many families lost their homes in the same tragedy. As the northern end of the Project road happens to be at the farthest distance from Meppadi amongst all alternatives, additional cost in widening and improvement of geometry of the stretch would be involved apart from the recurring cost of maintenance.

### Alt-2 Maripuzha (South) to Meenakshi Bridge (North)

On the south side, the existing road at Maripuzha village from which a take-off had been proposed in Alternate-1, has been retained. On the north side, it was proposed that the project approach road join the existing Meppadi – Chooralmala road at a feasible location closest to Meppadi, i.e., at Meenakshi Bridge.

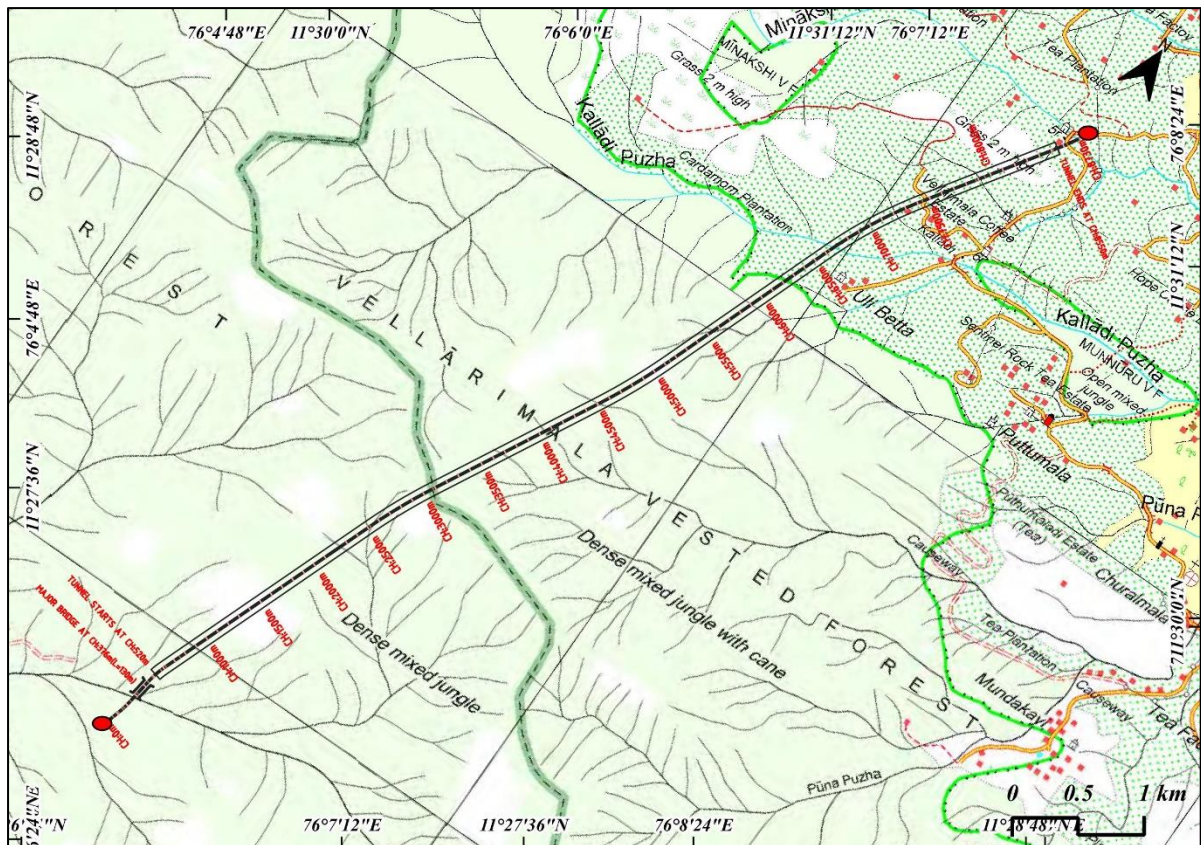


Figure 2: Alt-1 Maripuzha (South) to Meenakshi Bridge (North)

After taking off from Maripuzha, the alignment is practically straight all the way to Meenakshi bridge. Mild curves are proposed based on site conditions and to break monotony of the road users. The proposed alignment crosses Iravanjipuzha at km0+370 where a major bridge is proposed for a length of 120m. Iravanjipuzha is located in the forest area under Edathara Section of Kozhikode Division. South portal of the tunnel was proposed in private land at km 0+510 and the north portal is at km 8+620 m. Thus, the tunnel length is 8110 m with a maximum gradient of 2.50%. This road

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alignment meets Meenakshi bridge on existing Meppadi-Kalladi- Chooralmala road at the north end. Approach roads of 510 m on south side and 115m on north side are envisaged in this option. Total route length of this alternative from Maripuzha to Meenakshi Bridge is 8735m.

In this option, length of approach roads is reasonably low. The portal areas are on stable ground. North end of this option is meeting near Meenakshi bridge which is approximately 6 km from Meppadi town. The present connectivity of Meppadi town from this proposed north end has comparatively better geometry. The strengthening of this present road is in progress under Executive Engineer, Wayanad, PWD, Kerala.

### Alt-3 Muthappanpuzha (South) to Meenakshi Bridge (North)

The existing MDR from Muthappanpuzha to Maripuzha is 1.5 km length which involves 17 sharp curves and steep gradients in elevation. In consideration of this, Alt-3 was envisaged to avoid need for development of this existing stretch but to take off the proposed project from Muthappanpuzha village.

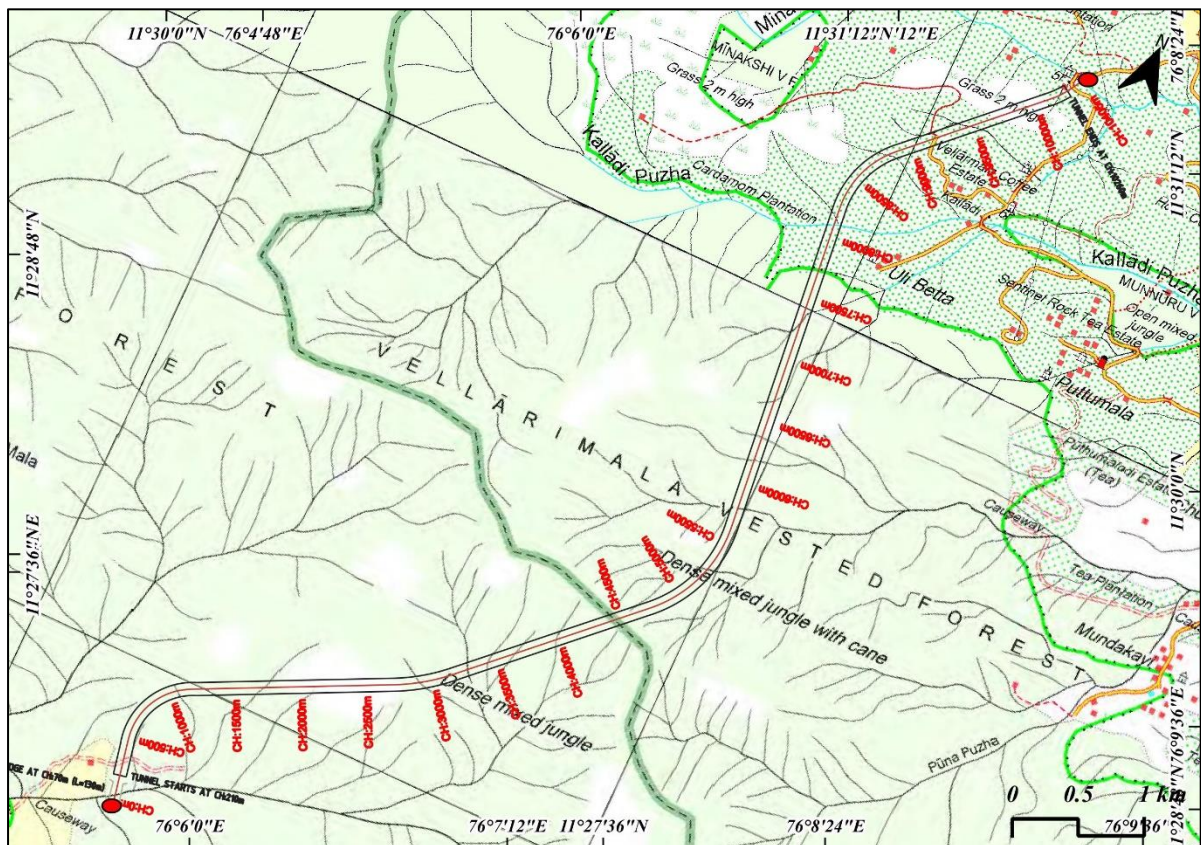


Figure 3: Alt-3 Muthappanpuzha (South) to Meenakshi Bridge (North)

This option starts from Muthappanpuzha village which is located on Anakkampoyil to Maripuzha road on south side of route under Study. A bridge of 130m was necessary across Iravanjipuzha at km 0+070. Immediately after crossing Iravanjipuzha, the road alignment reaches the proposed south portal at km 0+210. Later, it negotiates right hand curve and moves in north-east direction. The route length has been increased by introducing horizontal curves at appropriate locations in order to keep the gradient within permissible limits. In this trial, tunnel length works out to 10,050 m with a maximum grade envisaged at 2.97%. The alignment ends near Meenakshi Bridge located on Meppadi-Kalladi-



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Chooralmala road. Approach roads of 210 m on south side and 145 m on north side are envisaged in this option. Total new route length of this option was 10,405 m.

In this option, the location of south end was selected at Muthappanpuzha to avoid development of the difficult part of present road having sharp curves with steep gradient. There will be substantial saving towards the cost of development of existing road by State PWD with better road geometry than other alternatives. The length of approach road planned is reasonably low which is 210 m and 145 m on south and north ends respectively. As the total length of approach road is 355 m only, the land requirement would be the least amongst all alternatives. North end of this option is meeting near Meenakshi Bridge which is hardly 6 km away from Meppadi town. The present connectivity of Meppadi town from this proposed north end is being developed by PWD Kerala. Comparing with all the options, the elevation difference between south and north end of this option is the highest. Hence, the length of tunnel is the maximum compared to other alternatives. The tunnel is longer by about 2020 m than the tunnel proposed in Alt-2, thereby increasing in cost towards tunnel construction by about Rs. 242 crores.

### Alt-4 Maripuzha (South) to Kalladi (North)

With a view to reduce tunnel length in comparison to Alt-3 and also to connect Kalladi Village in Kalpetta Block of Wayanad District on north side, this option was explored.

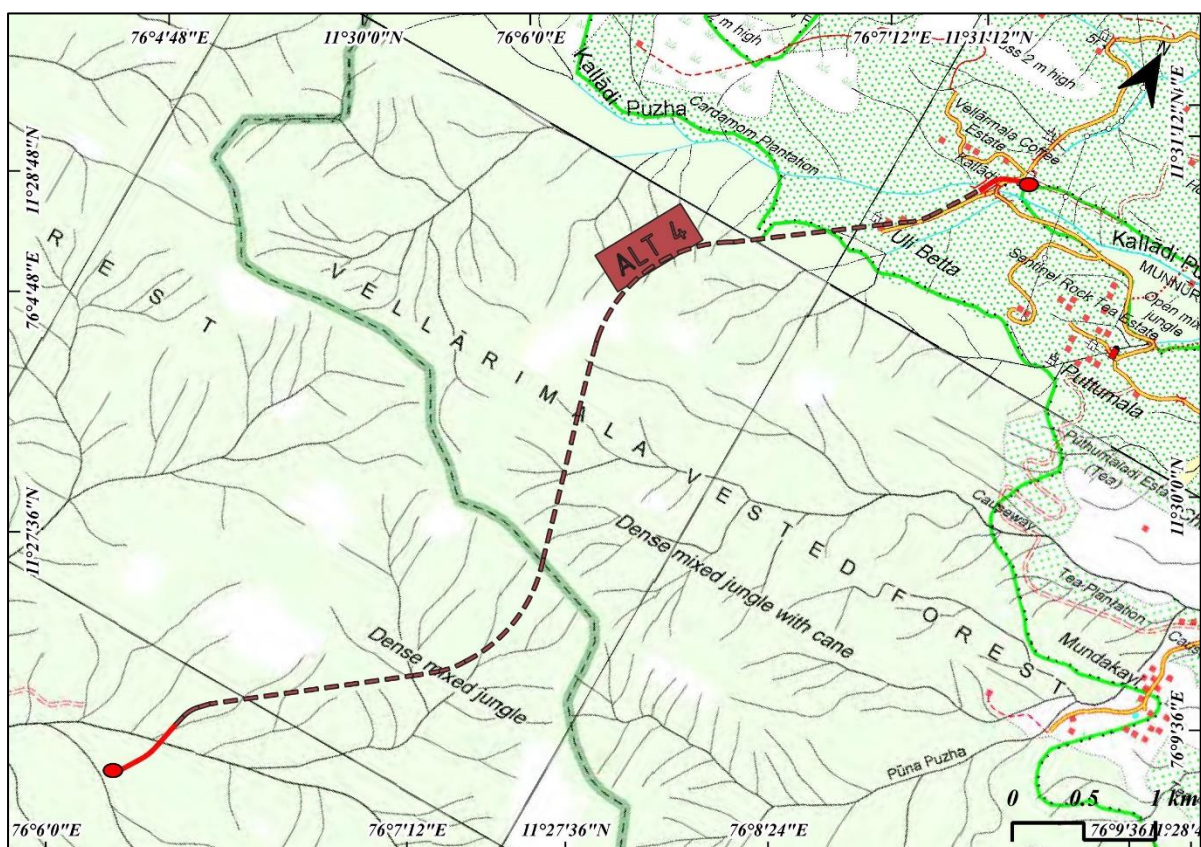


Figure 4: Alt-4 Maripuzha (South) to Kalladi (North)

Approach roads having length of 580 m and 462 m were envisaged on south end and north end respectively. As was the case in Alternates 1 and 2, on south side, the take-off was proposed from Maripuzha village. Thus the available road connectivity was maximized. The alignment crosses

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Iravanjipuzha at km 0+425m where a major bridge having length of 130 m was envisaged. River flows in forest land under Edathara Section of Kozhikode Division and strips of land on either side of river area belong to private owners. Immediately, after crossing Iravanjipuzha, road alignment negotiates a right hand curve where the south portal of tunnel is proposed at km 0+580. With a view to provide gradients within permissible limit inside the tunnel, the length of the tunnel is increased with introduction of three curves. The north portal is at km 8+150 on right bank of Kalladi River. The length of tunnel is around 7570 m with a maximum grade of 2.98%. The alignment ends near Kalladi bridge at km 8+612 on Meppadi-Kalladi-Chooralmala existing road. Total new route length from Maripuzha to Kalladi Bridge is about 8612m.

The total length of both approach roads is 1042 m which is the maximum amongst all the four alternatives. North end of this option is meeting near Kalladi Bridge which is about 8 km away from Meppadi town. The present connectivity of Meppadi town from this proposed north end is being developed by PWD Kerala.

Due to the nature of topographic and site constraints, the design speed of north approach road for Alt-4 is restricted to 65 kmph.

### **Comparison of Alternatives**

The four technically feasible alternate alignments are compared as per the following Techno - Economic parameters:

**Route Length:** The overall length between the two take-off points as per Alt-1 is the lowest at 7.64 km with cumulative length of approach roads of 0.58 km. However, the project road length between Maripuzha and Meenakshi Bridge is 11.642 km. The disadvantages of Alt-1 are:

- The need for improvement and annual maintenance of the additional length of 4 km of existing MDR of Meppadi-Chooralmala road in comparison to Alt-2 and Alt-3 where the Approach road joins the Meppadi-Chooralmala road at Meenakshi Bridge.
- The fragile geological settings of the additional stretch of Chooralamala road.

**Minimum tunnel length:** Alt-1 provides the least length tunnel at 6.87 km followed by Alt-4 and Alt-2 with tunnel lengths at 7.57 km and 8.03 km respectively.

**Forest Area to be affected:** Approach roads are of short lengths. Alt-3 would place the minimum requirement of land for approach roads as well as for widening / improvement of existing MDRs followed by Alt-2 and Alt-4. North end of Alt-1 passing through forest area which demands additional requirement of forestland.

**Geological features:** The tunnel and portal locations are on stable Geological strata. However, stronger supports would need to be provided at the northern end of tunnel in Alt-1.

**Connectivity to important villages:** The alignments in Alt-1 and Alt-4 would pass through Kalladi while the remaining two alternates take-off at the north side at Meenakshi Bridge.

**Land requirement:** For a project of such a magnitude, the land required for the project is very low even after accounting for semi-permanent requirement of dump yards. The requirement ranges between 19 to 30 Ha.

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**Approximate Project cost:** The cost of construction would be the least in Alt-1 which has the least length of tunnel. The existing MDR from Vellarimala rises by 35 m up to Kalladi and falls by 20 m to Meenakshi Bridge. The overall length of project road is 11.642 km. Hence, the cost of widening and protection works of the additional stretch of the Chooralamala road would off-set the savings due to reduced length of the tunnel. The length of tunnel in Alt-2 is comparatively longer w.r.t to Alt-1 and 4, however the length of approach roads is reasonably low as the north end is nearer to Meppadi town. However, the effective length of the project road at 8.730 km is the lowest. The tunnel gradient is of 2.5% and horizontal geometry is also superior to other alternatives.

Comparative Statement of each alternative considered is given below table and alignment plan of the same is presented in **Figure 5**.

Table 1: Comparative Statement

Sr. No.	Details	Alt-1	Alt-2	Alt-3	Alt-4
1	South end Location	Marippuzha	Marippuzha	Muthappanpuzha	Marippuzha
2	North end Location	Vellarimala	Meenakshi Bridge	Meenakshi Bridge	Kalladi Bridge
3	Route Length (m)	7642	8735	10405	8612
4	Tunnel Length (m)	6870	8110	10050	7570
5	South approach Road (m)	580	510	210	580
6	North approach Road (m)	192.5	115	145	462
7	Major Bridges	2	2	2	3
8	Length of Major Bridge (m)-120m per bridge	240	240	240	340 (260+80)
9	Minor Bridges/Culverts	3	3	3	3
10	Design Speed in Approach (KMPH)	80	80	80	65
11	Tunnel Gradient (%)	2.89	2.50	2.97	2.98
12	Land Requirement including dumping site (Ha)	Approx. 26	Approx.19.5	Approx. 29	Approx. 28
13	Improvement required for Chooralamala road to the south of Meenakshi Bridge	Yes (4.0 km)	Nil	Nil	Yes (1.6 km)

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Sr. No.	Details	Alt-1	Alt-2	Alt-3	Alt-4
14	Geology	North end & further 2.0 km is in highly land slide prone areas	Good	Good	North end & further 1.0 km is in land slide prone areas
15	Degradation of forest	46 Ha	35 Ha	45 Ha	40 Ha
16	Feasibility for improvement of existing North Road	Complex task due to Forest land	Feasible	Feasible	Feasible with additional cost
17	Travel Time	Maximum	Least	Minimum	Moderate
18	Vehicle operating Cost	Maximum	Minimum	Minimum	Moderate



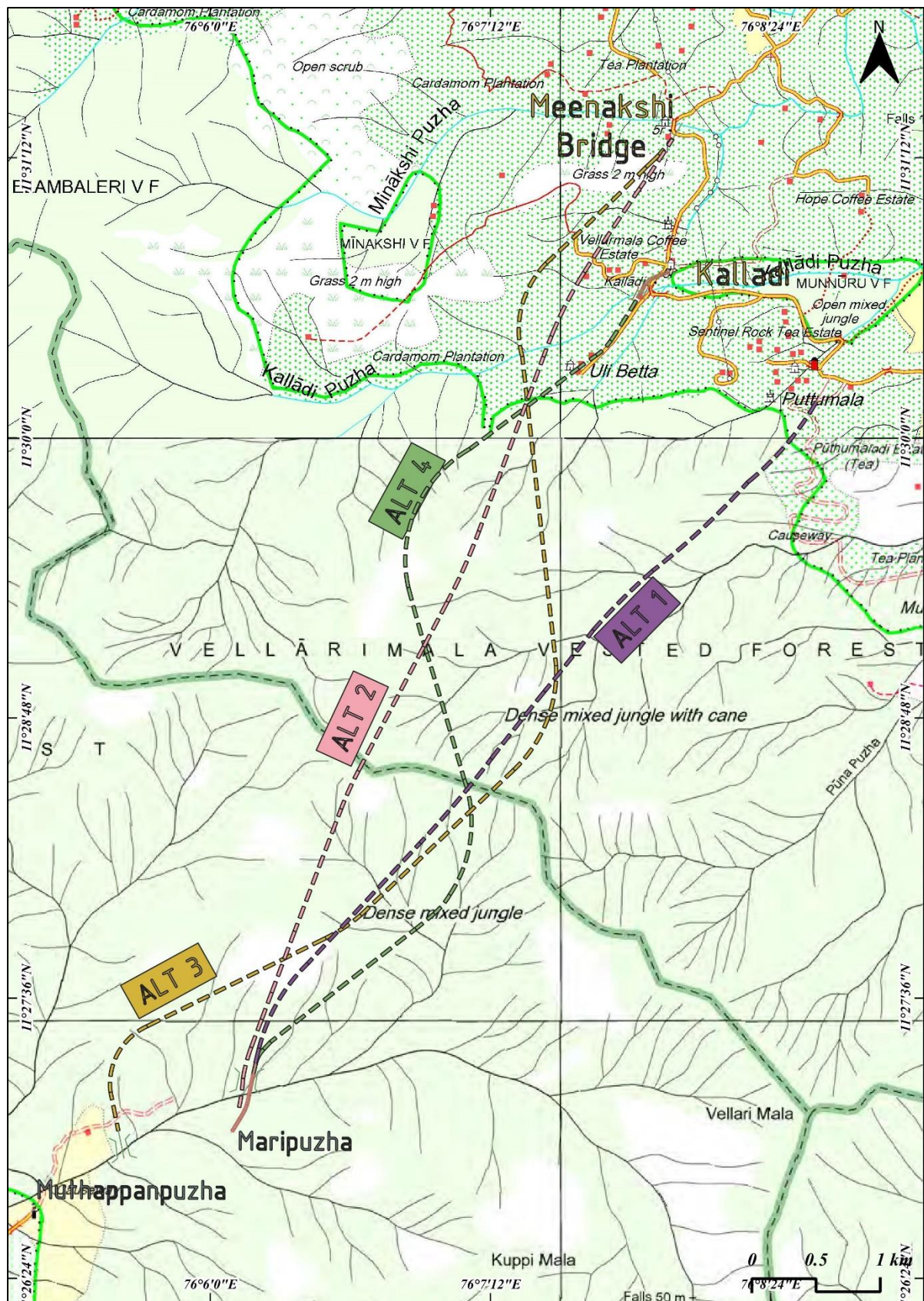


Figure 5: Comparison of Alternatives Considered

### **Conclusion**

In Alt-1, the horizontal alignment is within acceptable parameters and the tunnel gradient is 2.89%. Tunnel and portal area at the north end may need heavy supports. The length of tunnel at 6.87 km is the least amongst the four alternatives. North end of this option meets the Meppadi-Chooralmala road at Vellarimala, approximately 10 km far from Meppadi town which is the farthest compared to other options.

Moreover, on back drop of 2019 landslide disaster, further developments in same vicinity can not a permanent solution. Landslide is the most frequent geo-environmental natural hazard which significantly affects human life and environment. Well-planned mitigation measures, the severe landslide susceptible sites can be stabilized and minimize the landslide hazard. However, effective engineering measures involve considerable capital cost with heavy civil engineering works. The global stability of the area south of Vellarimala is in question. In view of above disadvantages, Alt-1 is not advisable for further engineering study.

Alt-3 has longest Tunnel length though it is technically feasible, but not favourable due to the longer length of tunnel.

Alt-4 though it is technically feasible, the proposal of alt-4 also fails in comparison with the proposed Alt-2. Overall length, habitations at North Portal, sharp bend, reduction of design speed to 65kmph at north approach, an additional River bridge and above all, more global stability of the slopes are in question.

In Alt-2, the horizontal alignment is much superior as well as is the vertical alignment with the tunnel gradient at 2.50%, among all the alternatives. The portal area is also found to be on a stable ground. The length of approach road planned is the bare minimum resulting in the least impact to land parcels. North end of this option is near Meenakshi Bridge, approximately 6 kms far from Meppadi town which is nearest compared to other options.

Benefits from highway are varied in nature, some of them are direct and some indirect. Direct benefits such as construction cost, maintenance cost can be easily measured, whereas Vehicle Operating Cost, value of passenger time savings, value of reduced noise levels and improved aesthetics cannot be measured easily. As this is shortest connectivity to Meppadi, indirect benefits are also added to its credit.

After examining the various aspects of the four alternatives, based on the anticipated impacts, purpose and objectives, it is recommended to adopt Alt- 2 in view of constructability, geometry, shortest connectivity economic and socio-environmental advantages.