1. ANALYSIS OF ALTERNATIVE

1.1. MAJOR REALIGNMENT AT ANKEVELLIA VILLAGE

The village is on RHS and pond is on LHS. The width of land available in this location is around 13.0m and also has sharp curve which are shown in **Figure 1.1.**The existing road alignment need to realignment due to constraints of availability of land and sharp curve. During consultation with village community / local people, it was revealed that road side retaining wall (protection wall) needs to be demolished for improvement of road geometrics, which will have a negative impact as it may impact the water carrying capacity of the pond. Hence, they recommended realignment to a town on left side, beyond the pond as there is barren land which is available.

The proposed alignment option 1 takes off from the existing NH 147 A (OLD SH 20) at km 58+410 on the left side and passes through green field to avoid built-up areas, travels through agriculture fields and merges with the existing NH 147 A (OLD SH 20) at km 57+070.The length of the option 1 is 1.3Km. The proposed alignment option 2 takes off from the existing NH 147 A (OLD SH 20) at km 58+972 on the right side and passes through green field to avoid built-up areas, travels through agriculture fields and merges with the existing NH 147 A (OLD SH 20) at km 56+983.The length of the option 2 is 2.7Km.The best option is option 1 on left side. The left side option is recommended for topographic survey as per review meeting held on 12.12.2016 in Gujarat and on 12.01.2017 in MORTH.

The best option on LHS marked in red colour has been studied as shown on **Figure 1.1**.

1.2. MAJOR REALIGNMENT AT RAJSITAPUR VILLAGE

The existing road taking right angle left turn at Rajsitapur village with a sharp curve having existing radius of 70m.The village exist on LHS within boundary wall which are shown in **Figure 1.2.** There is need of geometric improvements. Realignment is required to save the villagers house. The railway line is running on LHS.

The proposed alignment option 1 takes off from the existing NH 147 A (OLD SH 20) at km 20+970 on the right side and passes through green field to avoid built-up areas, travels through agriculture fields and merges with the existing NH 147 A (OLD SH 20) at km 17+810.The length of the option 1 is 3.7Km. The proposed alignment option 2 takes off from the existing NH 147 A (OLD SH 20) at km 21+634 on the left side and passes through green field to avoid built-up areas, travels through agriculture fields and merges with the existing NH 147 A (OLD SH 20) at km 17+307.The length of the option 2 is 4.6Km.The best option is option 1 on right side. The right side option is recommended for topographic survey as per review meeting held on 12.01.2017 in MORTH.

The best option on RHS marked in red colour has been studied as shown on **Figure 1.2.**

1.3. MAJOR REALIGNMENT AT DHARANGADHRA

The existing road taking right angle turn at Dhrangadhra on RHS and also crossing one railway line at the same location. So, the ROB on existing railway line is not possible to accommodate within the existing alignment i.e. realignment is required in this stretch. The realignment starts from Km 5+000 to Km 4+000.one ROB is proposed in realignment section. The best option on RHS has been studied as shown on **Figure 1.3**

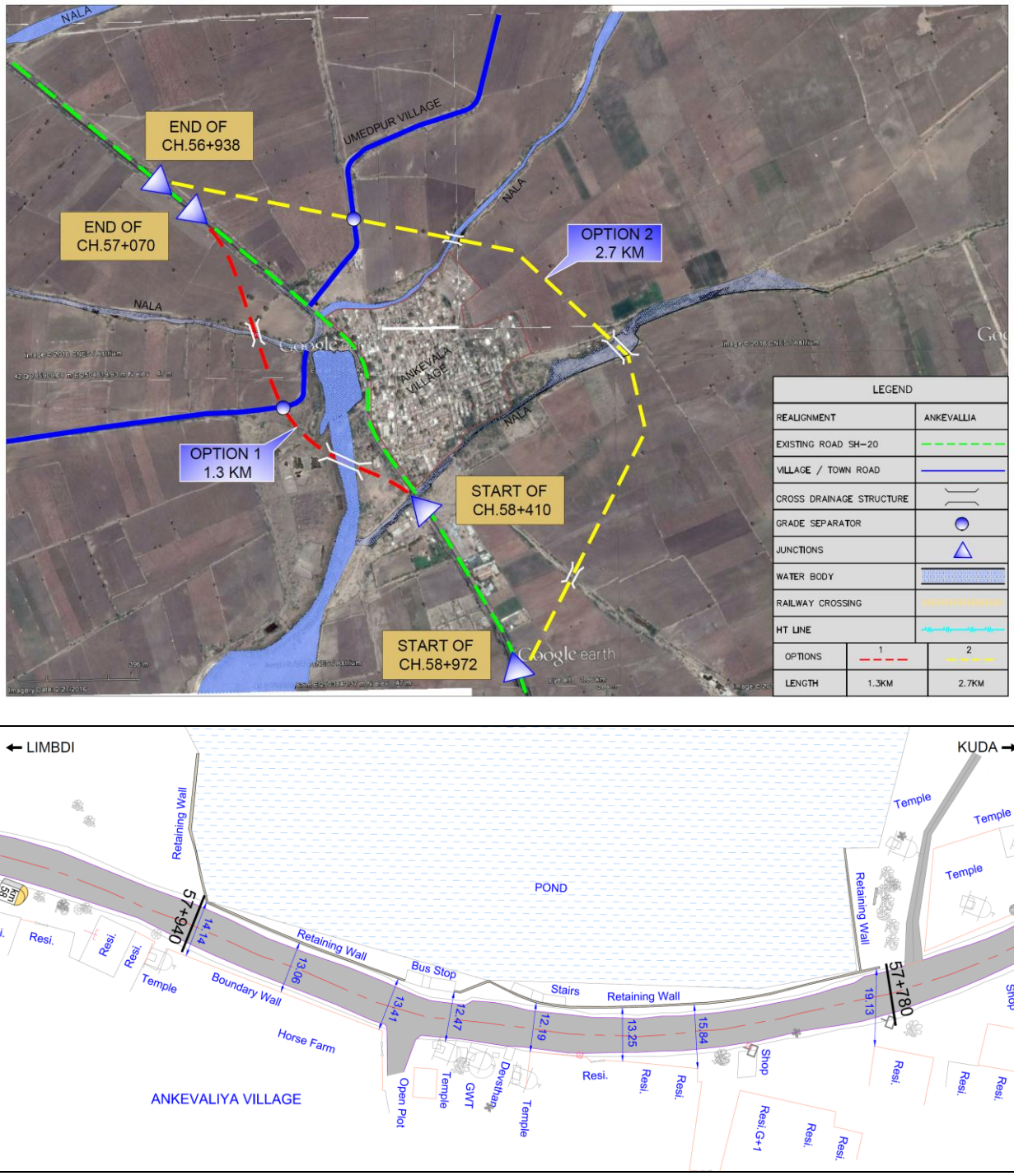
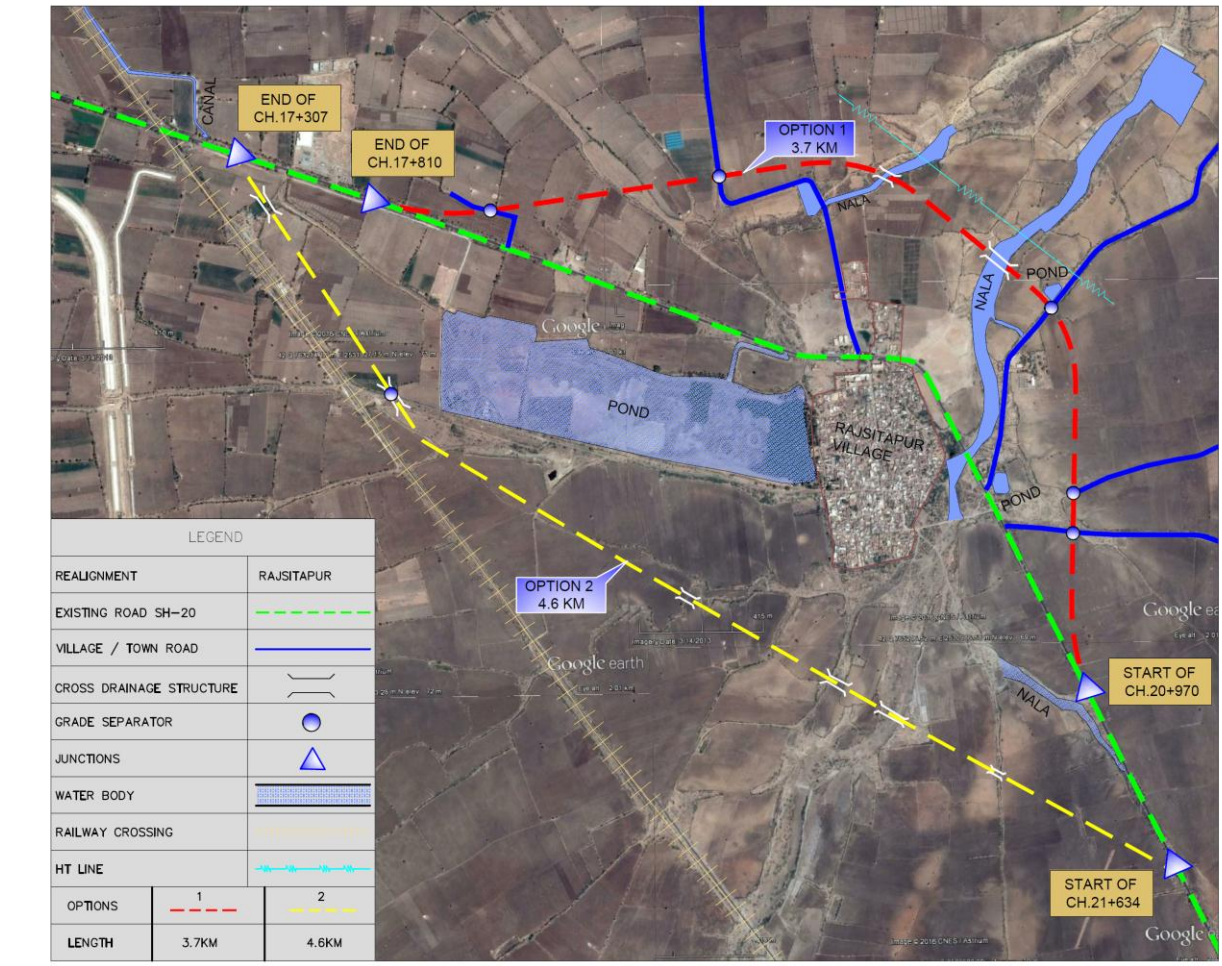


Figure 1-1: Realignments at Ankevellia village



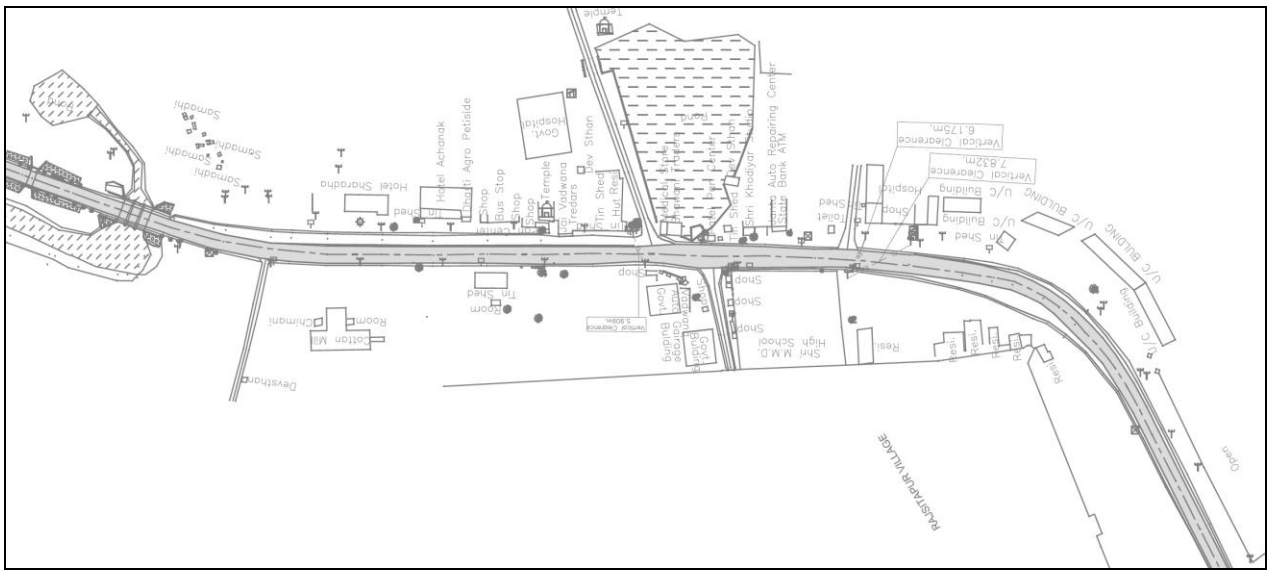


Figure 1-2: Realignments at Rajsitapur

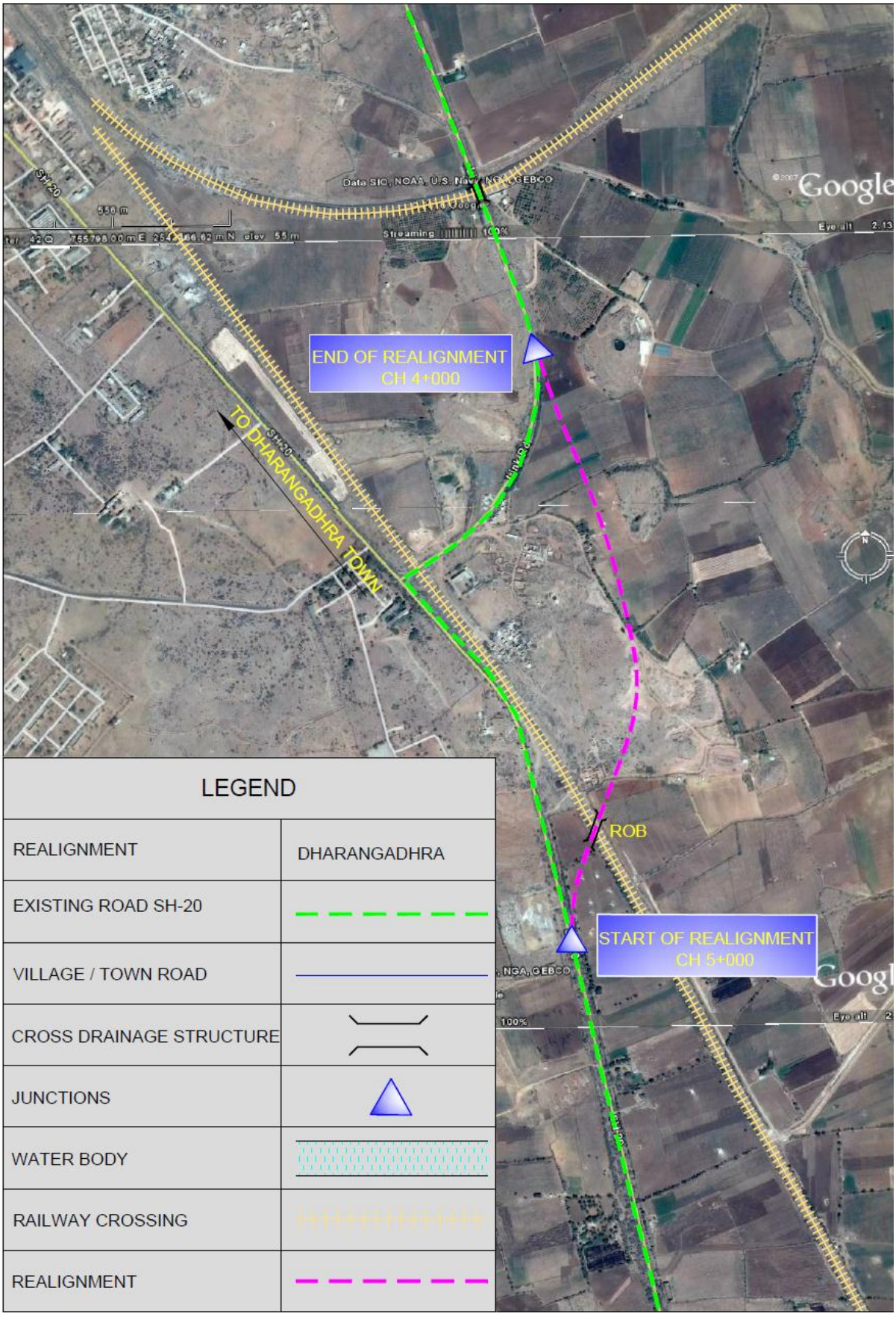


Figure 1-3: Realignments at Dharangadhra

1.4. BYPASSES OF WADHWAN-SURENDRANAGAR TOWN

The Wadhwan,Surendranagar and Dudhrej town extends on both side of existing SH-20 alignment between Km 43+300 to Km 33+000, about 10.3 km in length. The proposed bypass length on LHS is more than RHS as there is a Dholi dhaja dam after the city development area. The best 3options on RHS have been studied as shown on **Figure 1-5**.

The best 3options on RHS has been shown in **Figure 1-4** on the master plan of the towns.All alignments are outside of towns development area.

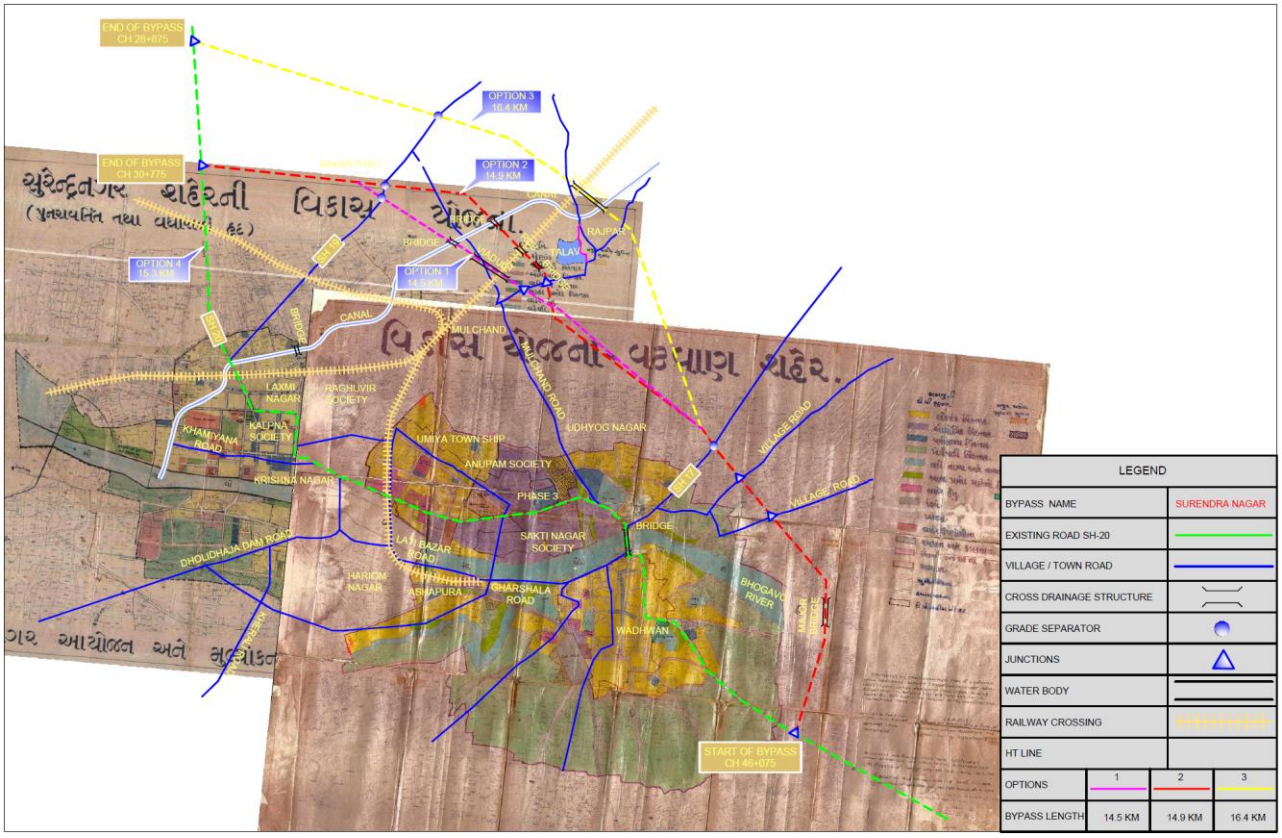


Figure 1-4: Surendranagar Bypass on Master Plan

The terrain is plain. Alignments are traverses through agricultural lands. The initial alignment options study has been done on Google Map.

Along Limbdi to Kuda project corridor, there are already two sections of existing bypass namely Dhrangadhra bypass (Sec. A :two lane existing bypass from km 4+670to km 0+900 along SH 20, Section B: Divided 4 lane existing bypass along A V M, SH 07 from km. 119+500 to km 123+790). While, at Wadhwan - Surendranagar town, road side establishments including residential and commercial buildings exist on both sides of road. To help alleviate congestion and encroachments and to improve travel speed and safety, three options for the Wadhwan - Surendranagar town realignment (proposed three bypass options on right hand side as option 1, option 2 and option 3 have been examined as shown in **figure 1-4.** Key characteristics of the alignments are described in **table 1-1.**

Following alternatives are evaluated:

a) Alternative 1, Option 1

b) Alternative 2, Option 2

c) Alternative 3, Option 3

d) Alternative 4, follow the existing alignment,development and upgradation on existing two lane old SH – 20 passes through Wadhwan / Surendranagar town.

e) Elevated section along existing town

Table 1-1: Details and Features along all the Three Alignment Options

Bypass Chainage (km)	Design Chainage (km)	Cross road	Approx. width(m)	Type of structures	Span Arrangement (m)	Remarks
Option-1(Length:14.877km)(start pt:46+426,end pt:30+465)						
1+600		Bhogavo river	200	MJBR	4x(18+24+18)	
3+600		Village Road	CW=3.5	PUP(3.0m)	1X7.0	
4+500		Village Road	CW=3.5	PUP(3.0m)	1X7.0	
5+200		SH-17	CW=7.0X2+1.2 MEDIAN	VUP(5.5m)	2x12.0	
9+500		Village Road	CW=3.5	PUP(3.0m)	1X7.0	
10+000		Rly. Crossing	Viaduct(length 1.085km),RE wall upto 7.5m	Viaduct	15x35+35+15x35	
10+300		Village Road & Nalla				
10+900		Underpass	CW=10.5 including 1.5m footpath on either side	Proposed underpass for Canal SR road(LVU=3.5m)	1x10.5	
11+000		Saurashtra Branch canal	66	MJBR	3x24.7	
11+100		Underpass	CW=10.5 including 1.5m footpath on either side	Proposed underpass for Canal SR road(LVU=3.5m)	1x10.5	
12+400		SH-19	CW=7.0	VUP(5.5m)	1x12.0	
13+700		Field Canal	4	Box	1X5.0	
14+200		Field Canal	2	Box	1X3.0	
Option-2(Length:15.380km)(start pt:46+426,end pt:30+465)						
1+600	18+797	Bhogavo river	200	MJBR	4x(18+24+18)	
3+600	20+776	Village Road	CW=3.5	PUP(3.0m)	1X7.0	
4+500	21+640	Village Road	CW=3.5	PUP(3.0m)	1X7.0	
5+200	22+380	SH-17	CW=7.0X2+1.2 MEDIAN	VUP(5.5)	2x12.0	
9+400	26+580	Village Road	CW=3.5	PUP(3.0m)	1X7.0	
9+750	26+940	Nalla	60	MJBR(in skew 30 degree)	15+2X22+15	
10+150	27+250	Rly. Crossing	RUB	RUB	1x14.0	
10+800	27+930	Saurashtra Branch canal	66	MJBR	3x24.7	
12+000	29+105	Village Road	CW=3.5	PUP(3.0m)	1X7.0	
12+800	30+000	SH-19	CW=7.0	VUP(5.5m)	1x12.0	
14+200	31+270	Field Canal	4	Box	1X5.0	
14+700	31+797	Field Canal	2	Box	1X3.0	
Option-3(Length:16.40km)(start pt:46+426,end pt:28+875)						
1+600		Bhogavo river	200	MJBR	4x(18+24+18)	
3+600		Village Road	CW=3.5	PUP(3.0m)	1X7.0	
4+500		Village Road	CW=3.5	PUP(3.0m)	1X7.0	
5+200		SH-17	CW=7.0X2+1.2 MEDIAN	VUP(5.5)	2x12.0	
7+700		Nalla	100m	MJBR	15+2X22+15	
9+400		Village Road	CW=3.5	PUP(3.0m)	1X7.0	
9+850		Saurashtra Branch canal	Viaduct(length 1.115km),RE wall upto 7.5m	Viaduct	17x35+35+15x35	
10+400		Rly. Crossing				
12+400		Canal crossing	30m(in skew)	MNBR	1X30.0	
13+100		SH-19	CW=7.0	VUP(5.5m)	1x12.0	

The comparison of alternatives is discussed in the following sections.

a) Option 1

The proposed alignment option 1 takes off from the existing NH 147 A (OLD SH 20) at km 46+458 on the right side and passes through green field to avoid built-up areas, travels through agriculture fields and merges with the existing NH 147 A (OLD SH 20) at km 30+428 after railway level crossing at Km 31+500. Total length of this option is 14+877 km. The terrain is plain with elevation varies from 57 to 75 m (based on google map).

Alignment traverses through mainly agricultural lands. Alignment crosses river Bhogavo at km 1+600 where a MJBR is proposed, cross roads / village road and state highways (SH 17 and SH 19) altogether at 5 locations, out of which pedestrian underpass(PUP) is proposed at 3 locations where alignment crosses the village roads (at km 3+600, 4+500 and at 9+500), while vehicular underpass are proposed at balance 2 locations where alignment crosses SH 17 and SH 19 respectively at km. 5+200 and at km 12+400. This alignment option also crosses a double decker railway line track at km

10+000 where 1.085km long viaduct is proposed (covering the railway track and a village road and a nalla 300 m ahead at km 10+300).Railway track is on high embankment, height around 6.5m and also need vertical clearance for railway is 8.5m.The below photo depicts the height of embankment. Alignment option 1 also crosses a SSNNL Saurashtra Branch canal at km 11+000 where a major bridge is proposed(refer **table 1-1**).

b) Option 2

The proposed alignment option 2 takes off from the existing NH 147 A (OLD SH 20) at km. 46+458 on the right side and passes through green field to avoid built-up areas, travels through agriculture fields and merges with the existing NH 147 A (OLD SH 20) at km. 30+428 after railway level crossing at Km 31+500. Total length of this option is 15+320 km. The terrain is plain with elevation varies between from 57 to 75 m (based on google map). Alignment traverses through mainly agricultural lands.

The alignment option 2 crosses river Bhogavo at km 1+600 where MJBR is proposed, crosses village roads at 4 locations – at km 3+600, 4+500 and 9+400,12+000, all of where pedestrian underpass(PUP) is proposed. Alignment also crosses SH 17 at km 5+200 and SH 19 at km 12+800, where vehicular underpasses are proposed (VUP 5.5m, 2 nos.). Alignment option 2 also crosses a nalla (stream) at km 9+750 where a skew (30^{o}) MJBR is proposed and a double decker railway line track at km 10+150 where a RUB is proposed. Railway track is on high embankment, height around 6.5m and also need vertical clearance for railway is 8.5m.The below photo depicts the height of embankment. Alignment option 2 also crosses a SSNNL Saurashtra Branch canal at km 10+800 where a major bridge is proposed(refer **table 1-1**).

c) Option 3

The proposed alignment option 3 takes off from the existing NH 147 A (OLD SH 20) at km 46+458 on the right side and passes through green field to avoid built-up areas, travels through agriculture fields and merges with the existing NH 147 A (OLD SH 20) at km 28+875 after railway level crossing at Km 31+500. Total length of this option is 16+400 km. The terrain is plain with elevation varies from 57 to 75 m (based on Google Map). Alignment traverses through mainly agricultural lands.

The alignment crosses river Bhogavo at km 1+600 where MJBR is proposed,canal at km 12+400 where minor bridge is proposed, cross road / village road at km 3+600,4+500 and 9+400 where pedestrian underpass(PUP) is proposed and state highways SH 17 and SH 19 at km 5+200 and at km 13+100 respectively where vehicular underpass are proposed. Alignment option 3 crosses a nalla (stream) at km 7+700 where a MJBR is proposed. Alignment option 3 crosses a SSNNL Saurashtra Branch canal at km 9+850 followed by crossing a double decker railway line track at km 10+400 where a continuous viaduct is proposed having its length about 1.115 km covering Saurashtra Branch canal at km 9+850 and the railway track 550 m ahead at km 10+400. (Refer **table 1-1**). Railway track is on high embankment, height around 6.5m and also need vertical clearance for railway is 8.5m.The below photo depicts the height of embankment.

The alignment has been so chosen that it is not likely to be affected by future growth near Wadhwan - Surendranagar town in the coming years, at least for the next 20 to 25 years.

As alignment passes through mostly mix of agricultural and plain land, there would not be significant loss of vegetation cover and thus resultant loss would be insignificant. Further, social impact of this alternative is negligible as there is no / minimal acquisition of properties involved.

Table 1-2: Comparative Statement and Assessment Matrix Wadhwan - Surendranagar Town Bypass Realignment

Description / Criteria	Option 1	Option 2	Option 3
General	Right side of NH 147 A with start chainage at km 46+458 and end chainage at km 30+428	Right side of NH 147 A with start chainage at km 46+458 and end chainage at km 30+428	Right side of NH 147 A with start chainage at km 46+426 and end chainage at km 28+875

Description / Criteria	Option 1	Option 2	Option 3
Length	14.877 km	15.380 km.	16.4 km
Terrain and Land Use	Plain and Agricultural	Plain and Agricultural	Plain and Agricultural
Future planned developments	Mostly on eastern side i.e. Right side	Mostly on eastern side i.e. Right side	Mostly on eastern side i.e. Right side
Nos. of Rly crossings	01	01	01
Proposed improvement / treatment at rly crossing	Viaduct	RUB	Viaduct
Nos. of canal crossings	03	03	02
Proposed improvement / treatment at canal crossing	01 MJBR	01 MJBR	Viaduct & MNBR
SH and Village Road Crossings	05	06	05
Proposed improvements at all the crossings	PUPs at VR 3 nos., VUPs at SH 2 nos., MNBR at Canal crossing(13+700), Viaduct 1.10 km long covering the railway track and a village road and a nalla , MJBR 2 Nos. (1 at river, 1 at canal)	PUPs at VR3 nos., VUPs at SH 2 nos., MNBR at Canal crossing(14+200), RUB at Rly. Cross, MJBR 3 Nos. (1 at river, 1 at Nalla km 9+750, 1 at Canal)	PUPs at VR 3 nos., MNBR at Canal crossing(12+400), Viaduct at Rly. Cross, Viaduct 1.0 km long covering the railway track and Canal, MJBR 2 Nos. (1 at river, 1 at Nalla km 7+700,)
Cross drainage (C/d) structures-proposed treatment at major and minor river / streams and canal crossings	River : MJBR, Nallah : Under Vidaduct, Saurashtra Branch Canal : MJBR Canal:MNBR	River : MJBR, Nallah : MJBR (Skew), Saurashtra Branch Canal :MJBR Canal:MNBR	River : MJBR, Nallah : MJBR, SaurashtraBranchCanal: Viaduct Canal:MNBR
Villages and Town Enroute	Dhudrej, Bakarthali, Mulchand, Rajpar, Wadhwan Urban area part 1, 3 and 4	Dhudrej, Bakarthali, Mulchand, Rajpar, Wadhwan Urban area part 1,3 and 4	Latuda, Bakarthali, Rajpar, Wadhwan Urban area part 1,3 and 4
Land Acquisition (Ha.)	87.0 ha	91.28 ha.	98.40 Ha.
Structures including govt. / private properties enroute	Nil	Nil	Nil
Approximate civil works construction cost	112.51 Crores	91.12 Crores	119.62 Crores
Remarks	Recommended	**Highly Recommended**	Least Recommended

All the three alignment options have been so chosen that any of the option is not likely to be affected by future growth near Wadhwan - Surendranagar town in the coming years, at least for the next 25 years. As alignment passes through mostly mix of agricultural and plain land, there would not be significant loss of vegetation cover and thus resultant loss would be insignificant. Further, social impact of this alternative is negligible as there is no / minimal acquisition of properties involved.

The major difference among 3 proposed alignment options is cost of viaduct (RoB) which is proposed for option 1 (covers Rly crossing, VR and Nalla between km 10+000 to 10+300), and option 3 (covers Saurashtra Branch canal and Rly crossing between km 9+850 to 10+400). Proposed length of both Viaducts (RoBs) is about 1.0 km. which can result in huge financial impact. Option 2 has proposed a RUB at rly crossing (Km 10+150), a skewed MJBR at Nallah (km 9+750) and again a MJBR to cross the main canal at km 10+800. However cost of 2 MJBR and a RUB as proposed for Option II marginally be economical (less financial burden) as compare to proposed huge structure Viaduct (ROB) for Option 1 and 3.

The bypass alignment option 3 requires traveling 16+400 km. i.e. (1.5 km. more than option 2, and 1.11 km more than option 1). However land acquisition area is 98.4 ha If option 3 is followed as against area of 87 ha for Option I, 89.4 ha for option 2. Looking at the above comparisons, considering all the pros and cons., it is recommended to adopt Option 2.

d) Existing two lane to be converted into two lanes with paved shoulder / four lanes (Alternate Option A4)

This option shall be considered as an alignment A 4 (OPTION 4) in **figure 1-5**. This alignment follows the existing road with minor realignments which generally necessitates in improving the poor geometrics. The widening w/o land acquisition and acquisition of properties is not possible, as ROW is very narrow even for two lane type configuration. The widening of road up to two lane with PS / 4 lane entails resettlement, relocation and rehabilitation of **huge roadside establishments** which includes residential and commercial buildings and other commercial properties including many shops – about **1873 nos. of Commercial & mixed use structures, 22 nos. of CPRs and 16 nos. of other properties / structures.** Existing environment will worsen with increased traffic through settlement, if this option is followed, but from the social point of view, impact will be much more, as many cultural and community properties will also come into picture, which will be required to relocate or enhanced.

e) Elevated section along existing town

The elevated section is not possible due to non-availability of land in town portion. The carriageway width in Wadhwan town from Km 42+800 to Km 41+600 is 4.0m only. Existing road geometric is very poor and also road is taken right angle turn in few locations inside the town.

1.4.1. Factors involved in the Preliminary Evaluation of all the 4 Options are given in the following Matrix

Table 1-3: Evaluation Matrix for Wadhwan - Surendranagar Town Alignment Options

Sr. No.	Factors / Criteria		Options			
			1	2	3	4
1.	Land Use	Impact on agricultural activity	✧ LD	✧ LD	✧ LD	♦ MD
		Impact on commercial activities	✡ D	♦ MD	♦ MD	✧ LD
		Future land use pattern	✧ LD	✡ D	♦ MD	✡ D
2.	Social	Rehabilitation / Resettlement	♦ MD	♦ MD	♦ MD	✧ LD
		Preservation of Cultural / Community Properties	✡ D	✡ D	✡ D	✧ LD
	-+	Land acquisition (Ha.)	♦ MD	✡ D	✧ LD	✧ LD
		Estimated time period for Land acquisition, with LAQ Act 2013	♦ MD	♦ MD	✧ LD	✧ LD
		Land Acquisition Cost (Rs.)	✡ D	✡ D	♦ MD	✧ LD
3.	Ease of Travel / Passenger Comfort	Length	♦ MD	♦ MD	✡ D	✧ LD
		Travel time	♦ MD	♦ MD	✡ D	✧ LD
4.	Environmental	Water and air quality	✡ D	✡ D	✡ D	♦ MD
		Protection of Flora and Fauna	✧ LD	✧ LD	✧ LD	♦ MD
5	Economic	Project cost	✡ D	♦ MD	✧ LD	♦ MD
		Construction stage impact costs	✡ D	♦ MD	✡ D	✧ LD
		Financial / Economical Analysis	✡ D	♦ MD	✧ LD	✡ D
		Total :	**14**	**19**	**07**	**01**
		2 Points for ♦ MD, 1 point for ✡ D, **(-1) for ✧ LD**				

Legend: ♦ Most Desirable: MD ✡ Desirable: D ✧ Least Desirable: LD

1.4.2. Preferred WADHWAN - SURENDRANAGAR TOWN Bypass

Various options for Wadhwan - Surendranagar town bypass realignment have been studied and described in Draft Feasibility Study Report (DFSR). From the discussion / consultation with local peoples, it became apparent that most of the future expansion / development also have to happen on the eastern side (right hand side of the project corridor alignment). Options 1 / 2 / 3 on the eastern side are the preferred options to be taken forward to DPR stage. Out of these, majority of the stack holders are likely to agree to adopt east side bypass alignment for Wadhwan - Surendranagar town city having **option** 2 as proposed.

Recommended Option: Based on the above evaluation matrix, it is proposed to develop **Option 2** with payment of compensation to the present land holders as it has the least environmental and social related impacts.

Shri. Pooran Singh, The Regional Officer is also recommended the **Option 2**

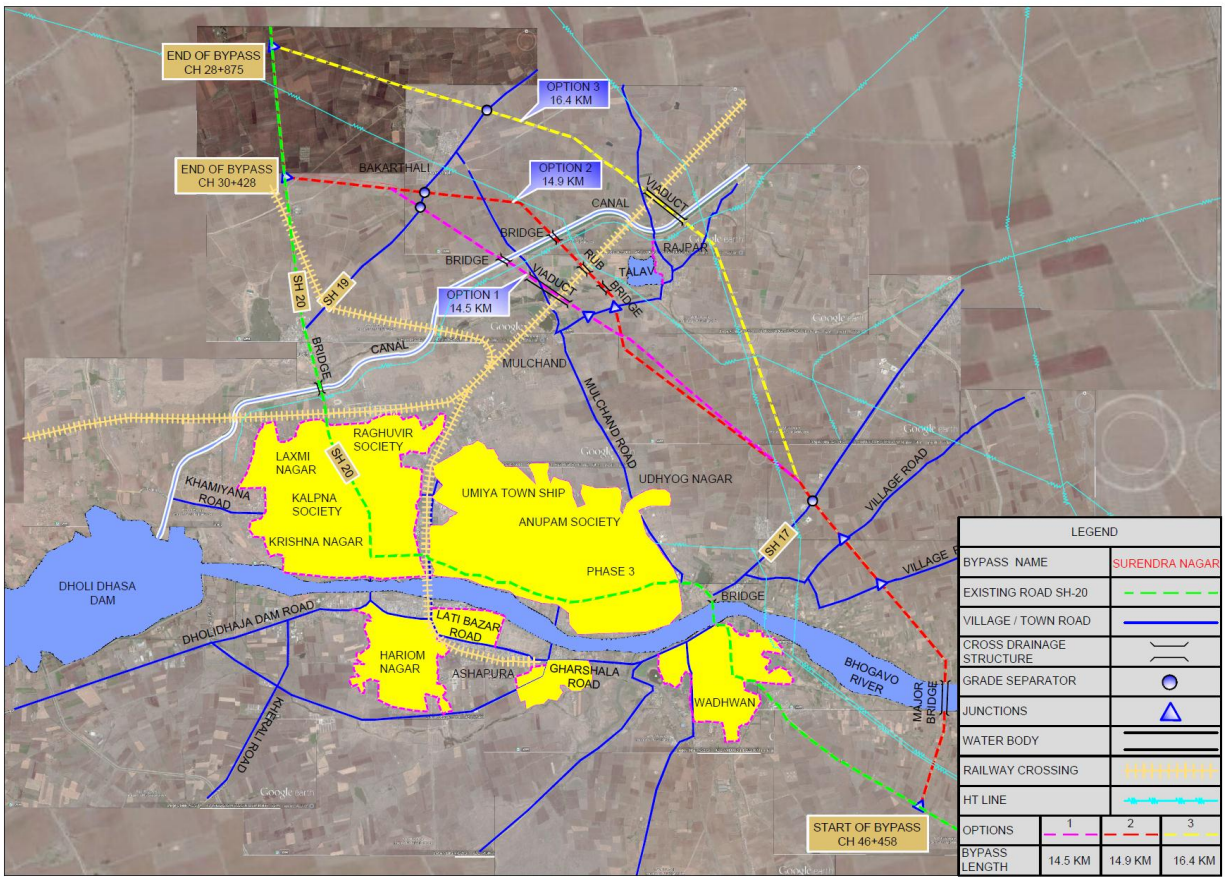


Figure 1-5: Surendranagar Bypass