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ADDIS ABABA INSTITUTE OF TECHNOLOGY
SCHOOL OF CIVIL AND ENVIRONMENTAL ENGINEERING



ASSESSMENT OF COST BENEFIT ANALYSIS
BETWEEN ROADWAY AND CABLEWAY
TRANSPORT MODES (A CASE STUDY FROM
KOLADIT JUNCTION TO GISHEN MARIAM
CHURCH)

A Thesis in Road And Transport

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A Thesis

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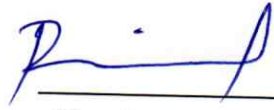
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CERTIFICATION

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ABSTRACT

Ropeways are potential means of transport that are adaptable to the existing terrain, and an alternative transport solution for difficult topographical landscapes, manmade obstacles, for instance Rivers, lagoons and estuaries. Ropeway decrease environmental impact caused by road construction and energy efficient than most transport systems and can be used in urban transport system to overcome the city traffic by installing intermediate towers.

Before 19th centuries, in Ethiopia, China, Japan, Brazil, Newzland and India used traditional cable car transport. Now a days, modern cable care were emerging specially in Latin America, people were using cable car to connect unsuitable terrain type with human or man-made berries and provide new perspective for viewing scenery as recreational activities. The maximum capacity of the existing cable cars is 4000 person per hr with maximum speed of 43.2km and the basic component of the Arial cable car is cabin, a driver, returned terminal, towers and ropes.

The objective of this research is to explore an alternative means of transportation mode for the road segments from Koladit junction to Gishen Mariam church. This section of the road is found in a very difficult terrain with combination of steep gradient and winding sharp curves to tackle escarpments and mountainous terrain. The problem of transportation will not be solved only by constructing road up to the church from Koladit junction, but also by introduction of other means of transportation that is suitable for its terrain type.

After collecting primary and secondary data from site during field visit, qualitative and quantities, methods adopted to analysis the data. The site visit were made on one of the peak season from between March 17, 2021 up to March 21, 2021 while the Meskel celebration was on March 19. Generally, 55.49% and 64.67% of the pilgrims and peoples living around the route have an interest to use cable car respectively. This helps to estimate the number of people that will use the cable car after implementations and intern the number of users is used for fix the average fair price. The estimated traffic used for economic evaluation of both cable car and roadway are stated in the table below.

Table 0-1:- Estimated traffic for cable car

Descriptions	L/Rover	S/Bus	L/Bus	Total
---------------------	----------------	--------------	--------------	--------------

Total AADT @2021 estimated by Beza Consulting	164	3	5	172
Percentage composition	95%	2%	3%	1
Total estimated traffic by local administration 20,000	19,070	349	581	20,000
Total Estimated traffic	61,023	3,349	16,278	80,651

Source:- Estimations

Table 0-2:- Estimated traffic for road user

Descriptions	Car	L/Rover	S/Bus	L/Bus	S/Truck	M/Truck	H/Truck	Truck & Total	
Total AADT @2021	0	164	3	5	68	7	8	1	256
Percentage composition	0	64.06	1.17	1.95	26.5	2.73	3.125	0.39	100

Source:- Estimations and adopted from the BCE data base

Economic analysis has carried out using HDM-4 model (version 1.1). The model, which based on life cycle costing, used for assessing the costs and benefits of implementation technologies. Within this framework, two mutually exclusive project alternatives i.e. i) Construction of cable car and ii) construction of road, have been considered for assessing the economic viability against the do nothing scenarios. Based on the traffic and engineering assessment, a comparison made between the construction of cable car and implementation of upgrading the existing road to asphalt Concrete road.

Summary results of the economic analysis presented in Table 0-3 below.

Table 0-3: Economic Analysis: Summary Results (Do-minimum versus With the Project Alternatives)

Scenarios	Construction of cable car	Construction of road way
Base Case		
IRR @ 10.23%	33.1%	26.8
NPV (In Million Birr)	18,851	220
Benefit Cost Ratio(B/C)	4.412	4.294
Cost Increased by 20 %		
IRR @ 10.23%	31.7	24.4
NPV (In Million Birr)	18,625	207
Benefit Cost Ratio(B/C)	4.367	3.599

Scenarios	Construction of cable car	Construction of road way
Benefits decreased by 20%		
IRR @ 10.23%	26.7%	23.5
NPV (In Million Birr)	13,716	163
Benefit Cost Ratio(B/C)	3.165	3.435
Cost Increased by 20% & Benefits decreased by 20%		
IRR @ 10.23%	26.0%	21.1
NPV (In Million Birr)	13500	150
Benefit Cost Ratio(B/C)	3.13	2.879

Source:- Out put from HDM4

The economic analysis, as well as overall engineering and traffic assessment show that both proposed technologies are economically worthwhile based on direct traffic benefits. However, the economic parameters of cable car is higher than the construction of road. In addition, users benefit for cable car: user cost savings including travel time is more viable than for the implementation of road. The EIRR of the project investment for cable car is 33.1%, which is higher than the EIRR of road construction. Even under the most pessimistic scenario of 20% increase capital cost and 20% decrease in project benefits, it yields an EIRR of 26.0% still higher value from the road construction (i.e., considering the cut-off rate applicable in Ethiopia is 10.23%). In addition, the fair price for transportation of cable car was estimated at an averagely price of 46.25birr per trip. For fair price analysis yearly pilgrim's growth rate and inflation rate was used.

This assessment reveals that the installation of cable car on rugged terrain with man mad and natural barriers, with seasonal traffic, with limited right-of-way and with beautiful landscape areas, is more viable than construction of roadways. Hence, this research presents the cost benefit analysis between cable car and road way construction in the case of Koladit Junction to Gishen Mariam Church which is located in northern part of Ethiopia around 482 km from Addis Ababa.

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ABBREVIATION

BCK: Beza Engineering Kenya Limited

BCR: Benefit Cost Ratio

BDG: Bicable Detachable Gondolas

CO : Carbon Oxide

EIRR:-Economic internal rate of Return

ERA: Ethiopian Road Authority

ETB: Ethiopian Birr

GDP: Growth Domestic Product

MT: Motorized Traffic

NF: Night Factor

NPV:- Net Present Value

NMT:- Non Motorized Traffic

NOx: Nitrogen Oxides and

NT: Normal Traffic

N: Nitrogen

P: phosphorus

PM: Particular Matter

SCF: Seasonal conversion Factor

TDG: Tricable Detachable Gondolas

VOC: Vehicle Operating Cost

UNESCO: United Nations Educational, Scientific and Cultural Organization

UNWTO: United Nations World Tourism Organization

VOC: Vehicle Operating Cost

CHAPTER 1 INTRODUCTION

1.1 Background

Ministry of transport of Ethiopia prepared a Ten-year Development Plan (2013-2022), to ensure and modernizing logistics transformation by significantly improving modern transportation modes, traffic safety and management. In this plan, the government have included the introduction of a new technology, cable car, in Ethiopia. A Cable car is an eco-friendly type of transportation mode used for mass transit where rail cars (Cabins) are dragged by a continuously moving cable running at a constant speed. Individual cars stop and start by releasing and gripping this cable as required. Cable cars are different from funiculars, where the cars permanently attached to the cable and cable railways, which are similar to funiculars, but where the rail vehicles are attached and detached manually.

Ropeways are extremely adaptable to difficult terrain and represent an optimal transport solution for challenging topographical landscapes such as hilly terrains.[47] However, even on flat land, ropeways have the capacity to overcome many other types of natural and manmade obstacles, for instance rivers, lagoons and estuaries, harbours, railways and motorways. In some areas, the cable car systems have emerged as an optimal way to connect informal settlements that were established over the past decades along steep slopes and hilly terrains and public transport supply is largely underdeveloped. The major potential of aerial ropeway systems is seen in the significant increase in accessibility between these settlements and other locations within the urban fabric, supporting social inclusion and access to work and education opportunities.[48]

The cable car is becoming more popular transport system struggle to keep up with booming construction and growing populations in the developing world. In Latin America, Cable cars are particularly common, where almost every city has expressed an interest in a cable car network. In 2004, Medellín introduced its cable car network to serve underprivileged hilltop neighborhoods, giving each line a letter and color – deliberately echoing the city’s existing metro system.[49]

The reason that have really taken off in Latin America is the ease of construction over steep terrain. In many mountainous cities, where informal developments tend to be built on hilltops, bus-based public transit is often unreliable or unavailable to people living in those difficult terrain. In contrast, cable cars can slide effortlessly over these areas.

The construction of a cable car in Lagos, Nigeria, is nearly complete and the World Bank has approved a \$175 million financing loan to construct one in Kampala, Uganda. [49]

Even though Ethiopia has multi-lateral problem regarding traffic jam and cost overrun on construction technologies, still introducing cable care technologies are under feasibility study.

One of the studies, which are taken currently by US based company name Doppelmayr to build a 5 to 7km length cable car on the outskirts of Addis Ababa. The solar powered cars can accommodate up to 35 people. They can perform the work of 200 buses in one hour. The company proposes building the car from Jemmo- Vatican, Klinto – Hayat, Legeatfao- Hayat and Bole Bulbula to Bole.

The study has demonstrated that roads construction produces significant adverse effects on environment and human health due to the discharge in atmosphere of pollutants released during the execution of the various construction processes (earthmovings, trucks transit on unpaved roads, crushing, and material production) and the operation of diesel-powered equipment. In additions, road construction at rugged terrain with dead end locations, will be very expensive than other means of transportation.

Installation of cable cars in Ethiopia, especially in places like Gishen Mariam Church can boost tourism which is located around mountainous terrain and with a beautiful land scape instead of constructing roads and disturb the landscape.

The road segment from Koladit junction up to Gishen Mariam church road has an existing road with 14km gravel with very difficult terrain. The start of segment 482km far from Addis Ababa and the elevation difference between the start of the road segments and the end of the road is around 1009 above mean sea level. Hence, geometrically departures will be introduced that will be very sensitive for safety and dangerous for environmental condition of the area. hence, this thesis mainly focuses on finding an alternative mode of transport along the section were manmade or nature barriers exist in general and compare cable care with that of roadway along Koladit junction up to Gishen Mariam in particular. Therefore, significance of this research is providing an alternative mode of transport for the segments that have difficult terrain other than upgrading the existing road to pavement standard. This will help policy makers and transport planes to consider cable car as an alternative transportation mechanism for the segments that have difficult terrain, dead end places, and isolated settlement and so on.

1.2 Problem Statements

Gishen Mariam church is one of the old traditional churches that have high seasonal tourise traffic. The pilgrimage is made four times a year resulting high human traffic congestion along difficult terrain

. The church is found one of the highest mountains in Ethiopia call Amba Geshen Mountain. The church is accessed with 14km gravel road that has combination of steep gradient and sharp curves in escapement terrain that is diverted from Dessi Kutaber asphalt road. The profile shows that the elevation difference between the start of the road upto the end of the road is around 1009m above mean sea level and existing road has a width if 7 meter and most of the travelers were coming for religious celebration.

Currently, because of high traffic and unsafe condition of the 14km road, the government of Ethiopia has a plan to construct the road to asphalt standard with an investment cost of Birr 94 million per kilometer which amounts to about Birr 1.3 billion. Hence, based on some country’s experience around the world with similar terrain and tourist attraction, an alternative mode of transport with less land acquisition and less travel time. In addition, landscape should be protected and not sacrificed in favor of increasing access. Instead, there should be a way of preserving the landscape as well as create access to historical and religious places.

Four times in a year, the area will experience a tremendous traffic for religious celebration. According to the woreda administration, because of difficult terrain with narrow width, traffic accidents were occurred on every celebrations, hence in order to overcome accidents, only changing the existing road from unsealed pavement type with paved standard but either widening the road with or find another mechanism to overcome the difficult terrain.

As shown in the figure 1.1 and 1.2, the existing road width 7m and at some place it will narrow to 5m and pass only one bus at a time and widening the road to standard is almost impossible at those locations. The figure illustrates the transversal direction of the landscape makes the construction work very difficult and makes the construction work expensive.



Figure 1-1 location of existing road



Figure 1-2 location of existing road

Hence, with the problem of environments and safety by construction of asphalt road will not ensure mobility of the peoples and pilgrims. Hence, an alternative mode of transport shall be assessed for the road segments from Koladit junction to Gishen Mariam church.

The significance of this research is instead of upgrading the existing road that have terrain constraints with seasonal traffic, other means of transport shall be considered.

1.3 Objective of the study

1.3.1 General Objective

The main objective of this study is to explore an alternative means of transportation mode other than construction of a road on difficult terrain or along barriers (man kind or natural). The existing road to Gishen Mariam Church, from Koladit to Gishen Mariam section, has taken as a case study to find /explore an alternative means of transportation mechanism and to draw a conclusion for better means of transportation on unsuitable terrain.

1.3.2 Specific Objectives

Specifically, the research tries to address the following objectives:

- i. **To** assess the traffic demand along the project road from Koladit Junction to Gishen Mariam and its potential source of traffic;

- ii. **To** assess the advantages and disadvantages of the construction of both the cable car and the road way;
- iii. **To** conduct comparative Cost and benefit analysis between cable car and roadway
- iv. Recommend the most viable mode for consideration by pertinent policy makers.

1.4 Research question

This proposal tries to address the following research questions:

- What types of transportation modes are currently common in the project area?
- What are the challenges of transport problems around this tourist attraction area?
- What kind of alternative shall we consider to alleviate transportation problems in Ethiopia?
- What are the problems that faced during upgrade of the existing roads specially mountains and escarpment section?
- Is cableway transport mode is feasible than roadway transport mode for this specific route from Koladit to Gishen Mariam?

1.5 Significance of Research

The results of the study will be of great benefit to the following:

- Can provide additional transport dimensions within the country and complementary solution that could help many isolated hillside residents access jobs and opportunities in the country.
- The result of the study will help the decision makers to have possible number of options on transportation system for comprehensive alternative planning process.
- Helps to provide information regarding cable car current practice in the world as well as in Ethiopia.
- In addition, tourism industries will have an alternative means of transportation for connecting tourism attraction areas.

1.6 Application and Limitation of the Study

The result of this study can be applied a cable way transportation mode to replace or to consider as an alternative with that of roadway transportation system around tourist attraction places, religious areas and places with difficult terrain type to construct roads.

The research will mainly focus on feasibility study to compare cableway with that of roadway construction on Koladit Junction to Gishen Mariam Church route which is located in northern part of Ethiopia around 482 km from Addis Ababa.

The cableway transportation mode is new to Ethiopian transportation mode. Hence, construction cost will be estimated in per Km adapting from some other countries that has already designed cableway transportation system and has similar characteristics with our location. In additions, feasibility study/cost benefit analysis made by HDM-4 however, software is manly designed for road constructions. Hence, for the study purposes it has been adjusted all inputs to suite for cable car construction.

CHAPTER 2 LITERATURE REVIEW

2.1 History of cable car in the world

Before 19th centuries, traditional means of transport which is ropeway were used like wood or woven from animal skin or plant fibers to pass rivers and gorges as show in the figure below.[17] Such early ropeways have been found in Ethiopia, China, Japan, Brazil, New Zealand, and Indian. In mid-19th, ropeway appeared as a modern transport mechanism and starts differentiated between passenger and cargo transportation. The first urban cableway was built in Lyon, France in 1862, where the three-car trains carried up to 324 people.[42]

From 1907, the experience acquired with the intensive use of similar systems for goods began to be applied to the construction of modern aerial cableways for passengers. In 1908, the first ropeway for passenger transportation in Central Europe, “Kohlernbahn” was built in Bozen, Italy, by Leinter. [42]

Since 2004 Colombian Medellin, “Metro cable” car was opened for traffic and then urban cable cars have grown in popularity around the world. Recent cable car projects mainly considered to serving those poor hillside neighborhoods, many of which were poorly connected to the rest of the city and underserved by conventional transport services. Connecting hilly areas to urban centers by aerial cable cars can bring considerable travel timesaving and other socio-economic benefits due to direct linkages and the absence of constraints from road traffic. This can be seen from recent projects in Medellín, Rio de Janeiro, Caracas, Guayaquil, Santo Domingo, La Paz, Yeosu, South Korea, Taiwan, Hong Kong, **Cape Town** and London. Sometimes especially places that have geographical barriers such as hills and rivers, Cable cars make other modes infeasible. [19]

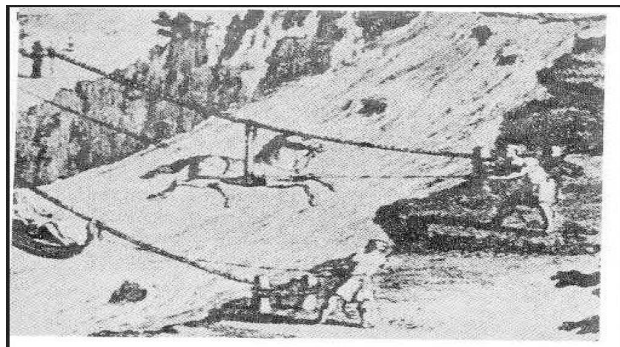
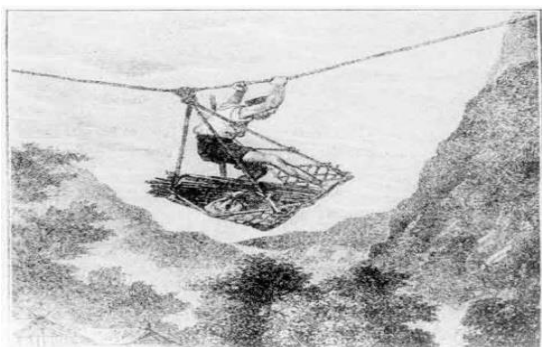


Figure 2-1 Traditional means of roadway in ancient times

Some of the world country’s experience that has used an alternative means of transportation modes that could overcome difficult terrain type with high seasonal traffic are illustrated in the following sub section.

2.1.1 Venezuela’s Mérida Cable Car

Venezuela’s Mérida Cable Car is one of the second longer cable car with 12.5km long and was constructed before 40years and closed in 2008. After modernizing and fixing mechanical installation, a recent model of cable car was launched in October 2016 again. This cable car connects the city of Merida and the Espejo peak and create access along the rugged terrain. [43]

This cable car gives access to the most beautiful Venezuelan mountain, unique landscape in the world, and facilitate the movement of tourists.



Figure 2-2:-Venezuela’s Mérida Cable Car

2.1.2 South Africa’s, Table mountain Aerial cable way

The Table Mountain Aerial Cableway is a cable car transportation system offering visitors a five-minute ride to the top of Table Mountain in Cape Town, South Africa. It is one of Cape Town's most popular tourist attractions with approximately one million people a year using the Cableway.[15]

At the top of Table mountain with an elevation of 1,067meters offers over view of Cape Town, Table Bay and Robben island north, and the Atlantic seaboard to the west and south

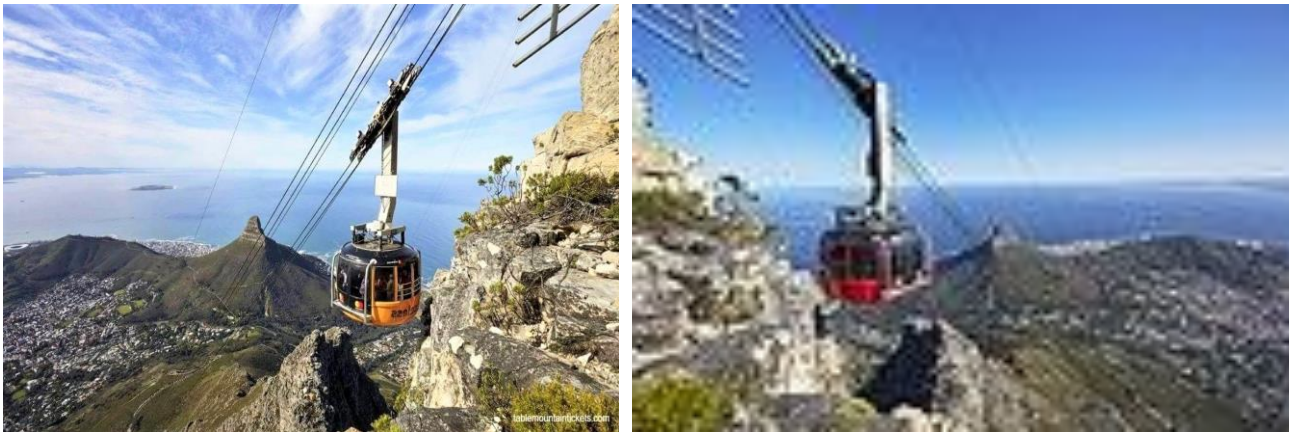


Figure 2-3 Cape Town, South Africa Cable Car

2.1.3 Switzerland, Stanserhorn Cable Car

The Stanserhorn is a mountain in Switzerland, located in the canton of Nidwalden near to the border with Obwalden, with the peak at 1,898 meters above sea level. It is a popular tourist destination, which can be reached from the adjacent town of Stans by a cable car, or via walking routes from Stans.



Figure 2-4 Stanserhorn, Switzerland

As shown in the above sub sections, Venezuela, south Africa and Switzerland installed cable car to connect isolated place and as the same time they have used the cable car as means of tourist attraction.

2.2 History of cable car in Ethiopia

It is difficult to get literatures regarding the history of cable car/rope way transportation system in relation to its past application in Ethiopia. In limited literatures, states that for centuries, pilgrims/tourist used leather rope to climb 15m cliff to reach to Debredamo monastery. Debre Damo monastery is situated on an isolated mountain in northern part of Tigray and only accessed by leather rope. Debre Damo was built, in the sixteenth century AD, with curved wood panels, painted ceilings

and walls dedicated to the legend of Saint (Abune) Aregawi.[21]. Hence, Ethiopian has a traditional cable car experience for centuries.

As shown in the figure below, this is the oldest cable way/ropeway transportation system used since 16th century and still peoples are using it to get to the monastery.



Figure 2-5 History of Rope way transportation system

Source: focusedcollection.com



Figure 2-6 Debre - damo monastery church

Source: africanarguments.org and focusedcollection.com

According to Solomon Yimer stated on eitho news, SWIG Railway Company presented the idea of building a commercial cableway to the Ethiopian Minister of Transport two years ago. According to the company, cable car construction has competitive advantages over railway and road construction method. Indeed, it significantly reduces the land use for roads and infrastructure and helps to access communities which are found on difficult terrain type. The company intends to finance the development of its project through public-private partnerships in which the public can invest. [22]

Currently, because of the expansion of cities, increasing in number of population, establishment of recreational areas on mountainous section, complication in ROW issues in towns might need cable car in the future.

2.3 Cable car purpose and use

Cable car transport is carried out using aerial cable cars, surface lifts, and funiculars (Doppelmayr 1997). With ski lifts and funiculars (or funicular railways), passengers are carried above ground level; with aerial cable cars, passengers are carried in the air.

Furthermore, cable way can provide the following services.

- i. Transportation alternatives and traffic jam alleviation. Cable way systems can overcome landscape barriers and directly connect tourist attractions and major transportation hubs. They can also be used to create new transportation routes, effectively replacing and sharing the burden of existing roads, while expanding the capacity of transportation services.
- ii. Connection services between recreational hotspots. Cable cars can systematically connect hotspots and recreational resources, thus saving time and travel costs between hotspots, increasing journey flexibility, and diversifying recreational activities.
- iii. Outdoor scenery and recreation. Introducing cable cars can provide a completely new perspective for viewing scenery and enjoying recreational activities, enabling tourists to appreciate unique natural views and scenery from the air.
- iv. Environmentally-acceptable electric drive and the possibility of transporting passengers above the ground, which can provide additional transport dimensions within urban centers.
- v. No exhaust emissions
- vi. Cable car speed limited to 12 m/s or 43,2 km/h with max capacity of 4000 person/h
- vii. The problem of right of way will decrease drastically since the cable car will be above the ground
- viii. Cable car systems can be applied to transportation of goods in addition to passengers.

2.4 Capacity of cable car

According to operating principles, aerial cable cars are divided into aerial tramways and gondolas. Aerial tramways (jig-back ropeways, reversible aerial ropeways) transport passengers using one or two cabins that move back and forth on cables. Their maximum speed is 12 m/s or 43.2 km/h.[44] With only two cabins, they can overcome greater inclines than gondolas, the span between the towers can be extraordinarily long (more than 1 km) so they can overcome major gaps and heights, and they are suitable for distances up to 3 km. The cabins stop completely at stations, so passengers have enough time to enter or exit. As only two cabins are available, they have small capacities (200 persons per

cabin, max. 2,000 persons/h), and the average waiting time of passengers at the station is longer; the times of entry and exit (stay times) also are longer than gondolas. Gondolas are uni-directional aerial cable cars with circulating vehicles (cabins). They consist of several cabins that can carry up to 30 persons each and have greater capacities than aerial cars, up to 4,000 persons/h. The speed is slower than aerial cars, with a maximum of 7 m/s for bi-cable gondolas and a maximum of 6 m/s for monocable gondolas.[44] Dwell times are shorter than aerial cars, as the cabins are smaller. Passengers do not need to wait for the vehicles at the station, as the vehicles constantly come and go. The spans between the towers are smaller than aerial tramways because there is more than one vehicle on the rope at a time and the lengths of gaps and precipices over which cabins can travel are smaller than for the aerial tramways. When at a station, cabins do not stand still but move slowly through the station, which can make it difficult for persons with disabilities and older adults to enter. Time of entry into the cabin is limited depending on the speed and length of the platform. Gondolas are the more suitable for public passenger transport, which requires maximum capacity. Aerial tramways are faster; the speed of a gondola—21–25 km/h—is less than the average speeds of buses in urban centers. The speeds of cable cars are low but, in the case of gondolas, the vehicles come constantly into stations and passengers do not need to wait.

2.5 Technology, Characteristics and Implementation

ART is a relatively new transit mode that is yet to be fully understood and documented in the research and professional communities. Therefore, it is important first to understand the characteristics and features of this technology, in order to later define its role and possible application areas. The main manufacturer of urban ART systems Doppelmayr/Garaventa Group, Leitner Technologies, and Poma Group. The basic components of any ART system include carriers (cabins), a drive and a return terminal, towers (to support ropes between terminals and stations), and ropes (which may be haulage or track ropes).

At the present time, ART technologies that have been used as mass transit modes in urban areas include five technologies:

- Aerial Tramways,
- Dual-Haul Aerial Tramways
- Monocable Detachable Gondolas (MDG),
- Bicable Detachable Gondolas (BDG) and
- Tricable Detachable Gondolas (TDG).

An aerial tramway consists of two passenger cabins that are suspended on a track rope and pulled by a haulage rope. These cabins typically, but not necessarily, reciprocate between terminals and pass each other midway on the cable span. In detachable gondola systems (i.e. MDG, BDG and TDG), the stations include an area where each gondola is detached from the ropeway; decelerated to a speed slow enough for boarding and disembarking; and then accelerated, allowing for the reattachment of the gondola's grip to the haulage rope. Safety systems include electronic monitors and mechanisms that automatically bring a gondola to a halt if the detachment or attachment of grips fails. The three types of detachable gondolas operate similarly; however, the BDG and TDG systems have one and two track ropes, respectively, and have improved stability and higher maximum speeds.

2.6 Mode of Transport Selection Criteria

Different transportation mode are exists around the world, and road transport has dominant position. Some of the criteria are used to select the mode of transport during pre-feasibility stage. Transport planners shall consider the following criteria's to select the suitable mode of transport for specific location. Some of the criteria's are stated below.

- Social
- economic activities of the area
- Cost (construction cost and running cost)
- Time (construction time and traveling time)
- Flexibility
- Environment: Terrain type
- Safety
- The number of traffic (passenger and goods)
- Other

2.6.1 Social (Demography, school and health center)

Number of People in transport project areas with their age limits must be considered to select the type of transportation mode, including the number of schools and health center must be identified.

2.6.2 Economy

Economic benefit to the area must be clearly identified to or selected the mode of transport. GDP contribution components like the amount of agriculture, industries like manufacturing and construction and service like tourist attraction place must be considered to select the type of mode of transport.

2.6.3 Environment

Ecosystems (forestry coverage, types of plant species, carbon emission, soil erosion, etc.) have to be identified to select mode of transport. Including the type of terrain along the project corridor must be identified before constructing the transportation mode or infrastructure.

2.7 Mode of Transport

Transportation or Transport is the movement of people, goods and animals from one location (origin) to another location (destination); could be horizontal, vertical or both. Transportation must be safe, convenient, comfortable, cost effective and sustainable.

Hence, in order to create access and mobility, transportation modes are used all over the world. Some of the common transportation modes are road, railway, water, cable, and space. Transport modes are designed to carry either passengers or freight, but most modes can carry a combination of both. Different modes have varying processes and information requirements. This partly branches from different infrastructures, different capabilities for handling larger or smaller amounts of cargo, but also from different international, national and even local regimes for a specific mode.

2.8 Method to Select Mode of Transport

Cost benefit or Feasibility study will be taken to select the transportation mode using different models based on the type of traffic existed in the area. The following subsection illustrate the models

2.8.1 Traditional Method

Data are collected from Pertinent government offices at different levels, nationally and regionally; Farmers in project areas; and Development and research offices, nationally and regionally.

2.8.2 Red Model

RED Model is developed to improve the decision-making process for the development and maintenance of low-volume rural roads.

2.8.3 HDM-4 Vehicle Operating Costs Module

The approach in conducting economic feasibility studies of existing roads and the sources of benefits are generally, Vehicle operating cost savings, Time savings, Congestion costs savings, Accident costs savings, Environmental benefits, Social (health, education, etc) Savings Etc.

2.9 Method for Determining sample size

There are several approaches to determine the sample size such as

Census for small population:- this method use the entire population as sample and helps to eliminate sampling error. This method is expensive and provide data on all the individuals but and makes it impossible to use for larger population. This method would be very effective when the number of population is small less than 200.

Using a sample size of a similar study:- this method recommends to use same sample size as those of studies similar to the one we planned. This method has risk of repeating the errors that were made in determine the sample size for another study.

Using Published Tables:- this method relay on published tables which provide the sample size for the given set of criteria. These sample sizes reflect the number of obtained responses, and not necessarily the number of surveys mailed or interviews planned (this number is often increased to compensate for nonresponse).

- Using formulas to calculate a sample size:- different kinds formulas were applied to determine the sample size.

$$n_0 = (Z^2pq)/e^2 \dots \dots \dots (1)$$

- Simplified formula for proportion:- Yamane provides a simplified formula to calculate sample sizes with the following formula. The formula stated in equation 2 below is Slovin's formula were n =size of the sample, N =Number of populations and e =error tolerance level

$$n = N/(1 + N(e^2)) \dots \dots \dots (2)$$

2.10 Impact of road construction on the environment

2.10.1 Effects on wildlife

2.10.1.1 Distraction of habitat

Roads can act as barriers or filters to animal movement and lead to habitat fragmentation. Many species will not cross the open space created by a road due to the threat of predation and roads also cause increased animal mortality from traffic. This barrier effect can prevent species from migrating and

recolonizing areas where the species has gone locally extinct as well as restricting access to seasonally available or widely scattered resources. [29]

The presence of roads also decreases the amount of habitat accessible to species. This is to say that it decreases the amount of usable habitat available to organisms without crossing a road. That being said, whether a habitat on the other side of the road becomes inaccessible to an organism or not varies between species. Roads are a permeable barrier to some organisms and impermeable to others. [32]

2.10.1.2 Effect on Birds

The traffic load near large cities may show dramatic cyclical changes induced by weekend tourism, and this could induce cyclical changes in the activity patterns of birds. Road implantation may also lead birds to avoid certain sites, as they are seen as being less habitable (because of increases in noise and chemical pollution). Certain bird populations may then become confined into smaller habitable sites, leading to an increase in possibility of extinction caused by illness or habitat perturbation. [30]

2.10.1.3 Facilitation of poaching of flora and fauna

Roads that run through forests that house edible animals may encourage or facilitate poaching. Especially in poor areas, the construction of roads has promoted not only poaching for personal consumption but also for sale (for consumption or as a pet) to third parties. Similarly, the construction of roads in forested areas has also promoted illegal logging as it becomes easier for illegal loggers to transport the wood.[31]

2.10.1.4 Roads as Barriers

Roads can impede animal movements by direct mortality or avoidance behavior. The barrier effect varies between species, road types, and adjacent habitat quality; however, traffic volume and speed strongly influence the effect. Some authors have suggested that divided highways with 90 m of cleared areas, as barriers are as effective as bodies of water twice as wide in obstructing dispersal of small forest mammals.[50]

The barrier effect for some species is less related to traffic than to habitat changes (road-forest edges and gap creation caused by roads). Small road clearances (less than 5 m) can impede movement of certain small mammals. Barriers to the movement of wildlife can lead to fragmentation of populations. Isolation caused by physical barriers to movement, such as roads, may reduce gene flow, thus causing genetic effects that in the extreme could result in local extirpation.

2.10.2 Effect on the quality of air

The air quality will be affected since the beginning of the road constructions by dust, noise and emission of gases from heavy equipment. Perhaps, Nitrogen Oxides (NO_x), fine Particulate Matter (PM_{2.5}), Volatile Organic Compounds (VOCs), Carbon Monoxide (CO), and Sulphur Dioxide (SO₂) are the most common air pollutants emitted by vehicles. Then after the road complete and open to traffic, emissions include particulate emissions from diesel engines, NO_x, volatile organic compounds, carbon monoxide and various other hazardous air pollutants including benzene. [33] Carbon dioxide is non-toxic to humans but is a major greenhouse gas and motor vehicle emissions are an important contributor to the growth of CO₂ concentrations in the atmosphere and therefore to global warming. [35]

Noise pollution is a factor of environmental degradation that is often overlooked and typically seen as not having a significant effect, though traffic noise can contribute to numerous disturbances for wildlife. An increasing number of studies have been done on the effects of noise on wildlife. Both the sounds made by motors and the wind over moving vehicle structures, and the ultrasonic vibrations transmitted through the air and ground from vehicle passage can overlap with the frequency ranges and amplitudes used by animals for communication.[27]

2.10.3 Impact on water bodies

The surface water runoff and the groundwater close to a construction site become polluted with various materials used in the construction work. As described for air pollution above, the following construction contaminants can pollute the water: VOCs, paints, glues, diesel, oils, other toxic chemicals, and cement. The immediate effect is creating turbidity in the runoff water and affected surface and groundwater (since some of the runoff water may infiltrate in the subsurface reaching the groundwater).

De-icing chemicals and sand can run off into roadsides, contaminate groundwater and pollute surface waters. Road salts (primarily chlorides of sodium, calcium or magnesium) can be toxic to sensitive plants and animals. Sand can alter stream bed environments, causing stress for the plants and animals that live there. Several studies have found a definite difference in physical properties of waters between catchments or hydric systems immediately adjacent to roads compared with those in environments further away from the studied roads. De-icing chemicals, salt, chlorides and the nutrients brought by particulate pollution such as nitrogen (N) and phosphorus (P) can trigger trophic cascades in adjacent waterways.[36]

In fact, both ground waters below your home and surface runoff close to your home may constitute a source of pollution emanating from the construction sites. Domestic animals and pets may drink contaminated water and soil may become contaminated too. Additionally, once the groundwater below your home becomes contaminated, it may affect you in the following ways: through direct consumption if you use water from a property well, and indirectly by affecting the quality of your indoor air (vapor intrusion of the volatile contaminants from water). Overall, water pollution from construction sites is underestimated and has potential to generate severe environmental problems.

2.10.4 Impact on soil

Soil at and around a construction site may become contaminated due to air transport followed by deposition of construction contaminants (listed at air pollution) as well as water runoff of construction contaminants (as listed for water pollution). Soil may constitute a sink for pollutants and some of those may accumulate in soil and persist over longer periods of time (e.g., PAHs).

Landslides, Physical disturbance can disrupt ecological systems, and roads promote such disturbances. For example, roads in mountainous areas can create landslides due to unstable soil and steep slopes. Paved road surfaces can increase water discharge rates in watersheds, thus increasing the potential for landslides and flash floods in streams and rivers.

2.10.5 Local Climate Effects

Roads interact with climate at a wide range of scales. At local scales, highly developed areas (urban centers) have been shown to experience an increase in temperature in a process called the urban-heat-island effect. Urban heating can also result in increased rainfall. [22]

Roads change the albedo (fraction of light reflected by a surface) and other surface characteristics, but other structures, such as buildings, parking lots, and sidewalks, also contribute to heat-island effects.

Local climate might also be affected simply by the presence of roads and associated development. The loss of pervious surfaces and vegetation and their replacement with impervious surfaces that hold heat and do not respire result in localized temperature increases. Temperature increases can result in increased volatilization of organic contaminants from vehicular emissions.[38]

CHAPTER 3 RESEARCH METHODOLOGY

3.1 Introduction

This research on cost benefit analysis between cable car and roadway is the aim to identify alternative means of transport mechanism for transportation corridors that have natural or man-made barriers in general and from Koladit junction up to Gishen Mariam Church in particular. Quantitative and qualitative methodologies has been utilized in researches in order to get a quantitative understanding of the interest of the people to use cable car or not and to identify the personal feelings and experience of respondents in the research process. This will enable the researcher to grasp perceived changes from the participants own view. The study will also employ quantities research methods for analysis of the road cost and benefits and number of road users based on secondary sources.

This chapter discusses the methodology used in order to achieve the objectives of the study and deals with the clear-over view about the study area, method of data collections and how the data was selected and organized. It also contains detailed discussion on assumptions made that helps to draw a conclusion.

3.2 Description of the study area

Finding alternative means of transportation was done on the road segments from Koladit junction to Gishen Mariam church that have very difficult gravel road with a combination of steep gradient and winding geometrical characteristics. The start of the project road is 482km away from Addis Ababa along Dessi kutaber asphalt road and then continue up to Gishen Mariam Church with 14km long. Gishen Mariam church located at easting of 539211.3503 and northing of 1273299.3829. The project road has a seasonal traffic and peoples are used 4 wheel drive and public transport. However, the dominant means of transport are non-motorized means of transport. The location of the existing road and the proposed alternative route for cable car construction are shown in the figure 3.1 below.



Figure 3-1:- The existing road and proposed route for cable car.

The proposed route for cable car, to overcome the difficult geometric characteristics, will be 6.52km of total length starting from Koladit to Gishen Mariam church in a different route from the existing road alignment.

As shown in the plan profile in Appendix 5, the Gishen Mariam church located 2,840m above mean sea level and the elevation difference from the start of the project road, which is Koladit junction up to Gishen Mariam church, is 1009m. In additions, the terrain classification shows dominantly mountainous and escarpment section.

3.2.1 Travel Time/Journey Time

During the site visit, journey time recorded along the existing road from Koladit Junction to Gishen Mariam Church and the recorded data are found in the table 3-1 below.

Table 3-1:- Journey time Recorded

Timing Segment	Distance, Km	Average Journey Time, min	Average Speed, Kph
Koladit Junction-Gishen Mariam Church	14km	42	20

Sourece:- Findings from site

As the table 3-1 above shows, the average speed along the project road is only 20km per hour and journey time is 0.7 hours. Traffic condition of the area

The project road is intended to connect one of the oldest church in Orthodox religion and the terrain type is very difficult. Hence, because of the difficulty of the terrain, the dominant mode of transport is 4WD and public transports as shown in the figure below. In additions, most of the peoples were using non-motorized mode of transport since public transport will be available during celebration days, which means four times a year.



Figure 3 2 :- Traffic composition of the area. Research Method

3.2.2 Geographic localization of the proposed route

Global Positioning System (GPS) were used to localization of the proposed line (from Gishen junction to Gishen) other than the existing gravel road. This route was selected based on topography of the area, the terrain classification of the road location and the characteristics of the traffic along the route. The proposed route starts at the junction name Koladit junction with the coordinate of X=536543.831 ,Y=1267590.407 and ends at the get of Gishen Mariam Church with the coordinate of X=539211.350 , Y=1273299.382 .

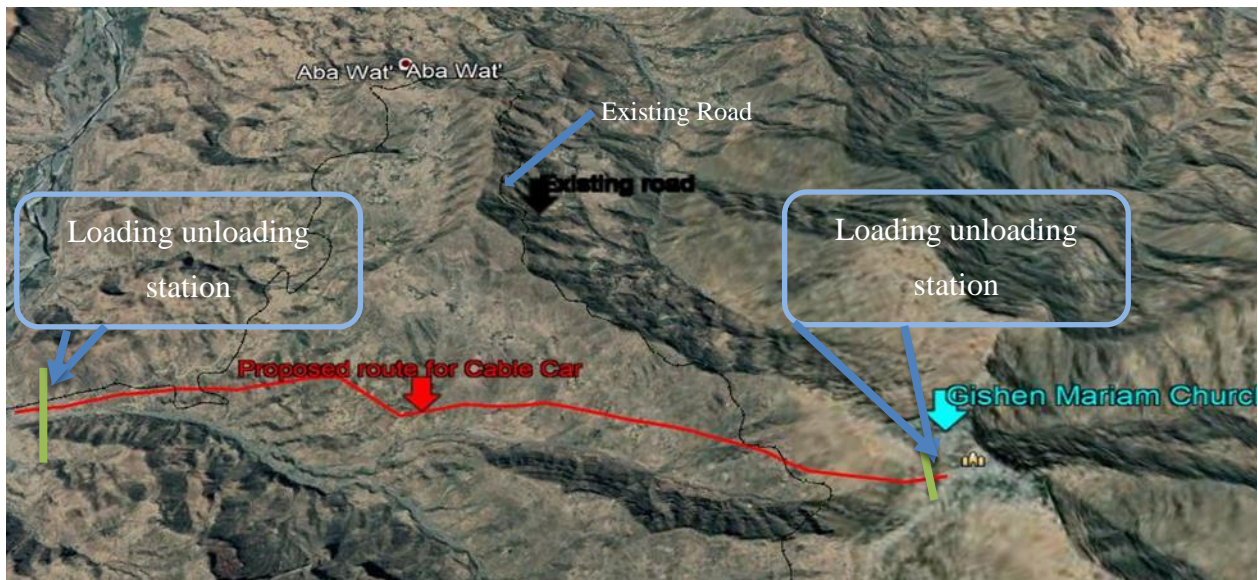


Figure 3-1:-Location of the area

3.3 Data source

The study involves both primary and secondary sources of data. The primary data was collected using qualitative approach with selecting random peoples and pilgrims for filling questioner. Four hundred twenty nine questioner were collected both from peoples living around the road corridors and from pilgrims. The major points of stated in the questioner is age, proximity, trip expectations, means of transport use to came to Gishen Mariam and their interest to use cable car after implementation. In addition, personal observation was also used as a source of primary data collection. This technique is believed to enable to collect more qualitative data as it helps to grasp information that cannot be obtained through interviews. Events observed include nature of road users, the area of parking lots, the location of market place and entrance of the church.

Collection of secondary data is another major source for the study. It involves books, research journals and articles, internet sources, different reports including different road project reports, woreda administration minutes of meetings, policies and manuals were gathered, reviewed and analyzed.

3.3.1 Data collection instruments

3.3.1.1 Questioner

In order to explore, experiences, interest and opinions of pilgrims as well as people living around the project road for using cable car or not is used by questioners. Out of the 427 individuals interviewed,

214 were pilgrims and 213 were peoples living around the area. This tool is used because it permits the researcher to explore the full facts and realities from those who have personally experienced it.

3.3.1.2 Key Informant on questioner

Questioners prepared and distributed randomly at four locations by four students recruited by the researchers during the site visit. On the questioners like age, education background, type of means of transportation used and their willingness to use cable car or not is included. As much as possible, the recruiters tries to distribute the questioners to represent all age group and picked from different mode of transport users. A structured questioner attached in Appendix 4.

3.3.1.3 Researcher's Observation

Field visit was made from March 17, 2021 up to March 21, 2021 to collect data, questioners and to appreciate the existing road condition as well as to identify the route for cable car installation. The traffic count was made on one of the peak season of the area among four peak seasons in a year. The field visit were planned considering “Meskel” celebration held on March 19 every year at Gishen Mariam church and peoples gathered to celebrate from all part of Ethiopia. A considerable amount of peoples were come for celebration, but according to the peoples living around, “Meskel” celebration was the only celebration that have minimum amount of people involved for celebration among four major celebrations.

During the field investigation, the following works were undertaken:-

- The existing roads were tracked
- Alternative routes were selected
- Questioners were distributed and collected,
- Interviews were taken,
- Meeting was held with local administrative and
- Traffic counts were taken

The field visits were done on one of the peak period among the four celebrations and the following points were observed:-

- The condition of the existing road is a very difficult and deteriorated road around 14km length with 7.0m width. Most of the road section passes through mountainous and escarpment.
- The landscape of the area were disturbed because of the road construction.

- Most of the peoples were came for religious purpose, hence there is no normal traffic, the existing traffic were seasonal traffic and the road is dead end.
- The project road has a difficult of parking area around the church. In addition, to expand the parking area it is very difficult because the project road has found at the ridge top.
- Shortage on public transportation was observed,
- According to the people living around Gishen Church, for **October** 1 celebration, getting out from church will take around one full day. As shown in the figure 3.5 and 3.6 the gates of the church from parking area is so narrow only one people can pass at a time.
- The existing road is under construction with total construction of 1,317,000,000 birr
- Based on the information from woreda peoples, the number pilgrims were decreased when compared to last year Meskel celebration. It might be due to COVID 19 and political situation of the area.

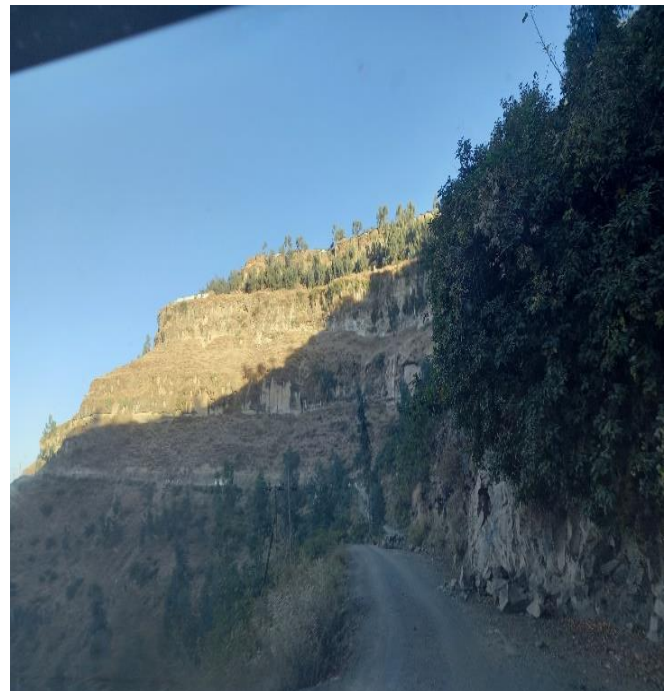


Figure 3-2 :- The condtion of the existing road



Figure 3-3:- the escarpment section of the road



Figure 3-4:- at the entrance of the Gishen Mariam and the location of parking areas.



Figure 3-5:- the entrance of Gishen Mariam

3.3.2 Method of Data Analysis

The qualitative information collected through questioners to assess the social aspects were categorized, checked and verified to identify regularities and patterns of different issues and problems. The interest of the people /pilgrims were fixed and make other questions as variables so that to identify the expectation of the respondent. Quantitative data obtained through different record and documents organized using appropriate format. Using qualitative and quantitative data, economic evaluation is analyzed using conventional method. The study findings were presented in the form of narration, cases and tables. Pictures and maps are also provided to supplement the outcome of the study.

3.3.2.1 Determination of sample size

Among different method of determining sample size, Yamane formula/equation were selected to determine the sample size of the populations. Since our population is finite and sample size can be estimated using simplified equation illustrated on equation number 3. This formula used to calculate the sample sizes with 95% confidence level and with .5 precision.

$$n = N / (1 + N(e^2)) \dots \dots \dots (3)$$

n= sample size, N= Population size and e= level of Precision.

$$n = 20000 / (1 + 20000(0.05)^2) \\ n = 392 \dots \dots \dots (3)$$

For our research purpose, based on the woreda people administration, number of pilgrims for Meskel celebration is around 20,000 pilgrims. Hence, the sample size for questioner would be estimated 392 based on Yamane formula.

3.3.2.2 Questioners

Questioners were designed to determine the interest of the community including pilgrims coming for religious celebration regarding the use of cable car to avoid the difficulty of the road from Gishen junction to Gishen Mariam. The data used in the study is obtained from the replies given by the people living around the road and people coming for Meskel celebration on March 19. Hence, simplified formulas called Yemane's equation applied to estimate the total number of people interviewed from both the nearby area and people coming for religious celebration.

A total number of 427 people were interviewed for research that is more than estimated by Yemane's formula in section 3.4 and we have interviewed commuters and peoples living around the project road respectively during celebration with four encoders. Once the data was compiled in a excel file, it could be analyzed using ranking method. This sample size is considered sufficient to perform a ranking method. To ensure the validity and reliability of this research, only complete data on the variables necessary for this study will be used for the sample.

The results from this interview are discussed in detail in chapter 4. Asked how they can feel if cable car present/is brought: many people replied that it could be a better way of public transport (safe, no congestion and quick) but some of the people says they fear of flying/using aerial paths and some people were prefer to use difficult road for getting more blessing. In addition, some people may fear that it might be more expensive than usual buses and taxis.

3.3.2.3 Variables

For the specifics of this case, the response variable is the willingness of the people coming to Gishen Mariam for religious purpose as well as people living around the area to use a cable car, a score of the community would use it and the score of the community would not use it. In our survey, respondents living around the project road and pilgrims coming from different location were asked around 11 and 14 questions respectively. Among the questions, interest of the peoples to use a cable car, age, educations, occupation and proximity are involved.

Hence, the interest of the people to use a cable car would be linked with different variables like with age, education occupation, mode of transport, proximity, frequency road condition and trip expectation and so on and give different score to anticipate the social risk of the proposed alternative or means of transport.

The score or rank were given based on the importance of the factors or influential component to choose cable are or not. For example, age is one of the main factor that will influence the choose of transportation mode. Hence, the score shall be larger or according to my classification, it is very high influential. In addition, mode of transport, proximity and road condition also considered as very high influential factors. The following table shows the weightage given for each variables with its influential factors but the results will be discussed in the next chapter.

Table 3-2:-Influential factors for variables.

Influential factors

Cost Benefit Analysis Of Cable Car Against Roadway (case study of Koladit Junction up to Gishen Mariam Church)

Description	Very High	High	Moderate	Low	Very Low
Rank/score	5	4	3	2	1

Table 3-3:-Score for all variables.

Number	Variables	Score based on influential factors
1	Age	5
2	Religion	2
3	Education	2
4	Occupation	2
5	Mode of Transport	5
6	Proximity	5
7	Purpose	3
8	Frequency	3
9	Road Condition	5
10	Trip Expectation	2
11	Interested in Coming Back	4

Each categories have its own subcategories and stated in the table below.

Table 3-4:- Sub categories for each variables

Number	Category	Score/Weight	Sub categories	Score
1	Age	5	0-18	1
			19-30	2
			31-42	4
			42-62	5
			63-70	5
			71-Above	5
2	Religion	2	Orthodox	2
			Muslim	2
			Catholic	2
			Protestant	2

Cost Benefit Analysis Of Cable Car Against Roadway (case study of Koladit Junction up to Gishen Mariam Church)

			other	2
3	Education	2	Illiteracy	2
			Up to first grade(0-8)	2
			Up to second grade(9-12)	2
			Diploma and above	2
4	Occupation	2	Employee	2
			Merchant	2
			house wife	2
			other	2
5	Mode of Transport	5	Private car	2
			Public transport	5
			foot	5
6	Proximity	5	Around the project road	5
			outside the project road	5
7	Purpose	3	celebration for religious	3
			tourism	3
			family visit	3
			other	3
8	Frequency	3	first time	3
			second time	3
			third time and above	3
9	Road Condition	5	Excelent	1
			Very Good	2
			Good	3
			Bad	5
			Very Bad	5
			worest	5
10	Trip Expectation	2	car accident and problems	5
			tiredness	5
			nothing	2

11	Interested In Coming Back	4	returning back	4
			not returning back	3

3.4 Design principles of both Cable car and Roadway

3.4.1 Introduction

The project road is located in the Northern part of the country, and lies in Amhara Regional State of the Federal Democratic Republic of Ethiopia, particularly in South Wello Administrative Zone, and is entirely located in Ambassel Wereda. The project road starts at around 60km from Desse town on Desse-Kutaber-Wegel Tena road. The road passes through small villages and one Kebele. The total project length is estimated to be around 14km, plus 1.8km spur road and a total of 1.56 access roads to parking areas. In addition, the project includes four parking lots, which are going to part of the overall project. The proposed road construction is shown in the figure below with its design type

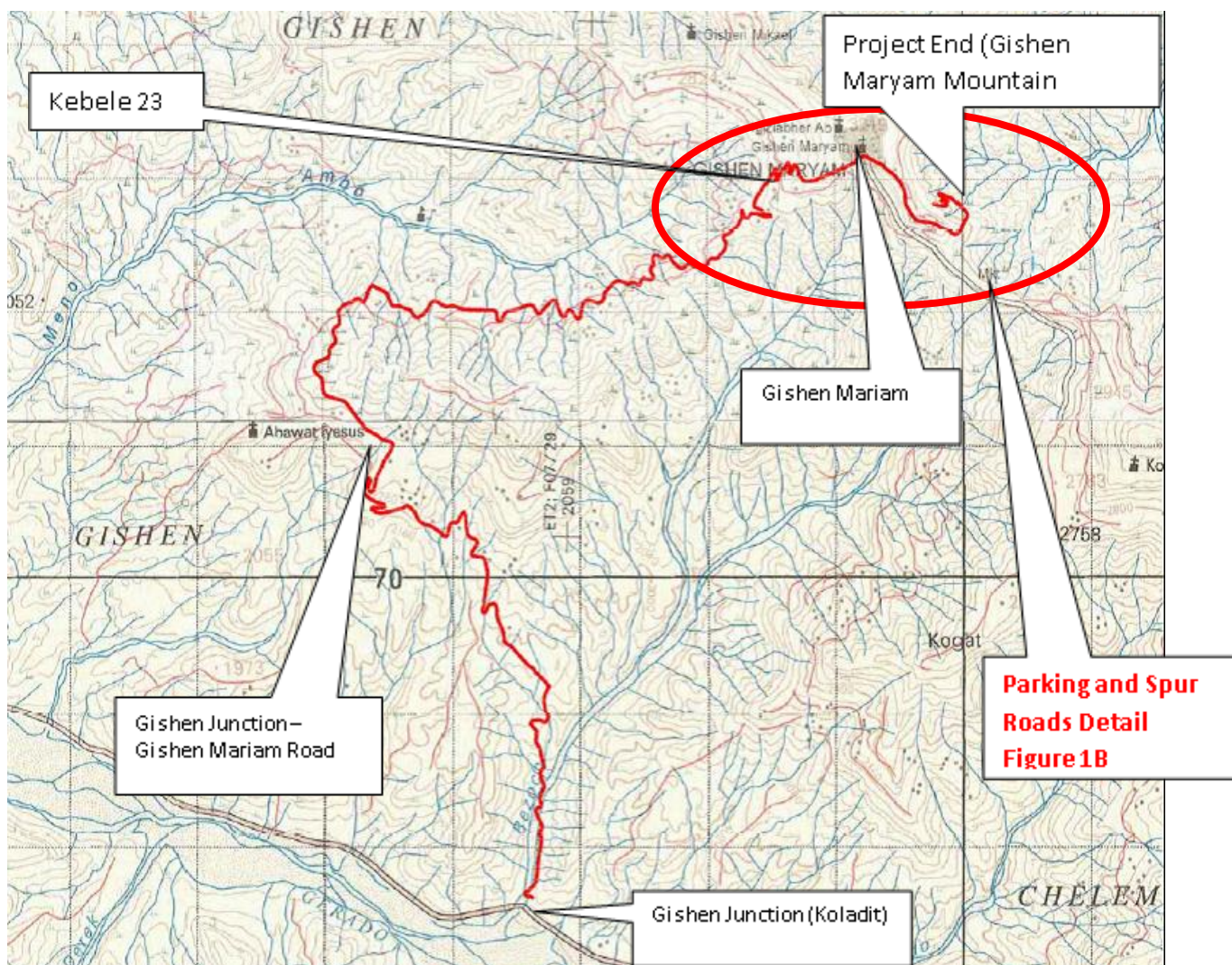


Figure 3-6:- Existing Road way

The total length of the proposed route for cable car is 6km as shown in the figure 3-7 below together with the existing road construction.

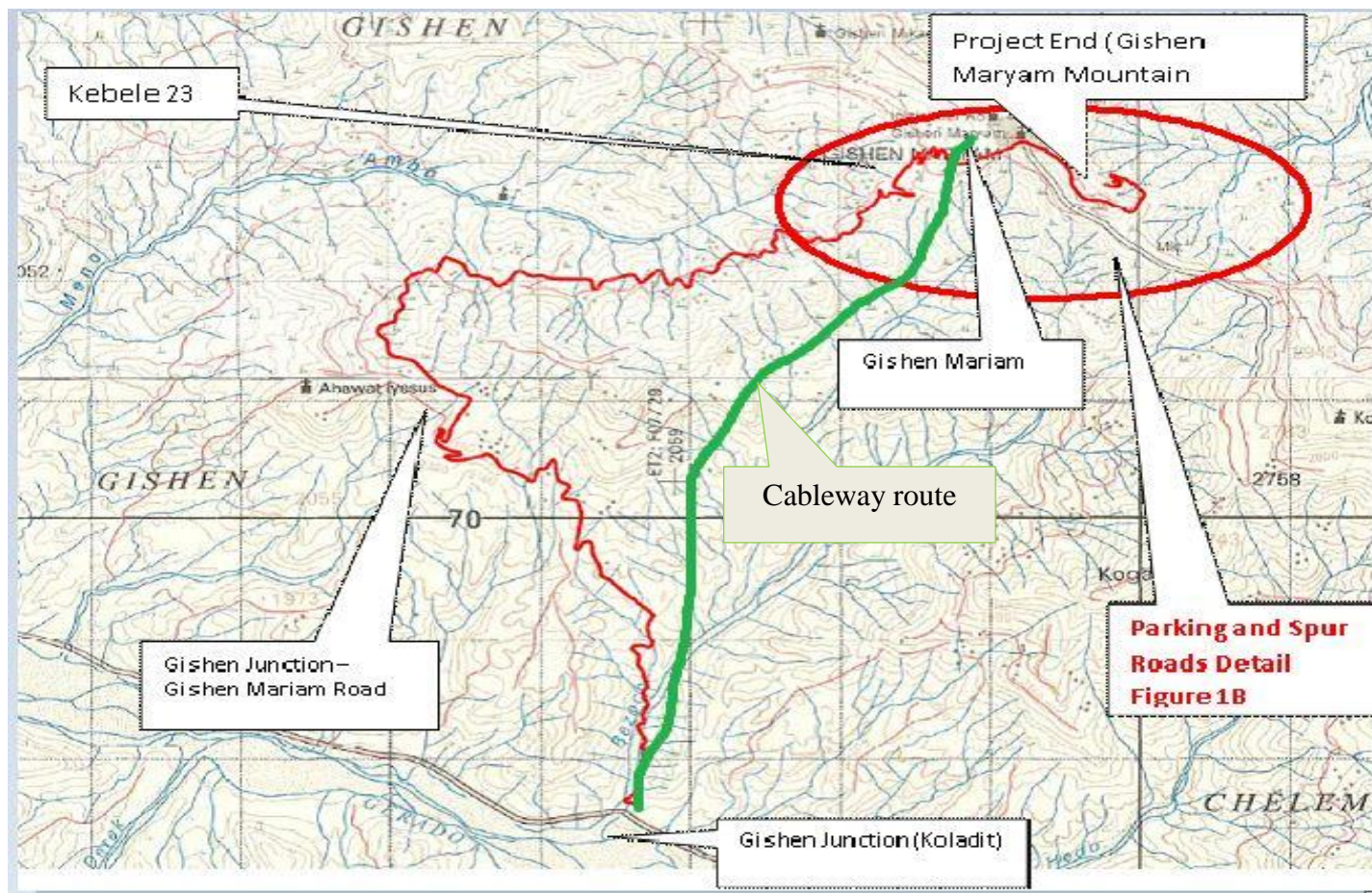


Figure 3-7:- Existing Road way

3.4.2 Proposed design

3.4.2.1 Road construction

According to the traffic study done by Beza consulting engineer’s plc, DC 5 design standard was proposed for the road from Koladit junction to Gishen Mariam church. Hence, in the table 3-5 parameters estimated for DC 5 based on 2013 ERA Geometric design manual.

Table 3-5:- Parameters on design

No.	Description	Limiting values for design
1	Design Class	DC 5
2	Design Vehicle	DV 4
3	Road Functional Classification	Link
4	Present Road Condition	5m wide gravel road from Gishen Mariam Junction(Koladit) to Gishen Mariam Mountain

5	Type of Surfacing	AC for Carriageway and DBST for Shoulder
6	Proposed Carriageway width/cross fall	3.5m/2.5%
7	Shoulder surfacing/width/cross fall	DBST/1.5-0.5/4%
8	Proposed length	14km

3.4.2.2 Aerial cable car

Proposed Aerial cable road construction to connect two points from Koladit junctions to Gishen Mariam church is stated in the table 3-6 below.

Table 3-6:- Parameters on design

No	System Characteristics	Dual Haul Aerial Tramway
1	Aerial Cable car	Dual Haul Aerial Tramway
2	Cable Configuration	Cabins are suspended from two fixed cables and are pulled by another cable
3	Maximum Number of Passenger cabins	2 cabins
4	Maximum Number of station	Can have multiple stations
5	Maximum Distance between Towers	less than 1000m
6	Cabin capacity	High capacity(more than 100Pass/cabin)
7	Maximum Transport capacity	2800 Pass/hr.
8	Speed	Up to 29km/hr.

3.4.3 Estimated Cost

Both construction and maintenance costs are estimated for both cable car and roadway implementations. The method used to estimate the costs are illustrated in the following sections.

3.4.3.1 Estimation of construction cost of roadway

As stated in the table 3-5 above Link road with DC 5 design standard proposed to construct for project road. The cost estimates include earthwork and structural works. Civil work of the infrastructure, installation of cables for the car to hang and loading unloading stations. Hence, the bill of quantities for construction or installation of cable car attached in Appendix 3. Design of the roads were done by Beza consulting Engineers plc three years back and the researcher revised the design as well as total cost by the current market price and found 1,316,700,136.62 birr. Detail cost breakdown is attached in the Appendix 2.

3.4.3.2 Estimation of construction of Ariel cable car

As stated in the table 3-5 above dual aerial cable car proposed to construct for project road. Since it is a new technology for our country, the estimation of construction cost is a bit complex. However, a number of assumption made and illustrated as follows:-

- The design and Construction of intermediate supports and loading and unloading sections considered as piers. Hence, the researcher assumed two station, at the start and end of the route for loading and unloading station and six intermediate supports based on the actual site and the specification of Ariel cable car.
- The implementation of cables for holding the cabins adopted from the cost used to compare cable car with that of skyway construction from Ministry of transport.

Detail cost estimations for cable car attached in Appendix 2 with this report.

3.4.3.3 Estimation of maintenance and operating cost for roadway

Maintenance cost used for the economic evaluations of the expenditure is adopted the current road maintenance cost used by on force/ERA.

3.4.3.4 Estimation of maintenance cost for cable car

The maintenance and operating cost calculated as follows for the implementations of cable car for 20 years. We have adapted the average maintenance and operating cost from four countries by extrapolating the maintenance cost estimated using the number of cabin designed for route from the case study done by World Bank, urban transport specialist in 2020. [52]

The procedures are

- Prepare/select four countries from the case studies and that have similar GDP with our country.
- Convert the price of the maintenance and operating cost(USD) in a year to per km
- The price of maintenance per km is in USD than changed with the rate of 45 on date august 22,2021
- Then extrapolate maintenance and operating cost per km for Ethiopia using number of cable car cabins.

The following figure shows that the maintenance of cable car in Colombia, Brazil, Equator, Bolivia and extrapolate for our case.

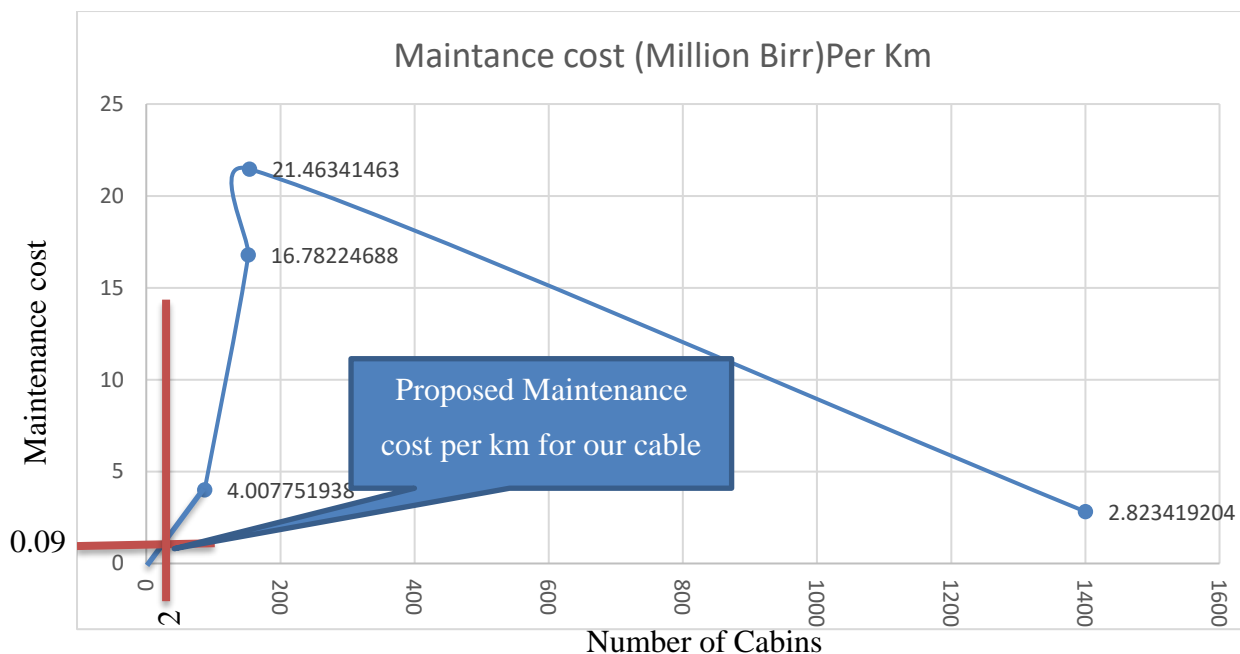


Figure 3-8:- Maintenance cost estimated

Table 3-7:- Maintenance and operating cost for four countries

	Open for Traffic	No of cars	Capacity (passenger/unit)	Speed (m/s)	Travel Time (min)	Capacity (passenger/hour/direction)	Length (km)	Maintenance cost (Million USD)	Maintenance cost (Million USD) Per Km in every year	Maintenance cost (Million Birr) Per Km
Colombia, Manizales aerial cable car Colombia	2009	87	10	5	4.75	8500	2.58	0.235	0.091	4.01
Brazil	2011	152	10	5	17	2800	0.721	0.275	0.381	16.78
Ecuador	2020	154	10	5	20	40000	4.12	2	0.487	21.46
Bolivia	2014	1400	10	5	12.37	29000	30.5	1.957142857	0.064	2.82

Source:- urban transport specialist in 2020

Based on the above figure 3.8 and table 3.6 the maintenance and operating cost extracted for our cable car implementation and cost benefit analysis, the final output illustrated in the table 3.7 below.

Table 3-8:- Estimated Maintenance and operating cost for cable car

Description	Total Maintenance and operating cost	Maintenance and operating cost per km
Cable car from Koladit junction to Gishen Mariam Church.	617,285.93	92,132.23

Source:- Researcher Implementations.

3.4.3.5 Estimation of Tariff for Cable Car

Calculation of fair for the transportation of cable car shown in these subsections.

The procedures are

- Calculate total construction cost and distribute for 20years.
- Estimate total maintenance cost for every year considering the overall inflation rate. As per statistics agency forecast, the inflation rate from 2022-2026 will be 8.04.[52]
- Sum up the capital cost and maintenance cost for each year
- Calculate the total number of traveler every year considering the growth rate of 2.6%. Growth rate estimated adopted from statistic agency.
- Then to get the fair price that can cover the expense, divide the summation of capital cost and maintenance cost by the number of Travers.

The following table will illustrate the procedure described above.

Table 3-9:- estimation of fair for the transposition of cable car

Year	Discounted Capital Cost	Maintenance cost	Total cost (Maintenance and Capital Cost)	Number of traveler	Fair price estimated
1.00	15564697.50	617285.93	16181983.43	288600.00	56.07
2.00	15564697.50	669137.95	16233835.45	296103.60	54.82
3.00	15564697.50	725345.54	16290043.04	303802.29	53.62
4.00	15564697.50	786274.56	16350972.06	311701.15	52.46
5.00	15564697.50	852321.62	16417019.12	319805.38	51.33
6.00	15564697.50	923916.64	16488614.14	328120.32	50.25
7.00	15564697.50	1001525.64	16566223.14	336651.45	49.21
8.00	15564697.50	1085653.79	16650351.29	345404.39	48.21
9.00	15564697.50	1176848.71	16741546.21	354384.90	47.24
10.00	15564697.50	1275704.00	16840401.50	363598.91	46.32
11.00	15564697.50	1382863.14	16947560.64	373052.48	45.43

Year	Discounted Capital Cost	Maintenance cost	Total cost (Maintenance and Capital Cost)	Number of traveler	Fair price estimated
12.00	15564697.50	1499023.64	17063721.14	382751.85	44.58
13.00	15564697.50	1624941.63	17189639.13	392703.40	43.77
14.00	15564697.50	1761436.73	17326134.23	402913.68	43.00
15.00	15564697.50	1909397.41	17474094.91	413389.44	42.27
16.00	15564697.50	2069786.79	17634484.29	424137.56	41.58
17.00	15564697.50	2243648.88	17808346.38	435165.14	40.92
18.00	15564697.50	2432115.39	17996812.89	446479.44	40.31
19.00	15564697.50	2636413.08	18201110.58	458087.90	39.73
20.00	15564697.50	2857871.78	18422569.28	469998.19	39.20
Average fair price adopted=					46.52

Source:- Researcher Implementations.

3.4.4 Estimation of Traffic Demand

3.4.4.1 Traffic for cable car

During the meeting with local peoples and the minutes of meeting signed by local administration and Beza Consulting Engineers Plc, a huge amount of seasonal traffic were encountered 4 times in a year and above 20,000 vehicles were recorded each day. The minutes of meeting with local peoples were attached with this report in APPENDIX 01. Almost all peoples were coming for religious celebration since; Gishen Mariam is one of the oldest church in Orthodox thewahedo. In addition, the orthodox believes that going to Gishen Mariam considered as going to holy city of Cristian, which is Jerusalem and they think that Jesus cross were kept here. Moreover, the name of the Gishen Mariam church also called Dagme Eyerusalem in Amharic words, which means another Jerusalem in Ethiopia.

The procedure used for estimating traffic for Cable car is as follows

- Consider the traffic estimated by Beza Consulting engineer's plc to use it as reference for estimating percentage composition of each vehicles.
- Take in to consideration of percentage composition only for utility and public transportations.
- Multiply each vehicle composition by the total number of traffic estimated by the woreda administration.
- Then determine the number of peoples coming for celebration by the multiplying the loading capacity of each vehicles categories.

Table 3-10:- AADT for Gishen Mariam

Descriptions	L/Rover	S/Bus	L/Bus	Total
Total AADT @2021 estimated by Beza Consulting	164	3	5	172
Percentage composition	95%	2%	3%	1
Total estimated traffic by local administration 20,000	19,070	349	581	20,000
Total People traveled	76,279	4,186	20,349	100,814
55% of the total Pilgrims	41,954	2,302	11,192	55,448
25% of Pilgrims as shifted traffic	19,070	1,047	5,087	25,204
Total Estimated traffic	61,023	3,349	16,278	80,651

Source:- from Beza Consulting engineers PLC and Researcher estimation

For the research purpose, a number of assumptions were taken to model the financial statues of the alternative transportation mechanism.

- Pilgrims start coming to Gishen Mariam Church for religious celebration 4 days before the actual celebration day.
- Cable car technology were new to the country and their might be a huge amount of modal shift will be experienced after installation. Hence, 25% of uninterested pilgrims will divert from roadway to cableway construction after the cable car was installed.
- The percent of estimated pilgrims that are interested to use the cable car were adapted or estimated from questioner.
- Total estimated traffic were adopted from the meeting held by Beza consulting Engineers plc with local administrative on 2018.
- The rise and fall geometric design parameters that will be used in the HDM-4 are estimated the rise and fall of the cables that the cables is travelling
- The electric power will be used from Gishen substation, since 33kv lines exists
- Construction cost was adapted from Medellin cable car and modified to suit for our country and total cost of construction of cable car is estimated 65million per KM. This is a rough estimation and the cost of construction will be dependent on the condition terrain, climate conditions availability of spaces, structure engineering networks communication and so on. The detail estimated Bill of quantities are attached in Appendix 2.

CHAPTER 4 RESULTS AND DISSCUSSION

4.1 Social Assessment

The descriptive statistic of the response variables shown in the following figures. The questioners were distributed among the people living around the area as well as pilgrims, it is important to evaluate if the type of affiliation is a significant variables to predict the probability of the willingness to take a possible aerial tramway. The questioner have 14 questions for pilgrims and 11 questions for the people living around the area. The questions tries to identify the age, religion occupation mode of transport used, proximity, purpose of travel, trip expectation and the interest to the people coming back and so on. Hence, the analysis was done by fixing the interest of using cable car with that of all variables like interest of the people-using cable car and with age, interest of using cable care with religion, the condition of the road and so on. The analysis for incorporating the willingness to take a possible cableway transportation mode will be illustrated in the following subsection.

4.1.1 Age related to interest of the people using cable car

Age group of respondents ranged from age of 18 up to 75 and we have categorized in two 5 sections. The searcher thinks that age is the main factor to choose the mode of transport hence; it has a score of 5 (very high).

As shown in the figure 4.1 among the pilgrims, 19-30 age groups are willing to use the cable care with total percentage of 31.6% and 13.21% were uninterested. Then age group of 31-42 were 10.38% is willing to use and 26.89% were not willing to use. In addition, in the figure 4.2 shows among the local peoples, age group, 31-42 and 19-30 age groups are willing to use the cable car with total percentage of 19.53% but 31-42 age groups, 10.7% were uninterested and with age group 19-30, 9.30% were uninterested. Then age group of 43-62, 7.44% is willing to use and 5.58% were not willing to use.

As the number shows 19-30 age group is more interested to use cable car, this is because this age group is very close to technologies and they are more willing to try new technologies than other age groups.

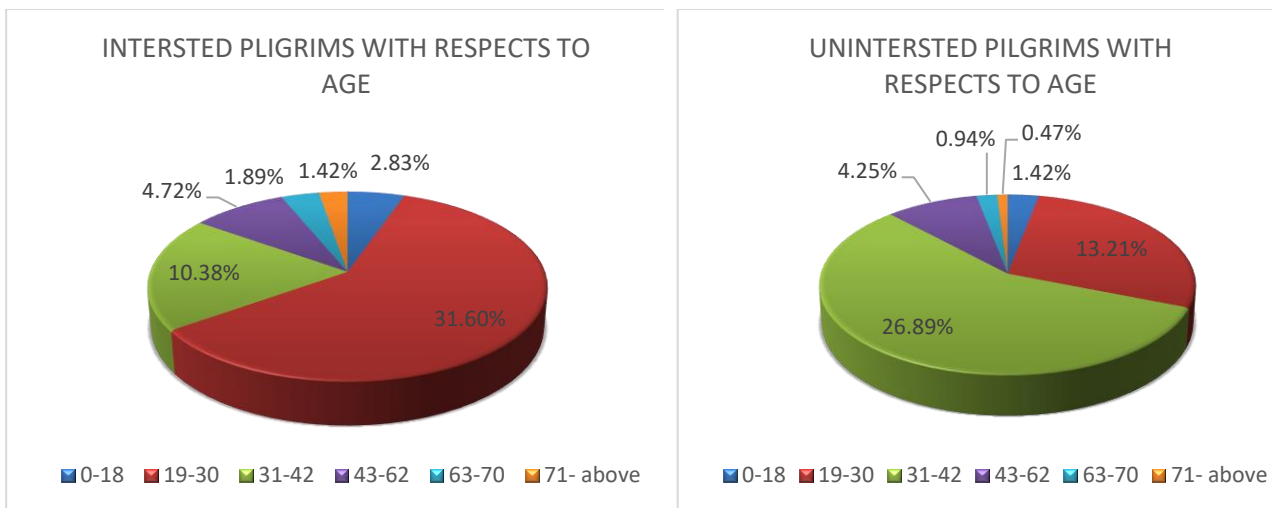


Figure 4-1 the interest of the pilgrims using cable car or not

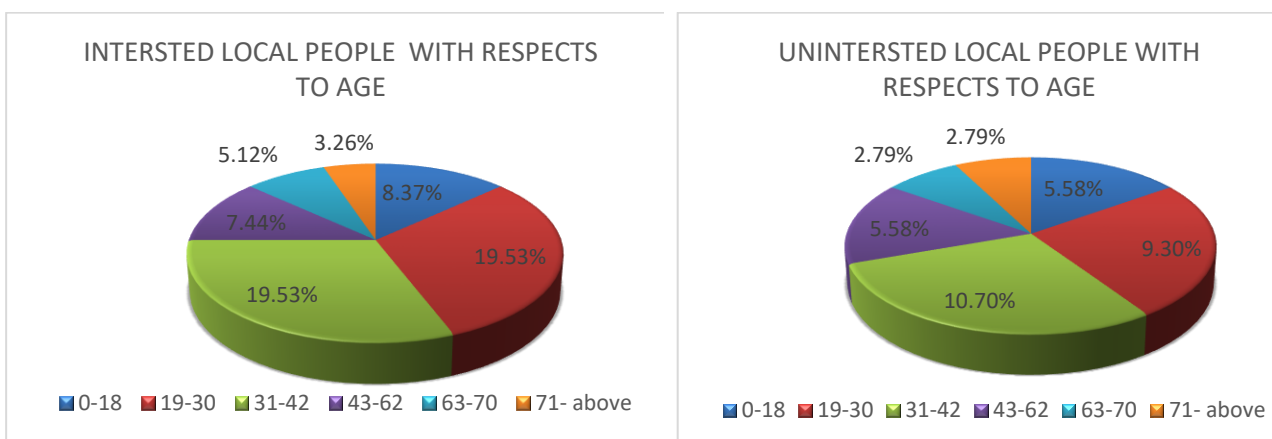


Figure 4-2 the interest of the local people using cable care or not

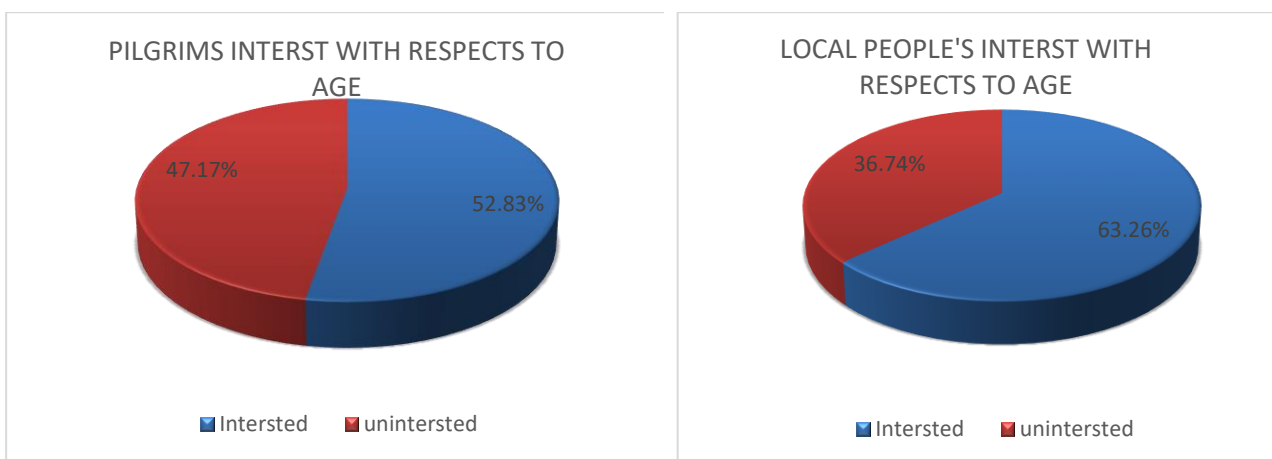


Figure 4-3 Total Percentage for using cable car or not.

As shown in the figure 4.3, all age groups were merged together and among the pilgrims, 52.83% were interested and 47.17% were not interested. Among the local people, 63.26 were interested and 36.74% were uninterested to use the cable car. This shows that if the cable are constructed and installed for the route from Koladit junction to Gishen Mariam Church as an alternative means of transportations modes in addition to the existing road.

4.1.2 Religion related to interest of the people using cable car

Religion is not a main factor for choosing cable car for traveling difficult terrain. Where the person is Orthodox or Muslim or other religion it does not affect the preference of choosing the cable car or not but it will help to understand the background of the road users. However, the religion variables used to identify the pilgrim’s religion that was travel to Gishen Mariam Church and has the low score.

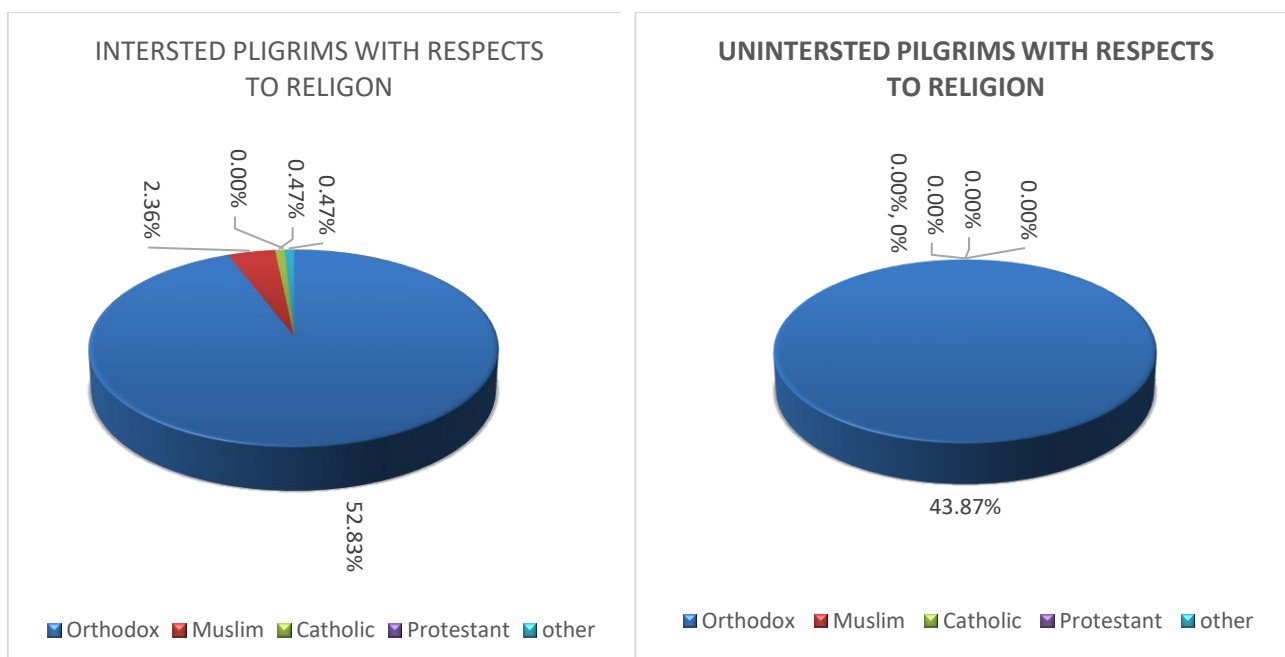


Figure 4-4 the interest of the travels with respects to their religion

As shown in the figure 4.4, majority of the pilgrim’s religions were orthodox with the total travelers 52.83% were interested and 43.87% were not interested to use cable car.

Looking in to the collected questioner and filed observations, the researcher tires to explore the religious background of the people living around the route. Hence, among the interviewer, almost 96.7% were orthodox and 2.4% were Muslims. From the travelers, almost all Muslims were came for family visiting and most of the orthodox were came of Meskel celebrations.

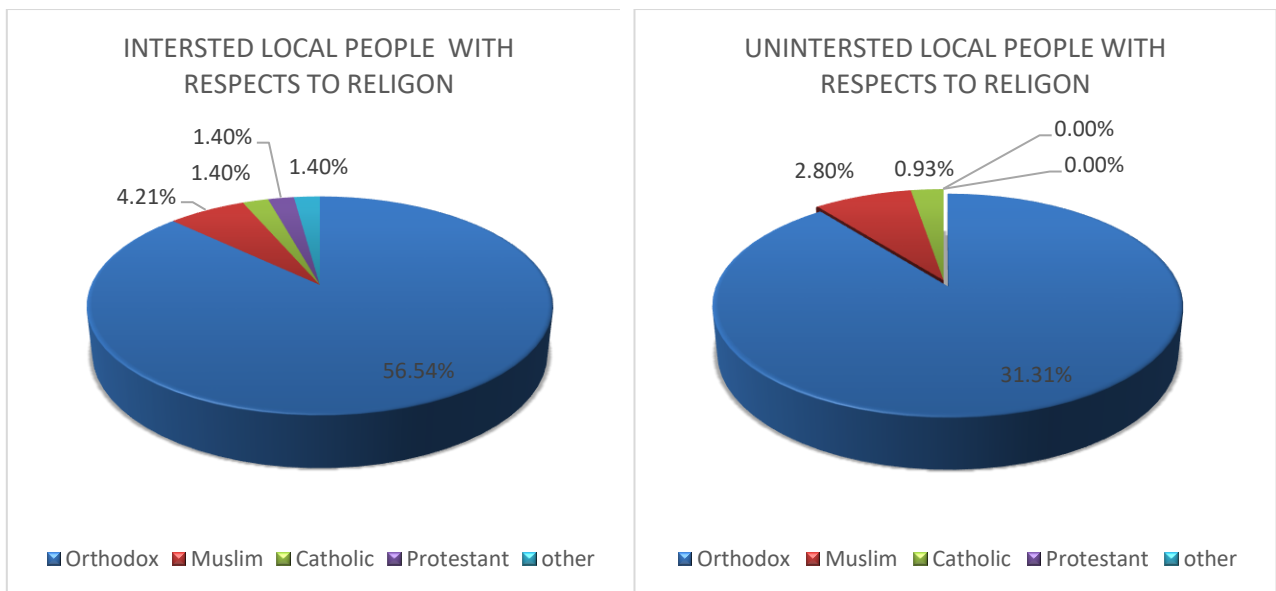


Figure 4-5 the interest of the local people with respects to their religion

As shown in the figure 4.5, among the local peoples, 56.54 orthodoxies were willing to use the cable car and 31.31% were not interested. Then Muslims local peoples with 4.2% and 2.8% were willing to use and were not willing to use the cable car respectively.

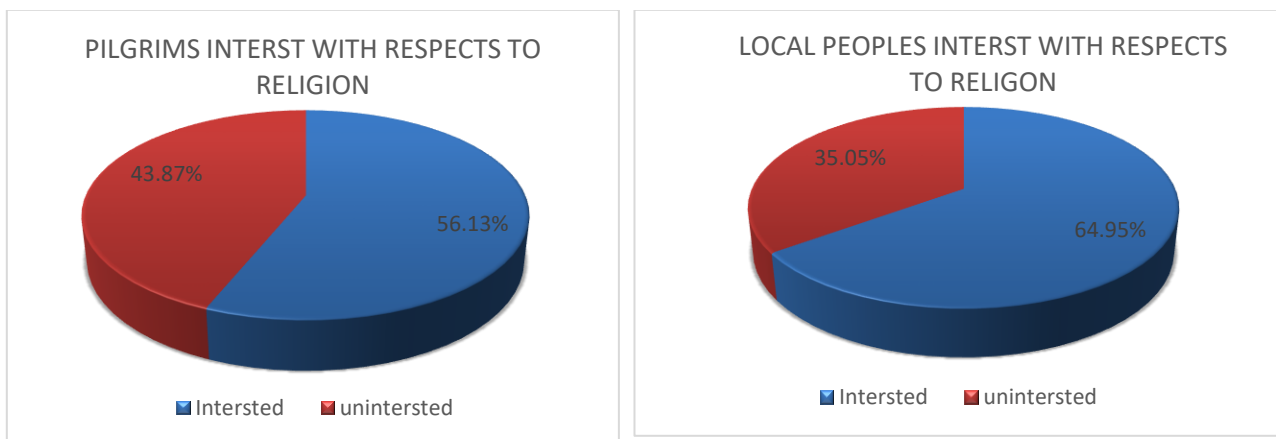


Figure 4-6 Total Percentage for using cable car or not with respects to religions.

Generally, 56.13% of pilgrims were willing to use the cable car and at the Contraries 43.87% were not willing to use the cable car. Among the local peoples, 64.95% were interested and 35.05% were not interested to use cable car.

4.1.3 Education Level related to interest of the people using cable car

Education level is not a main factor for choosing cable car to travel difficult terrain but it will provide the background of the travelers and also the people living around the route. As the result, Education level has low score.

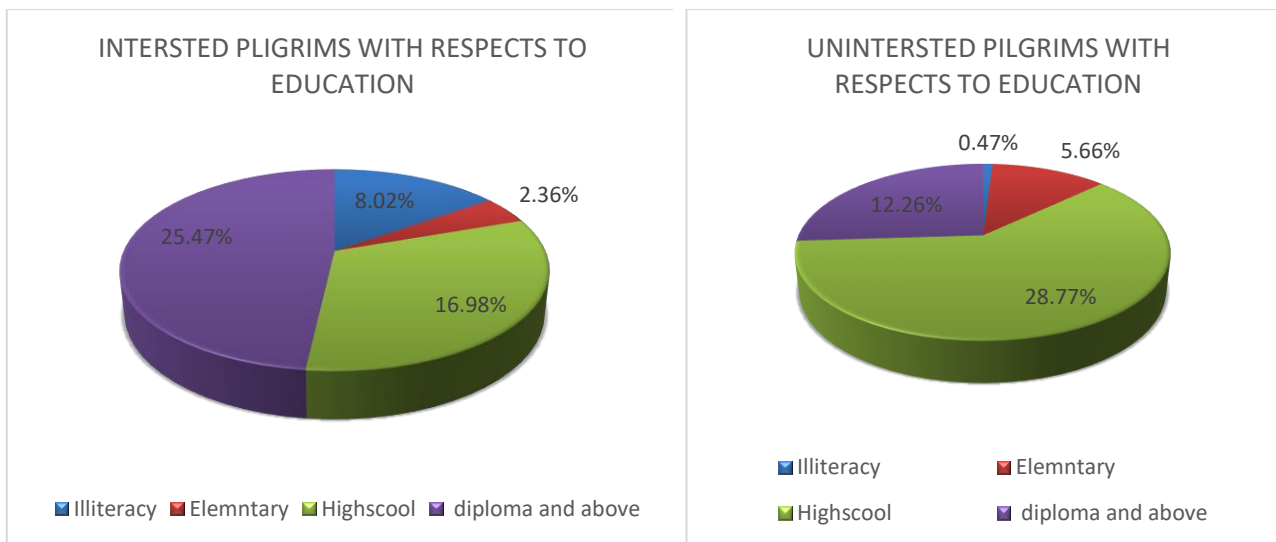


Figure 4-7 the interest of the travels with respects to their education status

As shown in the figure 4.7, Among the pilgrims that are interested to use cable car was with higher percentage with 25.47% of the pilgrims have Diploma and above, then 16.98%, which is interested to use, are high school students. The people with diploma and above education background has more interested to use a cable car since they are mainly near to technologies.

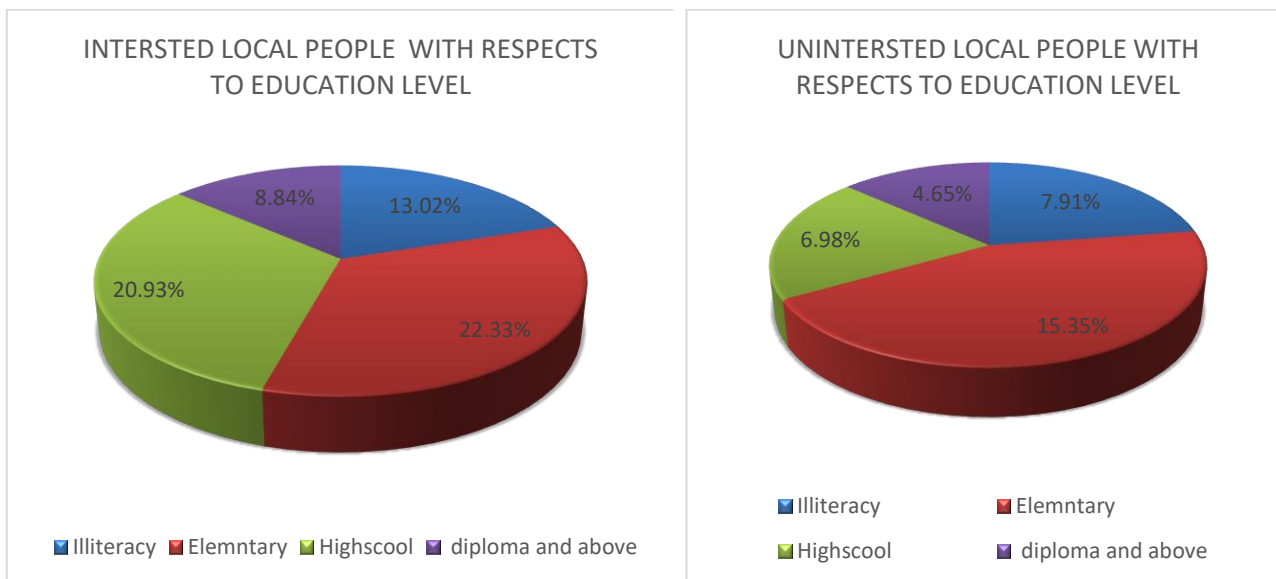


Figure 4-8 the interest of the local people with respects to their education status

As shown in the figure 4.8, among the local peoples that are interested to use a cable car is elementary students with 22.33%. Then secondly, high school students with 20.93% were interested.

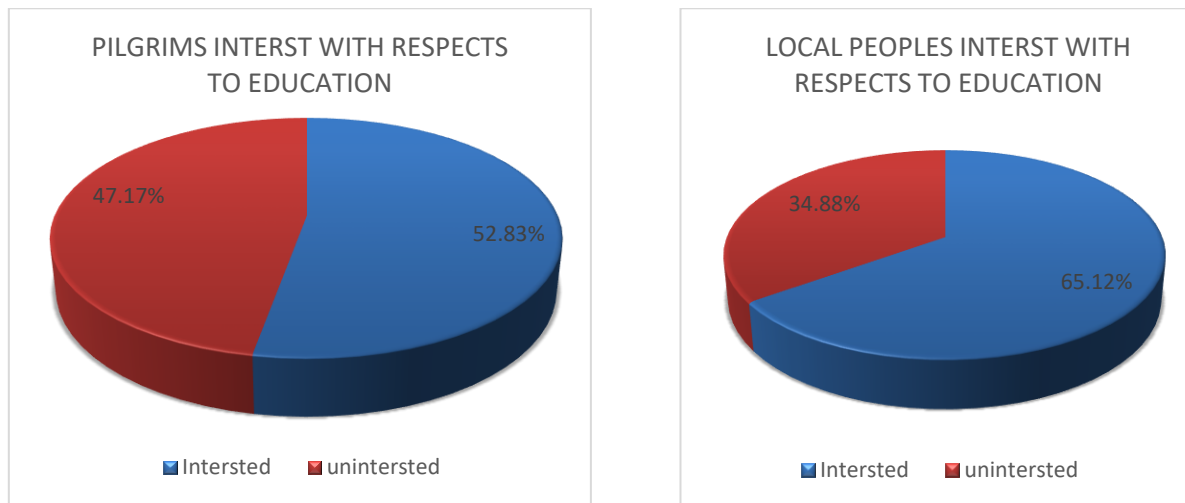


Figure 4-9 Total Percentage for using cable car or not with respects to their education status

As shown in the figure 4.9, generally, 52.83% pilgrims were interested and 47.17% were not interested to use cable car. In addition, among the local peoples, 65.12% were interested and 34.88% were not interested.

4.1.4 Occupation related to interest of the people using cable car

Occupation is not a main factor for choosing cable car to travel difficult terrain. Hence, we just used to identify the pilgrim’s occupation that traveled to Gishen Maraim Church. As the result, occupation got the low score.

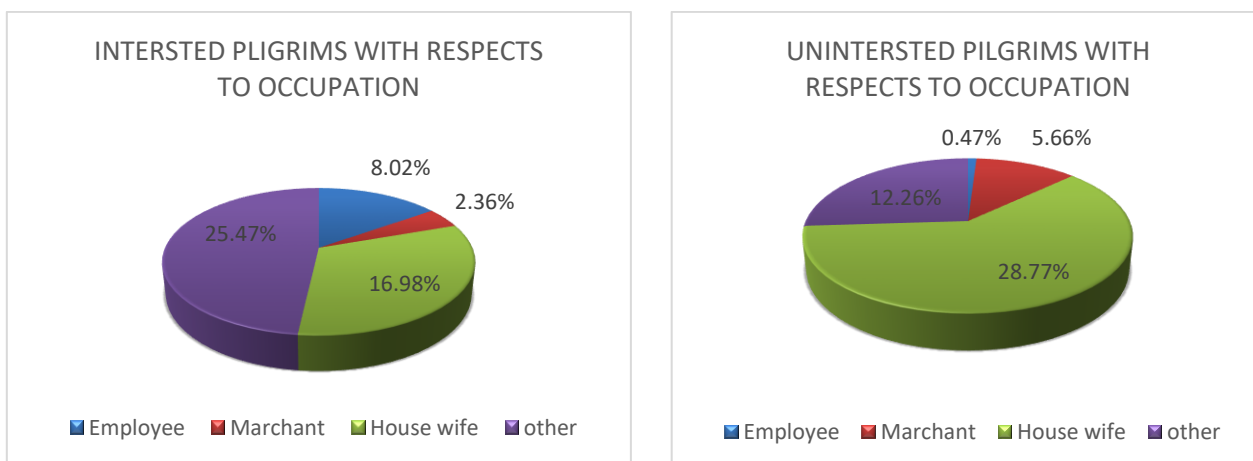


Figure 4-10 the interest of the travels with respects to their occupation status

In the figure 4.10, among the pilgrims, most of the travels that are willing to use cable car were others but the second abundant occupation were house wife.

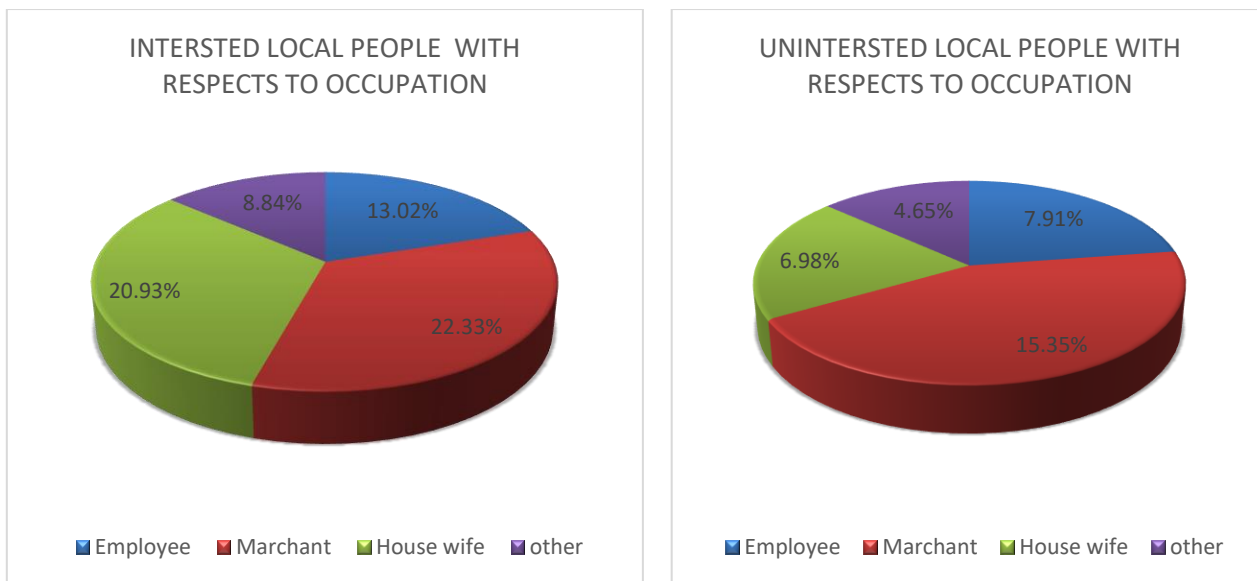


Figure 4-11 the interest of the local people with respects to their occupation status

Among the local peoples that are interested to use cable care were merchants with 22.33% and next house wife with 20.93%. as shown from the figure, local merchants were taking their items to the market every market day, the movement of peoples would have been better if they cable care were install.

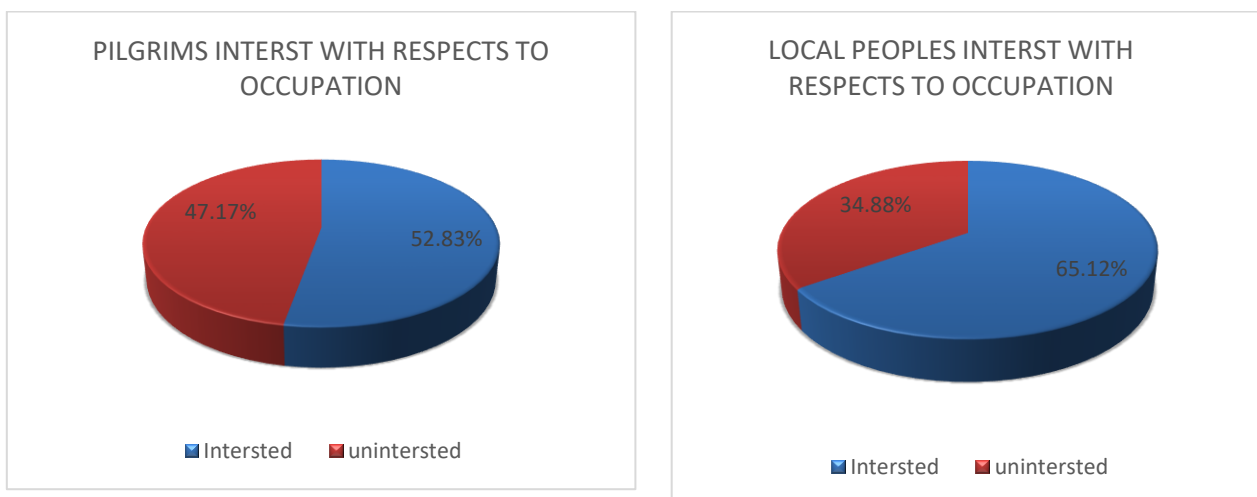


Figure 4-12 Total Percentage for using cable car or not with respects to their occupation status.

As shown in the figure 4.9, among the pilgrim’s with their occupation, 52.83% were interested and 47.17% were not interested. Moreover, for local peoples 65.12% were interested and 34.88% were not interested.

4.1.5 Mode of transport related to interest of the people using cable car

The existing transportation mode is a main factor that will affect for choosing cable car to travel difficult terrain. These variables can be considered, as modal shift analysis and it will help to estimate the number of people that will shift to cable car transportation mode. Hence, mode of transport verse the interest of the pilgrims as well as local peoples interested of using cable car has a high influential factor with 5 score.

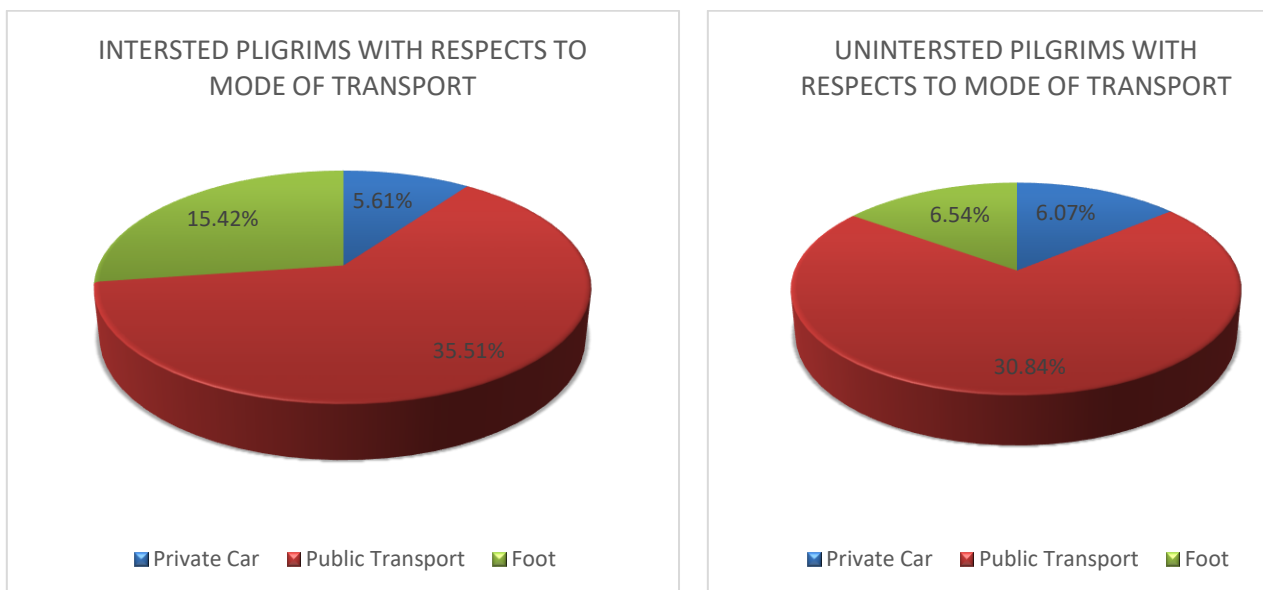


Figure 4-13 the interest of the travels with respects to their Mode of transport status

As shown in the figure 4.13 above, among the pilgrims that are interested to use cable car, 35.51% were used public transport and then 15.42% were came to Gishen Mariam with their foot. Among the pilgrims that are not willing to use cable car were 30.84% used public transport and 6.54% were used by foot.

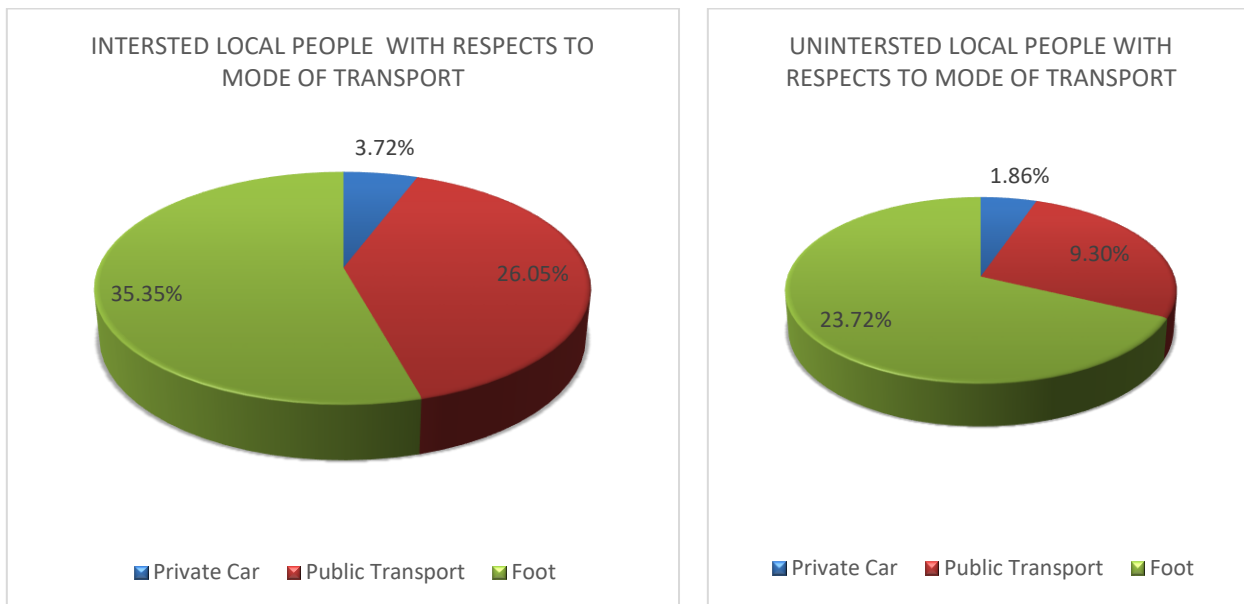


Figure 4-14 the interest of the local people with respects to their Mode of transport status

As shown in the figure 4.14 above, most of the local people that are interested to use cable car were came to Gishen Mariam with foot with 35.35% then 26.05% were came by public transport.

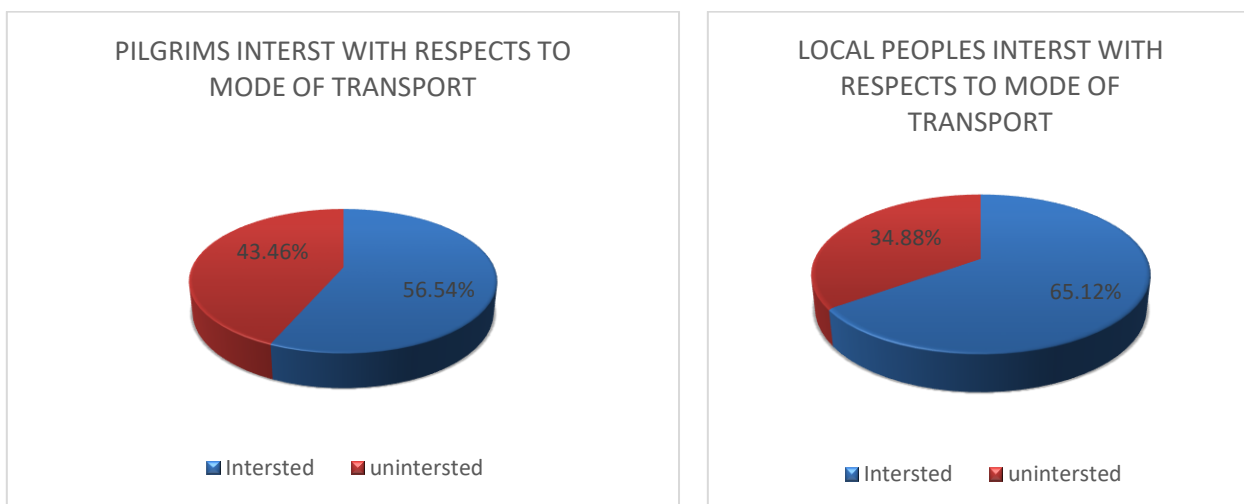


Figure 4-15 Total Percentage for using cable car or not with respects to their Mode of transport status

Generally, 56.54% of pilgrims were interested and 65.12% local peoples were interested. Moreover, 43.46% of pilgrims and 34.88% of local peoples were not interested to use cable car.

4.1.6 Purpose for travel with respect to the interest of the people using cable car

Purpose of travel has a moderate factor for choosing cable car for traveling difficult terrain. Hence, purpose for travel has given moderate score.

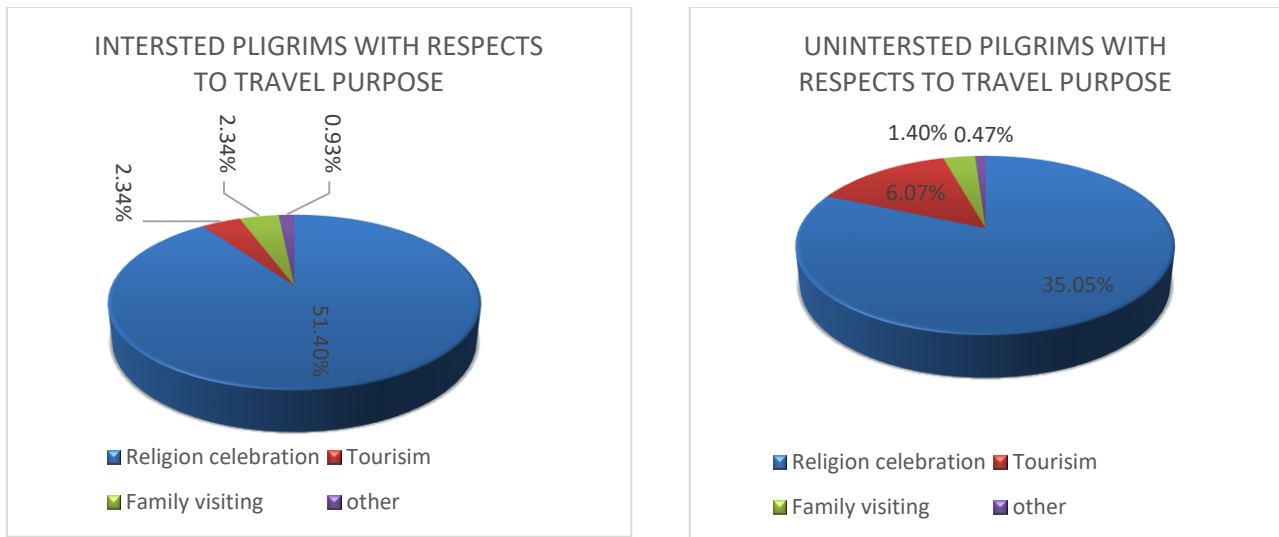


Figure 4-16 the interest of the travels with respects to their travel Purpose

As shown in the figure 4.16 most of the pilgrims that are interested to use cable car were came to Gishen Mariam for religious celebration with 51.04% and uninterested people that were came for religious celebration accounts 35.05%.

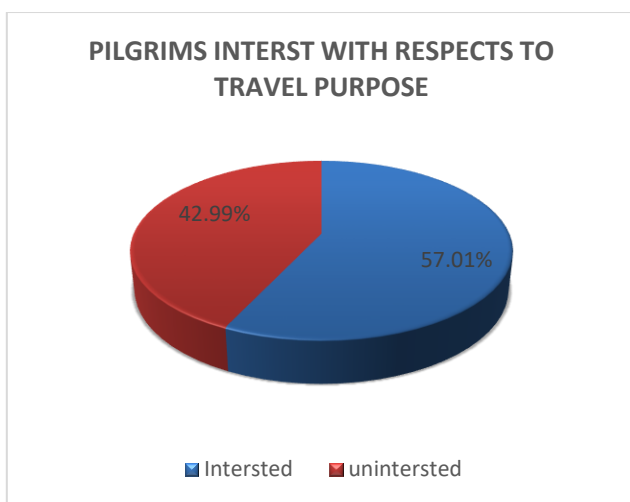


Figure 4-17 Total Percentage for using cable car or not with respects to their Mode of transport status

As shown in the figure 4.17, interested travelers were accounts 57.01% and uninterested pilgrims were accounts 42.99%.

4.1.7 Frequency for travel with respect to the interest of the people using cable car

Frequency has a main factor for choosing cable car for traveling difficult terrain. Hence, Frequency of traveling has given moderate score.

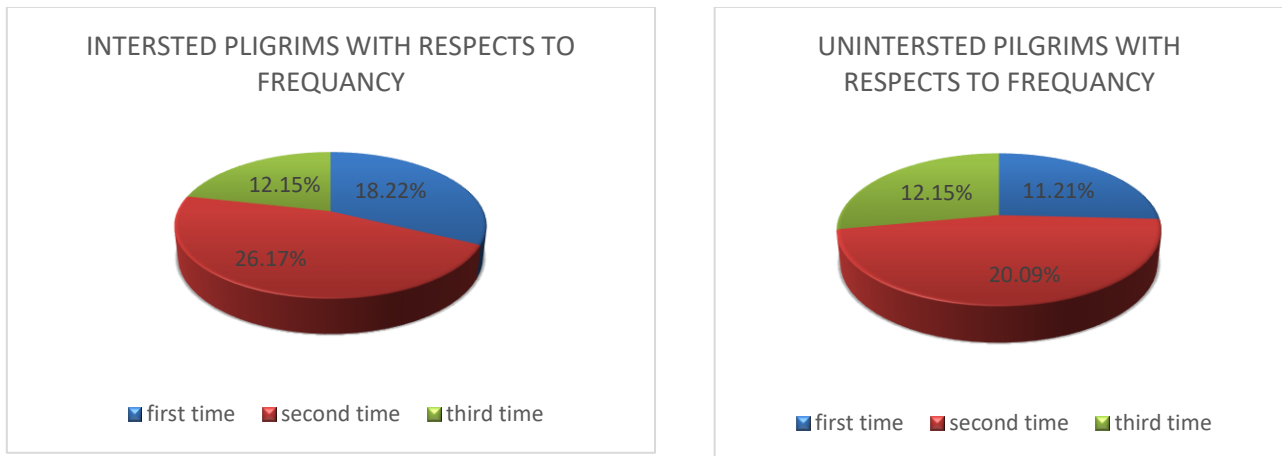


Figure 4-18 the interest of the travels with respects to their Mode of transport status

As shown in the figure 4.18, pilgrims that are interested to use cable car to travel to Gishen Mariam, were the one that are came with the second times with 26.17% and uninterested pilgrims came for the second times accounts 20.09%.

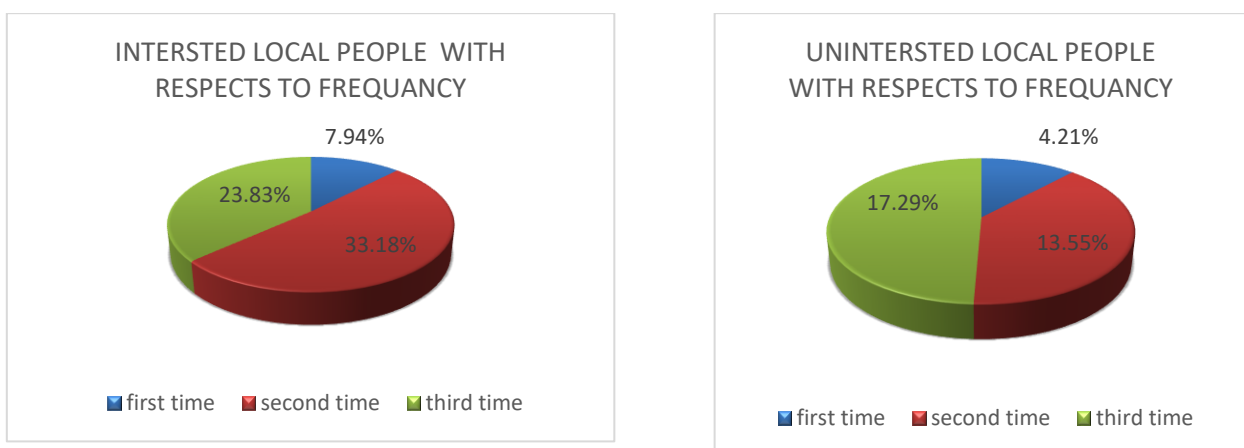


Figure 4-19 the interest of the local people with respects to their Mode of transport status

As shown in the figure 4.19, interested local people were the one that are travel to show for the second times with 33.18% and uninterested local peoples were accounts 13.55%.

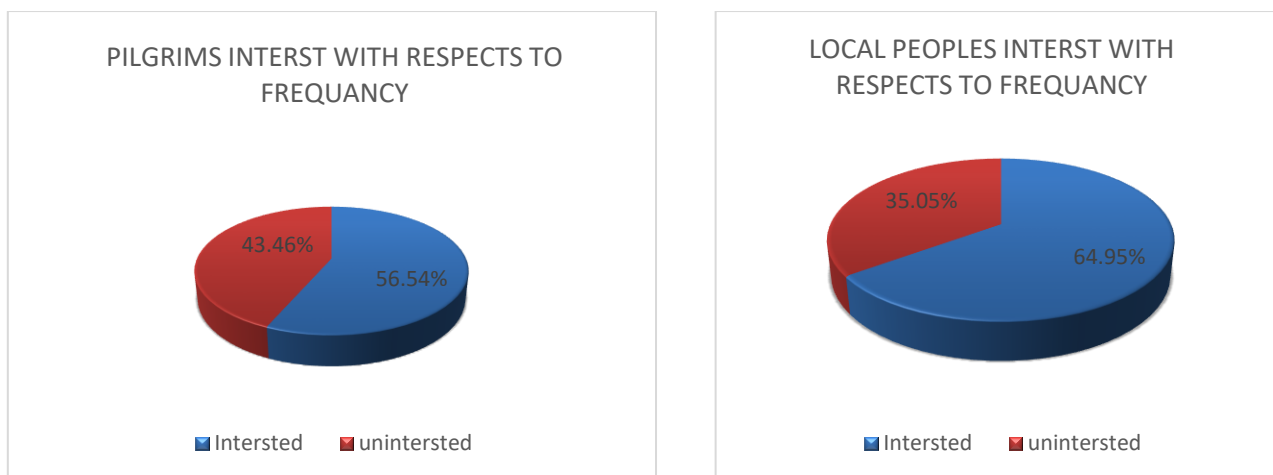


Figure 4-20 Total Percentage for using cable car or not with respects to their Mode of transport status

Generally, as shown in the figure 4.20, pilgrims and local peoples were accounts 56.54% and 64.95% respectively.

4.1.8 Proximity or origin and destination (OD) analysis

OD survey were taken in order to determine the trip pattern and characteristics along the proposed road. The proximity affects the preference of choosing the cable car or not. Hence, proximity has given high score.

Pilgrims																									
Destination	origin																								
	Harer	Hawassa	Hayke	Lalibela	Mersa	Mekelle	Raya	Bure	Bahirdar	Addis Ababa	Adama	Kutaber	combolcha	Weldya	Wechale	Delanta	Dessi	Debre Sina	Debrebrehan	Diredawa	Jinca	Gerager	Gonder	Gojam	Total
Gishen Mariam	3	4	5	3	1	1	7	1	13	44	2	5	10	27	6	1	57	1	6	1	1	1	6	8	214

Figure 4-21:- Origin Destination analysis

As shown in the figure 4.21, above most of the Pilgrims around 27% were came from Dessi which is 25km away from Gishen Mariam Church, then 21% were came from Addis Ababa which is 500km away from Gishen Mariam.

4.1.9 Trip Expectation

Since the road is very difficult and found on harsh terrain type, some people experience accidents, braking of cars, Tiredness and so on. However, on the contrary peoples were enjoying the trip, hence the analysis of trip expectations are stated below with table.

Table 4-1:- Trip expectations for Pilgrims

Trip Expectation for Pilgrims			
Number	Descriptions	Number of Peoples Encountered	Percentage
1	Difficulty Road	33	15.40%
2	Car Accident	18	8.40%
3	Difficulty Road plus rain	1	0.50%
4	Vehicle Broke Down	27	12.60%
5	vehicle strap	1	0.50%
6	Hunger	4	1.90%
7	Blessing	4	1.90%
8	walking by foot	28	13.10%
9	tiredness	62	29.00%
10	No Response	36	16.80%
Total=		214	

As shown in the table 4.1 most of the pilgrims were experiencing tiredness during traveling to Gishen Mariam church with an account of 29.0%. Then secondly, 15.4% were sensing that the road is very difficult and has a winding of curves. Among the pilgrims, 1.9% were feeling blessed with traveling with this difficult types of roads, even they were saying that they will not use cable car since they have a mindset that traveling along the difficult terrain will bring blessings.

Table 4-2:- trip experience for the people living around the area

Trip Expectation for Local Peoples			
Number	Descriptions	Number of People Encountered	Percentage
1	Car Accident	8	3.69%
2	Broke done of Vehicles	5	2.30%
3	Vehicle strapping	2	0.92%
4	Hunger	8	3.69%
5	Waling by foot	13	5.99%
6	Difficulty of the road	14	6.45%
7	Tiredness	129	59.45%
8	Sickness	1	0.46%

Trip Expectation for Local Peoples			
Number	Descriptions	Number of People Encountered	Percentage
9	Shortage transport	14	6.45%
10	Attacked by sneak	1	0.46%
11	No response	22	10.14%
Total=		217	

4.1.10 Results of interview/Questioner

As per sub section from 4.1.1 up to 4.1.9 shows that the interest of the pilgrims as well as the local people's interest using the cable car or not after the cable car were introduced. Hence, the total estimation when we combined all variables and illustrated in the table 4-3 below.

Table 4-3:- trip experience for the people living around the area

N o.	Category	% of Interested Pilgrims	% of uninterested Pilgrims	% of interested Local People	% of uninterested Local People
1	Age	52.83%	47.17%	63.26%	36.74%
2	Religion	56.13%	43.87%	64.95%	35.05%
3	Education	56.54%	43.46%	65.12%	34.88%
4	Occupation	52.83%	47.17%	64.62%	35.38%
5	Mode of Transport	56.54%	43.46%	65.12%	34.88%
6	Purpose	57.01%	42.99%		
7	Frequency	56.54%	43.46%	64.95%	35.05%
Average		55.49%	44.51%	64.67%	35.33%

Therefore, pilgrims with age group of 19-30 of an orthodox Christian that have diploma and above education background, public transport users and came for religious celebrations from Desse and Addis Ababa were interested to use cable car with 55.49% and 64.67% of the local peoples willing to use cable car. This shows that the majority of the pilgrims and local peoples will use the cable car instead of using public transport.

4.2 ECONOMIC EVALUATION

4.2.1 Demand Analysis

Based on the estimation above on table 3.9, 100,000 pilgrims and above were traveled every celebration to Gishen Mariam church for religious celebration from all over Ethiopia. Hence, based on the social assessments, 55.5% were interested to travel with cable car. Hence, among the total pilgrims, around 40,840 pilgrims were willing to travel to Gishen Mariam church by cable car from Gishen Junction to Gishen Mariam Church. In addition, after the cableway constructed and open for users, some of the people expected to shift to cable car in addition to the 55.5% is diverted traffic. The researcher estimated 25% of the pilgrims as a diverted traffic from modal shift.

Table 4-4. Estimation of number of peoples coming for celebration

Descriptions	L/Rover	S/Bus	L/Bus	Total
Total AADT @2021 estimated by Beza Consulting Engineers Plc	164	3	5	172
Percentage composition/estimated by Beza Consulting Engineers Plc	95%	2%	3%	1
Total estimated traffic by local administration 20,000	19,070	349	581	20,000
Total People traveled	76,279	4,186	20,349	100,814
Total interested People to use cable car	41,954	2,302	11,192	55,448
Sifted traffic(25% of total traffic)	19,070	1,047	5,087	25,204
Total Estimated Traffic	61,023	3,349	16,278	80,651

Source:- Researcher estimation

4.3 Economic Analysis

The Economic Evaluation results of the project established based on comparisons between costs and benefits has been done for both cable car and road way constructions. The economic study of the proposed mode of transport has investigated depending on the specific nature of the implementation strategy type.

The required input data and information for each alternative technology such as cable car and roadway collected through field visits and desk studies are attached with this document in Appendix 6.

The analysis done by considering each alternative or technologies with against do nothing. The major considerations in the measurement of costs and benefits for the economic appraisal of this project are: the travelling that incurs costs to road users such as the time spent travelling; costs arising from direct costs of fuel, maintenance and depreciation for technologies.

The result of the economic analysis expressed by the following standard measures to evaluate the economic viability of the proposed technologies such as-

-Net Present Value (NPV) – the sum of the discounted stream of project costs and benefits during the project lifetime. The project is acceptable as long as $NPV > 0$.

-Economic Internal Rate of Return (EIRR) - represents the discount rate at which the NPV of the project would be equal to zero. IRR above the cut-off point are economically viable.

- Benefit Cost Ratio

Currently, we use the minimum requirement of a project to be economically feasible is to have a positive NPV and an EIRR greater than the discount rate, 10.23%.

4.3.1 Economic Parameters

The financial investment and maintenance costs of the technologies estimated based on the current unit costs which are estimated for combination of different works. For the purpose of economic analysis, a conversion factor of 0.87 is used in the model to convert financial costs into Economic costs.[45] The conversion factor used is based on the Manual of National Economic Parameters and Conversion Factors for Ethiopia, which was prepared and issued by the Ministry of Finance.

In addition, the economical justified level of investment in road improvement is dependent on the discount rate to be applied in the economic analysis. This rate equals the opportunity cost of capital for the project. The appropriate discount rate is measured by the marginal rate of return on public sector investments. A discount rate of 10.23% is applied in the economic analysis of the project road.

4.3.2 Cost Benefit Analysis for Cable Car

The Cost- Benefit analysis of the cable car measures the capital cost in monetary terms on the one hand, and the benefits that accrue in the form of travel time and the vehicle operating cost savings on the other.

The major considerations in the measurement of costs and benefits for the economic appraisal of this cable car project are the travelling that incurs costs to cable car users such as the time spent travelling; costs arising from direct costs of electricity, maintenance and depreciation. The direct benefits were derived from the fare revenue projections based on estimated demand for the ART service, and the cost included capital(construction) cost as well as an annual ridership growth rate of 2%, construction time one year for MDG system and two year for TDG system [51]. The construction cost includes the civil work of the terminals and the piers that will hang the cables. The annual inflation and real discount rates of 10.23%. [45]. The primary evaluation criteria were the net present value, Benefit Cost Ration (B/C) and internal rate of return.

The analytical tool used in the evaluation of this project is the HDM model, which is very comprehensive and needs a wide range of inputs. The data input requirement of the model is discussed here in relation to the project study. The analysis is based on specific data requirements of the dynamic model that incorporate a series of mathematical sub models simulating the effects of different physical characteristics and conditions of the existing road, on the operating speeds of different types of vehicles and the resultant fuel and lubricant consumption, maintenance requirements, etc.

Table 4-5. The characteristic of Arial Cable car

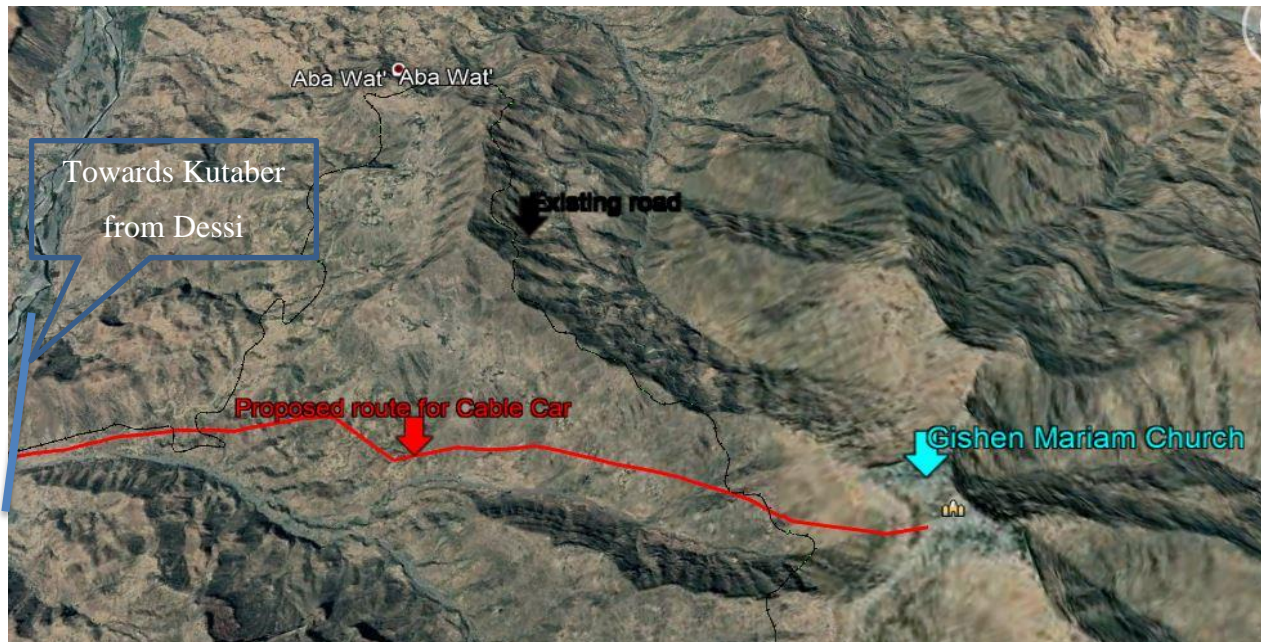
No	System Characteristics	Dual Haul Aerial Tramway
1	Cable Configuration	Cabins are suspended from two fixed cables and are pulled by another cable
2	Maximum Number of Passenger cabins	2 cabins
3	Maximum Number of station	Can have multiple stations
4	Maximum Distance between Towers	less than 1000m
5	Cabin capacity	High capacity(more than 100Pass/cabin)
6	Maximum Transport capacity	2800 Pass/hr
7	Speed	Up to 29km/hr
8	Estimated Passengers total amount	Above 20,000 Pilgrims
9	The Total Length of the proposed route	6.7km
10	Time it take to travel from Gishen Junction to Gishen Mariam (min)	12.4137931
11	Total Trips within 1hr	5
12	Total Passengers with one Cabin within 1hr	483
13	Total Passengers with one Cabin within one day	5800

Source:-Estimation

4.3.2.1 Cable car Route

As shown in the figure 4-22 below, the route of the cable car is illustrated. The route is shorter than the existing road almost by half but the start and the end of the projects are similar.

Figure 4-22:- the location of proposed route for cable car



4.3.2.2 Improvement strategies

4.3.2.2.1 Construction cost

Providing cable car have been considered for the route from Koladit Junction upto Gishen Mariam Junction as a means of public transport and comparing against the base case, do minimum alternative. The proposed alternative of the project consider constructing cable car in a different route from the existing gravel road. Capital cost of the project estimated based on the assumption illustrated on chapter 3 above. Hence, the capital cost for constructing cable car illustrated below on table 4.5. The BOQ is attached in Appendix 2.

Table 4-6 : Total Financial and Economic Costs of the Project (In Million ETB)

Option	Assumed Total Cost	Financial Cost Per Km	Economic Costs Per Km
Cable car construction	435,811,530.99	74,803,471.74	65,046,497.16

Source: - Estimation

Since, cable car was not implanted yet in our country, for our research, purpose we have adapted the construction cost done for skyway construction to be implemented from Ayat to Tulu Dimtu road Corridors.

4.3.2.2.2 Maintenance cost

On section 3.4.3.4, developed maintenance cost taking in to consideration of maintenance work form different countries and illustrated in the table 4-6 below.

Table 4-7:- Maintenance Cost Estimated

Option	Financial Cost Per Km	Economic Costs Per
Cable car Maintenance cost	92,132.23	76,469.75

Source: - Estimation

4.3.2.3 Results

Based on the demand analysis and all assumptions made for the input in HDM 4, construction of cable car instead of roads is more viable and has more advantages regarding economic evaluation as shown in table 4-6 below.

Table 4-8: Results of economic analysis

Description	EIRR %	NPV in Million ETB	BC
Gishen Junction – Gishen Mariam	33.1	18851	4.412
Sensitivity Test			
Cost Increase by 20%	31.7	18625	4.367
Benefit Decrease by 20%	26.7	13716	3.165
Cost Increase by 20% and Benefit Decrease by 20%	26.0	13500	3.13

4.3.3 Economic Evaluation for Road Construction

Upgrading the road from Koladit Junction up to Gishen Mariam Junction to AC (Asphalt Concrete) improvement alternatives have been considered and comparing against the base case, do minimum alternative. The proposed improvements of the project consider upgrading of the existing poor gravel road to paved standard, Asphalt Concrete (AC). Capital cost of the project is estimated for the two construction options and the estimated per km project costs are presented below and BOQ attached in Appendix 2.

Table 4-9 : Total Financial and Economic Costs of the Project (In Million ETB)

Option	Total	Financial Cost Per Km	Economic Costs Per Km
Asphalt Road	1,316,700,000	108,157,500.00	94,050,000

Source: - From BCE Data Base

4.3.3.1 Road Maintenance Standard and Strategies

Maintenance costs comprise routine and periodic maintenance components. The routine maintenance cost to be incurred every year involves day-to-day repairs for maintenance of road, structures etc. Periodic maintenance is aimed at pavement resurfacing/renewal for improving riding quality and condition of pavement and its interval depends on the maintenance strategy that we are assuming.

The maintenance strategies and standards used in the economic evaluation will depend on the existing road condition and current maintenance practices. The following maintenance strategies are used or assumed in the economic analysis.

- Do minimum

The ‘do minimum’ maintenance strategy reflects the current minimum maintenance standard, which is used to keep the road at acceptable level of serviceability.

Existing Gravel Road

- Routine Maintenance every year;
- Grading, Scheduled every 180 days;
- ‘With Project’ Case

The ‘with project’ maintenance strategy is adopted following the implementation of the upgrading of the project road. The applicable maintenance strategy of the ‘with project’ case that are applicable for both upgrading options (Asphalt Concrete and Double surface Treatment) option are presented below.

AC Option

- Routine Maintenance every year;
- Crack Sealing, Responsive when Wide Structural Cracking $\geq 10\%$;
- Pothole patching, Responsive when Pothole ≥ 10 no./km; and

- Overlay, Responsive when Roughness ≥ 5.0 IRI

Unit cost of road maintenance operations is presented in the following table.

Table 4-10: Estimate of Maintenance Operation Unit Cost, Financial

Work Item	Unit	Unit Cost, Birr
Routine Maintenance	Km	20,000
Gravel		
Re-Gravelling	M ³	204
Spot-Gravelling	M ³	60
Grading	Km	7100
Paved		
Overlay	M ²	75
Resealing	M ²	68
Patching	M ²	78
Crack Sealing	M ²	73

Source: - ERA and different Feasibility Study Reports.

4.3.3.2 Works schedule

The following work schedule is considered in the analysis:

Table 4-11 : Project Implementation Schedule

Activity	Period
Completion of Concept Design and tender process.	End of 2021
Construction (1 years starting Beginning of 2022)	2022
Completion of the construction	End of 2022
Open for traffic	Beginning of 2023
Design Period (20 years)	2023-2042

The construction works duration is considered one years and the road will be opened to traffic starting year 2022.

4.3.3.3 Input to HDM-4 Models

The economic analysis of the project has been undertaken using the Highway Development and Management Model (HDM-4) Version 1.1. The inputs to the model have been derived from field investigations and available secondary data collected from different organizations and ERA. The following are the basic inputs data used for the HDM-4 Model.

4.3.3.4 Traffic Data

The traffic volume and its composition in terms of AADT by vehicle type and annual traffic growth rates are key inputs for economic analysis. The derivation of the base year AADT and traffic growth rates have been discussed earlier in Traffic Survey and Analysis section. Eight vehicle Categories, pedestrians and Pack animals were considered for this study. The following table shows the AADT and traffic growth rate used in the HDM-4 Model.

Table 4-12: Base Year (2021) AADT, 2021

Descriptions	Car	L/Rover	S/Bus	L/Bus	S/Truck	M/Truck	H/Truck	Truck & Trailer	Total
Total AADT @2021	10	164	3	5	68	7	8	1	256
Percentage composition	0	64.06	1.17	1.95	26.5	2.73	3.125	0.39	100

Source:- BCE's Estimations

Table 4-13: Traffic Growth Rates (%PA)

Period	Cars	4WD	S/ Bus	L/Bus	S/Truck/	M/Truck	L/Truck	T/T
2021 - 2029	9.9	9.9	10.5	10.5	10.6	10.6	10.6	10.6
2030 - 2040	8.6	8.6	9.2	9.2	9.8	9.8	9.8	9.8

Source:- BCE's Estimations

4.3.3.5 Vehicle Fleet and Operating Costs

The vehicle fleet data provide the characteristics of the vehicles, which include vehicle type, number of axels, passenger car space equivalent factor, and average annual utilization in km, the economic cost of the vehicle, trip characteristics, value of time for passengers and the cargo.

The major inputs required for HDM-4 to estimate the VOC are the prices of vehicles, fuel (petrol and diesel), lubricants, tires, repairs and maintenance, the proportion of depreciation related to vehicle use and other vehicle fleet characteristics. Accordingly, the main data for the VOC model used for the analysis are the prices of vehicles, tire costs, prices of fuel and lubricants, maintenance, labor and crew costs and vehicle utilization.

For this study, cost and price data have been collected from a variety of sources including consultant's current investigation and previous studies, using the conversion factors for the economic cost of

vehicles, Tire, fuel, lubricants, maintenance and crew costs are calculated. The speed of the vehicles on the existing road project is measured during the condition survey. Based on this the average running speed over the whole route is estimated and inserted into the model.

The types of fuel used by the vehicles are petrol and diesel. The fuel prices vary from place to place in Ethiopia as determined by the Ethiopian Petroleum Enterprise. For the purpose of this study, the average fuel price has been considered.

As HDM4 model require vehicle fleet characteristics comprising physical characteristics, utilization and unit costs; therefore, the following table presented this information taken from recent road project studies.

Table 4-14 vehicle fleet characteristics for road construction.

Vehicle Type	Car	L/Rover	S/Bus	L/Bus	S/Truck	M/Truck	H/Truck	T/Truck
Passenger	4	4	20	45	2	2	2	2
Utilization								
Annual Run (km)	20000	40000	50000	60000	50000	60000	65000	65000
Annual Hours	600	900	1800	2000	1600	1800	2100	2100
Average Service Life	10	12	15	15	12	15	20	20
Unit Costs (Economic)								
New Vehicle Price (Birr)	2,000,000	4,200,000	2,074,000	2,650,000	2,350,000	3,900,000	4,800,000	5,180,000
Tyre Price (Birr)	2,458	7,925	10,750	14,517	8,560	14,517	14,517	14,517
Fuel (per liter)	20.04	17.70	17.70	17.70	17.70	17.70	17.70	17.70
Lubricant oil (per liter)	76	76	76	76	76	76	76	76
Crew Wages (Birr/hr.)	37.93	47.73	46.59	45.45	37.78	39.77	48.30	48.30
Annual Overhead (Birr)	18000	50000	60000	80000	30000	30000	50000	60000

Vehicle Type	Car	L/Rover	S/Bus	L/Bus	S/Truck	M/Truck	H/Truck	T/Truck
Maintenance Labor(ET B/hr.)	67.71	67.71	74.54	74.54	67.71	81.38	84.64	81.38
Annual Interest Rate (%)	10.23	10.23	10.23	10.23	10.23	10.23	10.23	10.23
Passenger Working time(per hour)	2.06	2.06	1.47	1.47	2.26	2.26	2.26	2.26
Passenger Non-working time (per hour)	0.72	0.72	0.52	0.52	0.79	0.79	0.79	0.79
Cargo Costs (per hour)					0.13	0.3	0.36	0.77

Source: Different Recent Feasibility Study Reports, ERA

4.3.3.6 Summary of Results

Based on the results of the economic evaluation, investment in the proposed upgrading of the road to asphalt is found to be economically viable using NPV Method. It is also analyzed under sensitivity analysis and the proposed road is still viable if both costs increase by 20% and benefits, decrease by 20% combined which is the worst case. The results of the economic analysis of the road project with the different standards presented below in Table 4-12.

Table 4-15: Results of Sensitivity Analysis

Scenarios	IRR @ 10.23%		NPV (In Million	Benefit Cost
	Discount Rate (%)		Birr)	Ratio(B/C)
Base Case				
AC	26.8%		220	4.294
Cost Increased by 20 %				
AC	24.1%		2078.82	3.599
Benefits decreased by 20%				
AC	23.5%		1632.23	3.435
Cost Increased by 20% & Benefits decreased by 20%				
AC	21.1%		1502.932	2.879

The results of the sensitivity analysis indicate that the project is economically viable even if both cost increases by 20% and benefits decrease by 20% taken together.

4.3.3.7 Summary of Results

As shown in the section, 4-14 the analysis were done for both cable car and roadway construction against do nothing with HDM-4 and the following tables show the results.

Table 4-16: Results of Economic Analysis

Scenarios	Construction of cable car	Construction of road way
Base Case		
IRR @ 10.23%	33.1%	26.8
NPV (In Million Birr)	18,851	220
Benefit Cost Ratio(B/C)	4.412	4.294
Cost Increased by 20 %		
IRR @ 10.23%	31.7	24.4
NPV (In Million Birr)	18,625	207
Benefit Cost Ratio(B/C)	4.367	3.599
Benefits decreased by 20%		
IRR @ 10.23%	26.7%	23.5
NPV (In Million Birr)	13,716	163
Benefit Cost Ratio(B/C)	3.165	3.435
Cost Increased by 20% & Benefits decreased by 20%		
IRR @ 10.23%	26.0%	21.1
NPV (In Million Birr)	13500	150
Benefit Cost Ratio(B/C)	3.13	2.879

The results of the sensitivity analysis indicate that the project is economically viable even if both cost increases by 20% and benefits decrease by 20% taken together. Hence, based on the results the cable car installation is more feasibility than construction of roads.

4.4 Right of way problems

One of the analysis for comparing the cost benefit analysis of the cable car against road way is by estimating the right of way limits. In the table, 4-16 show the area required to implement each theologies.

Table 4-17: Occupational Area

No	Descriptions	Total Occupational area M2	Score
1	Cable Car	33,500.00	1st
2	Road Way	700,000.00	2nd

Source:- Estimation

As shown in the table above construction of cable car as an advantage of consuming very less land acquisitions than road construction.

4.5 Travel Time/Journey Time

As shown in the table below the comparison between cable car and road way travel time from Koladit junction to Gishen Mariam Church.

Table 4-18:- Comparison of travel time between Cable car and roadway

Timing Segment	Distance, Km	Average Time, min	Journey	Average Speed, Kph
Koladit Junction – Gishen Mariam Church Road Construction	14km	42min		20
Koladit Junction - Gishen Mariam Church cable car	6.7km	13min		29

Source:- Estimation

The existing gravel road is clearly uneconomic with respects to travel time. The construction or implementation of cable car will decrease the travel time of 25min. This means that the existing road costs an average car user over ¼ hours in journey time.

CHAPTER 5 CONCLUSIONS

Assessment was made on the cost benefit analysis to compare a cable car against the road way on Koladit Junction to Gishen Mariam Church in North Central Ethiopia. There is an existing road at the moment but it will create a negative impact on the environment around mountainous and tourist attraction areas if it is upgraded to Asphalt Road. Based on the economic evaluations of the cable car, it has an ideal solution for dead-end and tourist attraction areas making access to the people living in isolated location with rivers and difficult terrains. The ultimate goal of investment on road infrastructure is reducing poverty in the project area and the country by promoting economic growth through direct benefit to road users; through easing access to market centers for food, education, health services and other services, promoting trading, and productivity of produce and reducing transport costs. However, these benefits will be exaggerated when the project road is located at the suitable terrain type connecting different towns and villages. If the location of the project is isolated and dead-end, with seasonal traffic and difficult terrain mountainous, road construction will have negative impact on investment as well adverse impact on environments due to vehicle emissions.

The study has shown that roads construction produces significant adverse effects on environment and human health due to carbon emissions and pollutants released during the execution of the various construction processes (earthmovings, trucks transit on unpaved roads, crushing, and material production) and the operation of diesel-powered equipment and more of vehicle emissions during the life of the road project. Among the pollutants, the concentration of particular matter (PM) is an increasing concern for the negative effects on human health of workers, inhabitants and environment.

A questionnaire was developed and 429 number of pilgrims and local people were interviewed and the responses were analyzed. The analysis was made in respect of age, location of the area, religion, frequency of trips to Gishen Mariam Church as variables and making interest to use cable car fixed. Hence, 65% of the people are willing to use a cable car and the rest 35% were not willing to use because they believe walking to church along difficult terrains is a blessing; some of them responded that cable car would be expensive and so on. Hence, additional 25% was added and 75% of the people were assumed to use cable car after installations. The study findings showed that cable car has an economic advantage over roadway construction by conducting cost-benefit analysis using the HDM-4 Software for the selected route. The analysis was done road way construction compared against do nothing and cable car construction against do nothing, and the results show that both projects are feasible but cable car has more economic benefits than road way.

The construction or installation of cable cars has the following advantage when compared with the construction of road for the route from Koladit junction to Gishen Mariam Church.

- Cheaper than construction of roads on hill mountainous, section.
- Decrease Travel Time
- Has less or zero emission during its implantation stage
- Consumes less right of way
- Increase the number of tourists
- It is also helped the transport planner to get an alternative means of transport for the place that have manmade and natural barriers in additions

Moreover, based on the economic activates of our country and the experience of other countries like Brazil, Ecuador, Bolivia and Colombia, the researcher developed an average fair price to be paid by the cable car users. The income will incorporated in yearly maintenance activities. The fair price is developed by considering the inflation of our countries as well and the growth on populations for the life of the cable car.

Finally, the overall observation of the area and economic analysis of the cable car implies, despite the lack of experience and literatures, cable car provision will improve access to mobility and physical access to remote and isolated area with dead-end and seasonal traffic, with difficult terrain like Gishen Mariam. The project under study implies that the importance of installing cable car on the area that is difficult to access with roads but the place is a tourist attraction area with seasonal traffic is high.

CHAPTER 6 RECOMMENDATION

Even though the cable car is an ideal solution for tourism as well as for tackling the existing geographical barriers, recommendations has done to avoid risk of using cable car.

- As the Ropeway Towers, which shall be made up of steel, are to be erected over the ground, the base of the towers shall be of some danger to the Wild Life. Thus they should be closed with a mesh wire enclosure which shall be approximately 6 feet (2 m) high. This would prevent any animals from straying into these steel girder bases of the towers.
- The main stations of the Ropeway housing the pulleys with moving parts should be secured for bird hits by enclosing them with bird meshes.
- Further research needs on accident rates and safety of the cable car.
- Further reaserch shall be conducted for modal shifting models.
- Ethiopia is a country with valleys and rugged areas so the installation of cable car wherever absolutely needed is very advisable.
- Generally, cable cars are advantageous to climb steep hills at a fraction of the investment cost of a new tunnel or bridge. Cable cars are also faster to implement than building new roads, which calls decision-makers to consider since they demand results quickly.

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APPENDIX 01

APPENDIX 02

APPENDIX 03:-Output of HDM 4 Analysis for Both Road way and Cable car implementations

- Base case scenarios for cable car

HDM - 4 Economic Analysis Summary
HIGHWAY DEVELOPMENT & MANAGEMENT
 Study Name: Gishen Junction - Gishen Mariam Cable Car
 Run Date: 24-08-2021

This report shows total economic benefits using the following:
 Currency: Birr (millions).
 Discount rate: 10%.
 Analysis Mode: Analysis-by-Project

Alternative: with project vs Alternative: without project

	Increase in Road Agency Costs			Savings in MT VOC	Savings in MT Travel Time Costs	Savings in NMT Travel & Operating Costs	Reduction in Accident Costs	Net Exogenous Benefits	Net Economic Benefits (NPV)
	Capital	Recurrent	Special						
Undiscounted	8,029	0	0	115,727.52	4.47	0	0	0.00	107,702.75
Discounted	5,525	0	0	24,372	4	0	0	0	18,851

Economic Internal Rate of Return (EIRR) = 33.1% (No. of solutions = 1)

HDM-4 Version 1.1 Page 1 of 1

HDM - 4 Benefit Cost Ratios
HIGHWAY DEVELOPMENT & MANAGEMENT
 Study Name: Gishen Junction - Gishen Mariam Cable Car
 Run Date: 24-08-2021
 Currency: Birr (millions)
 Discount Rate: 10.23%

Alternative	Increase in Agency Cost (C)	Decrease in User Cost (B)	Net Exogenous Benefit (E)	Net Present Value (NPV = B + E - C)	NPV/Cos Ratio (NPV/C)	Internal Rate of Return (IRR)
without project	0.000	0.000	0.000	0.000	0.000	0.000
with project	5,524.678	24,376.088	0.000	18,851.388	3.412	33.1 (1)

Figure in brackets is number of IRR solutions in range -90 to +900

HDM-4 Version 1.1 Page 1 of 1

- Increase 20% cost for cable car

HDM - 4		Economic Analysis Summary							
HIGHWAY DEVELOPMENT & MANAGEMENT		Study Name: Gishen Junction - Gishen Mariam Cable Car							
		Run Date: 24-08-2021							
This report shows total economic benefits using the following:									
Currency: Birr (millions).									
Discount rate: 10%.									
Analysis Mode: Analysis-by-Project									
Alternative: with project vs Alternative: without project									
	Increase in Road Agency Costs			Savings in MI VOC	Savings in MT Travel Time Costs	Savings in NMT Travel & Operating Costs	Reduction in Accident Costs	Net Exogenous Benefits	Net Economic Benefits (NPV)
	Capital	Recurrent	Special						
Undiscounted	8,029	0	0	115,462.18	3.69	0	0	0.00	107,436.62
Discounted	5,532	0	0	24,154	3	0	0	0	18,625
Economic Internal Rate of Return (EIRR) = 31.7% (No. of solutions = 1)									
HDM-4 Version 1.1									
Page 1 of 1									

HDM - 4		Benefit Cost Ratios				
HIGHWAY DEVELOPMENT & MANAGEMENT		Study Name: Gishen Junction - Gishen Mariam Cable Car				
		Run Date: 24-08-2021				
		Currency: Birr (millions)				
		Discount Rate: 10.23%				
Alternative	Increase in Agency Cost (C)	Decrease in User Cost (B)	Net Exogenous Benefit (E)	Net Present Value (NPV = B + E - C)	NPV/Cos Ratio (NPV/C)	Internal Rate of Return (IRR)
without project	0.000	0.000	0.000	0.000	0.000	0.000
with project	5,531.577	24,157.055	0.000	18,625.478	3.367	31.7 (1)
Figure in brackets is number of IRR solutions in range -90 to +900						
HDM-4 Version 1.1						
Page 1 of 1						

- Decrease 20% Benefit for cable car

HDM - 4		Economic Analysis Summary							
HIGHWAY DEVELOPMENT & MANAGEMENT		Study Name: Gishen Junction - Gishen Mariam Cable Car							
		Run Date: 24-08-2021							
This report shows total economic benefits using the following:									
Currency: Birr (millions).									
Discount rate: 10%.									
Analysis Mode: Analysis-by-Project									
Alternative: with project vs Alternative: without project									
	Increase in Road Agency Costs			Savings in MI VOC	Savings in MT Travel Time Costs	Savings in NMT Travel & Operating Costs	Reduction in Accident Costs	Net Exogenous Benefits	Net Economic Benefits (NPV)
	Capital	Recurrent	Special						
Undiscounted	9,635	0	0	94,127.33	8.28	0	0	0.00	84,500.51
Discounted	6,337	0	0	20,046	7	0	0	0	13,716
Economic Internal Rate of Return (EIRR) = 26.7% (No. of solutions = 1)									
HDM-4 Version 1.1									
Page 1 of 1									

HDM - 4		Benefit Cost Ratios				
HIGHWAY DEVELOPMENT & MANAGEMENT		Study Name: Gishen Junction - Gishen Mariam Cable Car				
		Run Date: 24-08-2021				
		Currency: Birr (millions)				
		Discount Rate: 10.23%				
Alternative	Increase i Agency Cost (C)	Decrease i User Cost (B)	Net Exogenous Benefit (E)	Net Present Value (NPV = B + E - C)	NPV/Cos Ratio (NPV/C)	Internal Rat of Return (IRR)
without project	0.000	0.000	0.000	0.000	0.000	0.000
with project	6,336.772	20,052.752	0.000	13,715.981	2.165	26.7 (1)
Figure in brackets is number of IRR solutions in range -90 to +900						
HDM-4 Version 1.1						
Page 1 of 1						

- Increase cost and benefit by 20% for cable car

HDM - 4 Economic Analysis Summary

HIGHWAY DEVELOPMENT & MANAGEMENT

Study Name: Gishen Junction - Gishen Mariam Cable Car
Run Date: 24-08-2021

This report shows total economic benefits using the following:
Currency: Birr (millions).
Discount rate: 10%.
Analysis Mode: Analysis-by-Project

Alternative: with project vs Alternative: without project

	Increase in Road Agency Costs			Savings in MI VOC	Savings in MT Travel Time Costs	Savings in NMT Travel & Operating Costs	Reduction in Accident Costs	Net Exogenous Benefits	Net Economic Benefits (NPV)
	Capital	Recurrent	Special						
Undiscounted	9,635	0	0	93,911.48	7.03	0	0	0.00	84,283.42
Discounted	6,344	0	0	19,889	6	0	0	0	13,530

Economic Internal Rate of Return (EIRR) = 26.0% (No. of solutions = 1)

HDM-4 Version 1.1 Page 1 of 1

HDM - 4 Benefit Cost Ratios

HIGHWAY DEVELOPMENT & MANAGEMENT

Study Name: Gishen Junction - Gishen Mariam Cable Car
Run Date: 24-08-2021
Currency: Birr (millions)
Discount Rate: 10.23%

Alternative	Increase in Agency Cost (C)	Decrease in User Cost (B)	Net Exogenous Benefit (E)	Net Present Value (NPV = B + E - C)	NPV/Cos Ratio (NPV/C)	Internal Rate of Return (IRR)
without project	0.000	0.000	0.000	0.000	0.000	0.000
with project	6,343,670	19,874,083	0.000	13,530,413	2.133	28.0 (1)

Figure in brackets is number of IRR solutions in range -90 to +900

HDM-4 Version 1.1 Page 1 of 1

- Base case scenarios for Road way

HDM - 4 Economic Analysis Summary
ROADWAY DEVELOPMENT & MANAGEMENT Study Name: Gishen Junction - Gishen Mariam
 Run Date: 24-06-2018

This report shows total economic benefits using the following:
 Currency: Birr (millions).
 Discount rate: 10.23%.
 Analysis Mode: Analysis-by-Project

Alternative: with project vs Alternative: with out project

	Increase in Road Agency Costs			Savings in MT VOC	Savings in MT Travel Time Costs	Savings in NMT Travel & Operating Costs	Reduction in Accident Costs	Net Exogenous Benefits	Net Economic Benefits (NPV)
	Capital	Recurrent	Special						
Undiscounted	0.00	-41.73	0.00	-10.97	-0.01	0.00	0.00	0.00	30.78
Discounted	0.00	-17.47	0.00	-9.72	0.00	0.00	0.00	0.00	7.74

Economic Internal Rate of Return (EIRR) = 29.2% (No. of solutions = 2)

HDM-4 Version 1.1 Page 1 of 1

HDM - 4 Benefit Cost Ratios
ROADWAY DEVELOPMENT & MANAGEMENT Study Name: Gishen Junction - Gishen Mariam
 Run Date: 24-06-2018
 Currency: Birr (millions)
 Discount Rate: 10.23%

Alternative	Increase in Agency Costs (C)	Decrease in User Costs (B)	Net Exogenous Benefits (E)	Net Present Value (NPV = B + E - C)	NPV/Cost Ratio (NPV/C)	Internal Rate of Return
with out project	0.000	0.000	0.000	0.000	0.000	0.000
with project	-17.470	-9.728	0.000	7.742	-0.443	29.2 (2)

Figure in brackets is number of IRR solutions in range -90 to +900

HDM-4 Version 1.1 Page 1 of 1

- Increase 20% cost for Road way

HDM - 4 Economic Analysis Summary
ROADWAY DEVELOPMENT & MANAGEMENT
 Study Name: Gishen Junction - Gishen Mariam
 Run Date: 24-06-2018

This report shows total economic benefits using the following:
 Currency: Birr (millions).
 Discount rate: 10.23%.
 Analysis Mode: Analysis-by-Project

Alternative: with project vs Alternative: with out project

	Increase in Road Agency Costs			Savings in MT VOC	Savings in MT Travel Time Costs	Savings in NMT Travel & Operating Costs	Reduction in Accident Costs	Net Exogenous Benefits	Net Economic Benefits (NPV)
	Capital	Recurrent	Special						
Undiscounted	0.00	-36.13	0.00	-10.97	-0.01	0.00	0.00	0.00	25.16
Discounted	0.00	-15.54	0.00	-9.72	0.00	0.00	0.00	0.00	5.81

Economic Internal Rate of Return (EIRR) = 24.8% (No. of solutions = 2)

HDM-4 Version 1.1 Page 1 of 1

HDM - 4 Benefit Cost Ratios
ROADWAY DEVELOPMENT & MANAGEMENT
 Study Name: Gishen Junction - Gishen Mariam
 Run Date: 24-06-2018
 Currency: Birr (millions)
 Discount Rate: 10.23%

Alternative	Increase in Agency Costs (C)	Decrease in User Costs (B)	Net Exogenous Benefits (E)	Net Present Value (NPV = B + E - C)	NPV/Cost Ratio (NPV/C)	Internal Rate of Return
with out project	0.000	0.000	0.000	0.000	0.000	0.000
with project	-15.538	-9.728	0.000	5.810	-0.374	24.8 (2)

Figure in brackets is number of IRR solutions in range -90 to +900

HDM-4 Version 1.1 Page 1 of 1

- Decrease 20% Benefit for roadway

HDM - 4 Economic Analysis Summary
ROADWAY DEVELOPMENT & MANAGEMENT Study Name: Gishen Junction - Gishen Mariam
 Run Date: 24-06-2018

This report shows total economic benefits using the following:
 Currency: Birr (millions).
 Discount rate: 10.23%.
 Analysis Mode: Analysis-by-Project

Alternative: with project vs Alternative: with out project

	Increase in Road Agency Costs			Savings in MT VOC	Savings in MT Travel Time Costs	Savings in HMT Travel & Operating Costs	Reduction in Accident Costs	Net Exogenous Benefits	Net Economic Benefits (NPV)
	Capital	Recurrent	Special						
Undiscounted	0.00	-41.73	0.00	-12.30	-0.01	0.00	0.00	0.00	29.43
Discounted	0.00	-17.47	0.00	-10.94	-0.01	0.00	0.00	0.00	6.52

Economic Internal Rate of Return (EIRR) = 23.0% (No. of solutions = 2)

HDM-4 Version 1.1 Page 1 of 1

HDM - 4 Benefit Cost Ratios
ROADWAY DEVELOPMENT & MANAGEMENT Study Name: Gishen Junction - Gishen Mariam
 Run Date: 24-06-2018
 Currency: Birr (millions)
 Discount Rate: 10.23%

Alternative	Increase in Agency Costs (C)	Decrease in User Costs (B)	Net Exogenous Benefits (E)	Net Present Value (NPV = B + E - C)	NPV/Cost Ratio (NPV/C)	Internal Rate of Return
with out project	0.000	0.000	0.000	0.000	0.000	0.000
with project	-17.470	-10.950	0.000	6.519	-0.373	23.0 (2)

Figure in brackets is number of IRR solutions in range -90 to +900

HDM-4 Version 1.1 Page 1 of 1

- Increase cost and benefit by 20% for cable car

HDM - 4 Economic Analysis Summary
ROADWAY DEVELOPMENT & MANAGEMENT
 Study Name: Gishen Junction - Gishen Mariam
 Run Date: 24-06-2018

This report shows total economic benefits using the following:
 Currency: Birr (millions).
 Discount rate: 10.23%.
 Analysis Mode: Analysis-by-Project

Alternative: with project vs Alternative: with out project

	Increase in Road Agency Costs			Savings in MT VOC	Savings in MT Travel Time Costs	Savings in NMT Travel & Operating Costs	Reduction in Accident Costs	Net Exogenous Benefits	Net Economic Benefits (NPV)
	Capital	Recurrent	Special						
Undiscounted	0.00	-41.73	0.00	-14.67	-0.01	0.00	0.00	0.00	27.05
Discounted	0.00	-17.47	0.00	-13.05	-0.01	0.00	0.00	0.00	4.41

Economic Internal Rate of Return (EIRR) = 17.0% (No. of solutions = 2)

HDM-4 Version 1.1 Page 1 of 1

HDM - 4 Benefit Cost Ratios
ROADWAY DEVELOPMENT & MANAGEMENT
 Study Name: Gishen Junction - Gishen Mariam
 Run Date: 24-06-2018
 Currency: Birr (millions)
 Discount Rate: 10.23%

Alternative	Increase in Agency Costs (C)	Decrease in User Costs (B)	Net Exogenous Benefits (E)	Net Present Value (NPV = B + E - C)	NPV/Cost Ratio (NPV/C)	Internal Rate of Return
with out project	0.000	0.000	0.000	0.000	0.000	0.000
with project	-17.470	-13.058	0.000	4.412	-0.253	17.0 (2)

Figure in brackets is number of IRR solutions in range -90 to +900

HDM-4 Version 1.1 Page 1 of 1

APPENDIX 04

APPENDIX 05

APPENDIX 06

APPENDIX 01

ժող - 7 Պ Ա

Բժժ ԶԳ - ԳՈՅ : ԵԳՇԳՍ : ԵԳՇԳՍ : 3575 : 395 Բ
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 ժՅԵ ԱԳԳ : 08/08/2010
 ՆՅԳԳ ԷՆԳԳ - 3 Պ Ա

Ժ.Ք	ԱԳՍ ՆԻՆՆԳ	ԲՆՈՒ : 3 ԿԵՇԳ	ԼՈՍՈՒՍԵ ԼՍԳՄ
1.	ԶՍԺՅ : ԳՅՆՈՒ : ՆԿԲ	ԲՆԻՇԼԳԿԵ	0913 767757
2.	ՆԺԲՆՈՒ ԱԳԳ : ԶՅ : ՆԿԵ	ԲՆՆՆ 7/90/Կ/Ե	0920-241541
3.	ԼՈՒՍՈՒՍԵ ԿԵԿԳ 7/ՍՈՒՍԺԸ	ԲՆՆՆ 7/Կ/Կ/ՆԺԸ	0921042941
4.	ԼՈՒՍՈՒՍԵ ԺՈՍՍՍԺԸ ԿԿԿԳ	ԲՆՆՆ 7/Կ/Կ/ՆԺԸ	0922 745293
5.	ԺՆՆ : ՆԵՍՍԺԸ ԺԸԼ	ԲՆԻՇԼԳԿԵ	0919914793
6.	ՈՒՍ : ԳՅՆՈՒՍ ԿՆՆՆ : ՆԿԵ	ԲՆՆՆ : ԱԳԳ	0945 1883 65
7.	ՍՍՆ : ԿԱՄ : ԺՈՒՍԺԸ : ՈՍԺԸ	ԲՆ/Յ/Կ/ՆՈՍԺԸ	0913 994579
8.	ՍՍՆ : ՈՍՏ : ԱԳԼ	Բ/Ո/Յ/Կ/ՆՈՍԺԸ	0912 714048
9.	ՍՍՆՈՍ : ՍՍՆՈՍ : ԶԳՍ	ԲՆԻՇԼԳԿԵ	0920 208149
10.	ԺՆՆ : ՆԿԵ : ՈՍԺԸ	Բ/Ո/Յ/Կ/ՆՈՍԺԸ	0920 337433
11.	Լ/ՍՍՏԳԳ ՆԿԵ : ԱԳԼ	Կ Կ	0920 199160
12.	ԺՆՆ : ՍՍՅԳԼ : ՆՈՍՅ	Կ Կ	0920 487813
13.	ՆԵՍ ԲՆՆՆ ՍՍՍ ԵՄ ՆՆՆՆՆՆ	Կ Կ	0911 34 37 68
14.	ՆԵՍ ԳՍ ՆՆՆՆ	Կ Կ	0911 77 51 80
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APPENDIX 02

Estimated Construction cost of Cable car

Pay Item	Description	Unit	Estimated Qty	Rate	Amount (ETB)
	8100: FOUNDATION FOR STRUCTURES				
81.01	Additional foundation investigations				
(a)	Geotechnical Investigation , Foundation Investigation fixed cost	PS	1.00	400,000.000	400,000.000
(b)	Percentage allowed for overhead & profit on item 81.01 (a)	%	25.00%		100,000.000
81.02	Excavation of material				
(a)	Excavation of soft material irrespective of depth	m ³	299.20	133.97	40,084.72
(b)	Excavation of hard material irrespective of depth range	m ³	149.60	326.70	48,875.06
81.05	Backfill to excavations utilizing				-
(a)	materials from the excavation	m ³	89.76	170.242	15,280.92
(b)	Imported material	m ³		327.713	-
(d)	Rock Fill	m ³		400.081	-
(d)	Mass concrete (C-15) with plums of stone (Cyclopean Concrete) for Retaining walls	m ³	19.50	3,284.382	64,045.46
	8100 - Total				668,286.16
83.01	Steel reinforcement for structure				-
(b)	High yield stress steel bars (Deformed (Grade 420)	ton	1.17	78233.76863	91,363.46
(c)	Sheating material	m ²		25	-
	8300 - Total				91,363.46
84.01	Cast in situ concrete for structures				
(a)	Class 30/20 concrete in superstructure, approach slab, abutment seats & back walls. Peir caps, including formwork and class F1 & F2 finish	m ³	125.41	6,179.278	774,955.614
(c)	Cyclopean concrete (60% Grade 20/20 concrete and 40% stone plums /rock) for bridges	m ³	312.23	3,088.999	964,478.211
	8400 - Total				1,739,433.82
	total Cost for One Peir				2,499,083.44
	Contigouncy (10%)				249,908.34
	total Cost for One Peir				2,748,991.78
	PIRE	Number	10.00	2,748,991.785	27,489,917.85
	Track components				7,879,960.00
	Total Construction Cost				35,369,877.85
	Contigouncy (10%)				14,147,951.14
	Total Construction Cost				49,517,828.99
	Total Construction Cost Per KM				7,390,720.74

Estimated Construction cost of Cable car

Pay Item	Description	Unit	Estimated Qty
	8100: FOUNDATION FOR STRUCTURES		
81.01	Additional foundation investigations		
(a)	Geotechnical Investigation , Foundation Investigation fixed cost	PS	1.00
(b)	Percentage allowed for overhead & profit on item 81.01 (a)	%	25.00%
81.02	Excavation of material		
(a)	Excavation of soft material irrespective of depth	m ³	299.20
(b)	Excavation of hard material irrespective of depth range	m ³	149.60
81.05	Backfill to excavations utilizing		
	(a) materials from the excavation	m ³	89.76
	(b) Imported material	m ³	
	(d) Rock Fill	m ³	
(d)	Mass concrete (C-15) with plums of stone (Cyclopean Concrete) for Retaining walls	m ³	19.50
	8100 - Total		
83.01	Steel reinforcement for structure		
	(b) High yield stress steel bars (Deformed (Grade 420)	ton	1.17
	c) Sheating material	m ²	
	8300 - Total		
84.01	Cast in situ concrete for structures		
(a)	Class 30/20 concrete in superstructure, approach slab, abutment seats & back walls. Peir caps, including formwork and class F1 & F2 finish	m ³	125.41
(c)	Cyclopean concrete (60% Grade 20/20 concrete and 40% stone plums /rock) for bridges	m ³	312.23
	8400 - Total		
	total Cost for One Peir		
	Contigouncy (10%)		
	total Cost for One Peir		
	PIRE	Number	10.00
	Track components		
	Total Construction Cost		
	Contigouncy (10%)		
	Total Construction Cost		

Total Construction Cost Per KM		
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Rate	Amount (ETB)
400,000.000	400,000.000
	100,000.000
133.97	40,084.72
326.70	48,875.06
	-
170.242	15,280.92
327.713	-
400.081	-
3,284.382	64,045.46
	668,286.16
	-
78233.76863	91,363.46
25	-
	91,363.46
6,179.278	774,955.614
3,088.999	964,478.211
	1,739,433.82
	2,499,083.44
	249,908.34
	2,748,991.78
2,748,991.785	27,489,917.85
	7,879,960.00
	35,369,877.85
	14,147,951.14
	49,517,828.99

	7,390,720.74
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Pay Item	Description	Unit	Estimated Qty	Rate	Amount (ETB)
	8100: FOUNDATION FOR STRUCTURES				
81.01	Additional foundation investigations				
(a)	Geotechnical Investigation , Foundation Investigation fixed cost	PS	1.00	400,000.000	400,000.000
(b)	Percentage allowed for overhead & profit on item 81.01 (a)	%	25.00%		100,000.000
81.02	Excavation of material				
(a)	Excavation of soft material irrespective of depth	m ³	299.20	133.97	40,084.72
(b)	Excavation of hard material irrespective of depth range	m ³	149.60	326.70	48,875.06
81.05	Backfill to excavations utilizing				-
(a)	materials from the excavation	m ³	89.76	170.242	15,280.92
(b)	Imported material	m ³		327.713	-
(d)	Rock Fill	m ³		400.081	-
(d)	Mass concrete (C-15) with plums of stone (Cyclopean Concrete) for Retaining walls	m ³	19.50	3,284.382	64,045.46
	8100 - Total				668,286.16
83.01	Steel reinforcement for structure				-
(b)	High yield stress steel bars (Deformed (Grade 420)	ton	1.17	78233.76863	91,363.46
(c)	Sheating material	m ²		25	-
	8300 - Total				91,363.46
84.01	Cast in situ concrete for structures				
(a)	Class 30/20 concrete in superstructure, approach slab, abutment seats & back walls. Peir caps, including formwork and class F1 & F2 finish	m ³	125.41	6,179.278	774,955.614
(c)	Cyclopean concrete (60% Grade 20/20 concrete and 40% stone plums /rock) for bridges	m ³	312.23	3,088.999	964,478.211
	8400 - Total				1,739,433.82
	total Cost for One Peir				2,499,083.44
	Contigouncy (10%)				249,908.34
	total Cost for One Peir				2,748,991.78
	PIRE	Number	6.00	2,748,991.785	16,493,950.71
	Track components(Rolling stock)		6.7	44,000,000.00	294,800,000.00
	Total Construction Cost				311,293,950.71
	Contigouncy (10%)				124,517,580.28
	Total Construction Cost				435,811,530.99
	Total Construction Cost Per KM				65,046,497.16

This report shows total economic benefits using the following:

Currency: Birr (millions).

Discount rate: 10%.

Analysis Mode: Analysis-by-Project

Alternative: with project vs Alternative: without project

	Increase in Road Agency Costs			Savings in MT VOC	Savings in MT Travel Time Costs	Savings in NMT Travel & Operating Costs	Reduction in Accident Costs	Net Exogenous Benefits	Net Economic Benefits (NPV)
	Capital	Recurrent	Special						
Undiscounted	9,635	0	0	93,911.48	7.03	0	0	0.00	84,293.42
Discounted	8,344	0	0	19,889	6	0	0	0	13,530

Economic Internal Rate of Return (EIRR) = 26.0% (No. of solutions = 1)

Economic Analysis Summary

Study Name: Gishen Junction - Gishen Mariam Cable Car

Run Date: 24-08-2021

This report shows total economic benefits using the following:

Currency: Birr (millions).

Discount rate: 10%.

Analysis Mode: Analysis-by-Project

Alternative: with project vs Alternative: without project

	Increase in Road Agency Costs			Savings in MI VOC	Savings in MT Travel Time Costs	Savings in NMT Travel & Operating Costs	Reduction in Accident Costs	Net Exogenous Benefits	Net Economic Benefits (NPV)
	Capital	Recurrent	Special						
Undiscounted	9,625	0	0	94,127.33	8.28	0	0	0.00	84,500.51
Discounted	6,337	0	0	20,046	7	0	0	0	13,718

Economic Internal Rate of Return (EIRR) = 26.7% (No. of solutions = 1)

This report shows total economic benefits using the following:

Currency: Birr (millions).

Discount rate: 10%.

Analysis Mode: Analysis-by-Project

Alternative: with project vs Alternative: without project

	Increase in Road Agency Costs			Savings in MT VOC	Savings in MT Travel Time Costs	Savings in NMT Travel & Operating Costs	Reduction in Accident Costs	Net Exogenous Benefits	Net Economic Benefits (NPV)
	Capital	Recurrent	Special						
Undiscounted	8,029	0	0	115,462.18	3.69	0	0	0.00	107,436.62
Discounted	5,532	0	0	24,154	3	0	0	0	18,625

Economic Internal Rate of Return (EIRR) = 31.7% (No. of solutions = 1)

This report shows total economic benefits using the following:

Currency: Birr (millions).

Discount rate: 10%.

Analysis Mode: Analysis-by-Project

Alternative: with project vs Alternative: without project

	Increase in Road Agency Costs			Savings in MI VOC	Savings in MT Travel Time Costs	Savings in NMT Travel & Operating Costs	Reduction in Accident Costs	Net Exogenous Benefits	Net Economic Benefits (NPV)
	Capital	Recurrent	Special						
Undiscounted	8,029	0	0	115,727.52	4.47	0	0	0.00	107,702.75
Discounted	5,525	0	0	24,372	4	0	0	0	18,851

Economic Internal Rate of Return (EIRR) = 33.1% (No. of solutions = 1)

Benefit Cost Ratios

Study Name: Gishen Junction - Gishen Mariam Cable Car
 Run Date: 24-08-2021
 Currency: Birr (millions)
 Discount Rate: 10.23%

Alternative	Increase in Agency Cost (C)	Decrease in User Cost (B)	Net Exogenous Benefit (E)	Net Present Value (NPV = B + E - C)	NPV/Cos Ratio (NPV/C)	Internal Rate of Return (IRR)
without project	0.000	0.000	0.000	0.000	0.000	0.000
with project	6,343,670	19,874,083	0.000	13,530,413	2.133	28.0 (1)

Figure in brackets is number of IRR solutions in range -90 to +900

Benefit Cost Ratios

Study Name: Gishen Junction - Gishen Mariam Cable Car
 Run Date: 24-08-2021
 Currency: Birr (millions)
 Discount Rate: 10.23%

Alternative	Increase in Agency Cost (C)	Decrease in User Cost (B)	Net Exogenous Benefit (E)	Net Present Value (NPV = B + E - C)	NPV/Cost Ratio (NPV/C)	Internal Rate of Return (IRR)
without project	0.000	0.000	0.000	0.000	0.000	0.000
with project	5,524.878	24,376.088	0.000	18,851.388	3.412	33.1 (1)

Figure in brackets is number of IRR solutions in range -90 to +900

Benefit Cost Ratios

Study Name: Gishen Junction - Gishen Mariam Cable Car
 Run Date: 24-08-2021
 Currency: Birr (millions)
 Discount Rate: 10.23%

Alternative	Increase in Agency Cost (C)	Decrease in User Cost (B)	Net Exogenous Benefit (E)	Net Present Value (NPV = B + E - C)	NPV/Cost Ratio (NPV/C)	Internal Rate of Return (IRR)
without project	0.000	0.000	0.000	0.000	0.000	0.000
with project	6,336.772	20,052.752	0.000	13,715.981	2.165	28.7 (1)

Figure in brackets is number of IRR solutions in range -90 to +900

Benefit Cost Ratios

Study Name: Gishen Junction - Gishen Mariam Cable Car
 Run Date: 24-08-2021
 Currency: Birr (millions)
 Discount Rate: 10.23%

Alternative	Increase in Agency Cost (C)	Decrease in User Cost (B)	Net Exogenous Benefit (E)	Net Present Value (NPV = B + E - C)	NPV/Cost Ratio (NPV/C)	Internal Rate of Return (IRR)
without project	0.000	0.000	0.000	0.000	0.000	0.000
with project	5,531.577	24,157.055	0.000	18,625.478	3.367	31.7 (1)

Figure in brackets is number of IRR solutions in range -90 to +900

This report shows total economic benefits using the following:

Currency: Birr (millions).

Discount rate: 10.23%.

Analysis Mode: Analysis-by-Project

Alternative: with project vs Alternative: with out project

	Increase in Road Agency Costs			Savings in MT VOC	Savings in MT Travel Time Costs	Savings in NMT Travel & Operating Costs	Reduction in Accident Costs	Net Exogenous Benefits	Net Economic Benefits (NPV)
	Capital	Recurrent	Special						
Undiscounted	0.00	-41.73	0.00	-14.87	-0.01	0.00	0.00	0.00	27.05
Discounted	0.00	-17.47	0.00	-13.05	-0.01	0.00	0.00	0.00	4.41

Economic Internal Rate of Return (EIRR) = 17.0% (No. of solutions = 2)

This report shows total economic benefits using the following:

Currency: Birr (millions).

Discount rate: 10.23%.

Analysis Mode: Analysis-by-Project

Alternative: with project vs Alternative: with out project

	Increase in Road Agency Costs			Savings in MT VOC	Savings in MT Travel Time Costs	Savings in NMT Travel & Operating Costs	Reduction in Accident Costs	Net Exogenous Benefits	Net Economic Benefits (NPV)
	Capital	Recurrent	Special						
Undiscounted	0.00	-41.73	0.00	-12.30	-0.01	0.00	0.00	0.00	29.43
Discounted	0.00	-17.47	0.00	-10.94	-0.01	0.00	0.00	0.00	6.52

Economic Internal Rate of Return (EIRR) = 23.0% (No. of solutions = 2)

Economic Analysis Summary

Study Name: Gishen Junction - Gishen Mariam

Run Date: 24-06-2018

This report shows total economic benefits using the following:

Currency: Birr (millions).

Discount rate: 10.23%.

Analysis Mode: Analysis-by-Project

Alternative: with project vs Alternative: with out project

	Increase in Road Agency Costs			Savings in MT VOC	Savings in MT Travel Time Costs	Savings in NMT Travel & Operating Costs	Reduction in Accident Costs	Net Exogenous Benefits	Net Economic Benefits (NPV)
	Capital	Recurrent	Special						
Undiscounted	0.00	-36.13	0.00	-10.97	-0.01	0.00	0.00	0.00	25.16
Discounted	0.00	-15.54	0.00	-9.72	0.00	0.00	0.00	0.00	5.81

Economic Internal Rate of Return (EIRR) = 24.8% (No. of solutions = 2)

This report shows total economic benefits using the following:

Currency: Birr (millions).

Discount rate: 10.23%.

Analysis Mode: Analysis-by-Project

Alternative: with project vs Alternative: with out project

	Increase in Road Agency Costs			Savings in MT VOC	Savings in MT Travel Time Costs	Savings in NMT Travel & Operating Costs	Reduction in Accident Costs	Net Exogenous Benefits	Net Economic Benefits (NPV)
	Capital	Recurrent	Special						
Undiscounted	0.00	-41.73	0.00	-10.97	-0.01	0.00	0.00	0.00	30.76
Discounted	0.00	-17.47	0.00	-9.72	0.00	0.00	0.00	0.00	7.74

Economic Internal Rate of Return (EIRR) = 29.2% (No. of solutions = 2)

Benefit Cost Ratios

Study Name: Gishen Junction - Gishen Mariam

Run Date: 24-06-2018

Currency: Birr (millions)

Discount Rate: 10.23%

Alternative	Increase in Agency Costs (C)	Decrease in User Costs (B)	Net Exogenous Benefits (E)	Net Present Value (NPV = B + E - C)	NPV/Cost Ratio (NPV/C)	Internal Rate of Return
with out project	0.000	0.000	0.000	0.000	0.000	0.000
with project	-17.470	-10.950	0.000	6.519	-0.373	23.0 (2)

Figure in brackets is number of IRR solutions in range -90 to +900

Benefit Cost Ratios

Study Name: Gishen Junction - Gishen Mariam

Run Date: 24-06-2018

Currency: Birr (millions)

Discount Rate: 10.23%

Alternative	Increase in Agency Costs (C)	Decrease in User Costs (B)	Net Exogenous Benefits (E)	Net Present Value (NPV = B + E - C)	NPV/Cost Ratio (NPV/C)	Internal Rate of Return
with out project	0.000	0.000	0.000	0.000	0.000	0.000
with project	-17.470	-13.058	0.000	4.412	-0.253	17.0 (2)

Figure in brackets is number of IRR solutions in range -90 to +900

Benefit Cost Ratios

Study Name: Gishen Junction - Gishen Mariam
Run Date: 24-06-2018
Currency: Birr (millions)
Discount Rate: 10.23%.

Alternative	Increase in Agency Costs (C)	Decrease in User Costs (B)	Net Exogenous Benefits (E)	Net Present Value (NPV = B + E - C)	NPV/Cost Ratio (NPV/C)	Internal Rate of Return
with out project	0.000	0.000	0.000	0.000	0.000	0.000
with project	-15.538	-9.728	0.000	5.810	-0.374	24.8 (2)

Figure in brackets is number of IRR solutions in range -90 to +900

Benefit Cost Ratios

Study Name: Gishen Junction - Gishen Mariam

Run Date: 24-06-2018

Currency: Birr (millions)

Discount Rate: 10.23%.

Alternative	Increase in Agency Costs (C)	Decrease in User Costs (B)	Net Exogenous Benefits (E)	Net Present Value (NPV = B + E - C)	NPV/Cost Ratio (NPV/C)	Internal Rate of Return
with out project	0.000	0.000	0.000	0.000	0.000	0.000
with project	-17.470	-9.728	0.000	7.742	-0.443	29.2 (2)

Figure in brackets is number of IRR solutions in range -90 to +900

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1.0 እድሜ

ሀ. 0 – 18

ሐ. 31 – 42

ሰ. 63 – 70

ለ. 19 – 30

መ. 42 – 62

ረ. 71 ና በላይ

2.0 የሃይማኖት ሁኔታ

ሀ. ኦርቶዶክስ

ሐ. ካቶሊክ

ሰ. ሌላ

ለ. ሙስሊም

መ. ፕሮቴስታንት

3.0 የትምህርት ደረጃ

ሀ. ያልተማረ/ያልተማች

ለ. አንደኛ ደረጃ/1-8 ክፍል

ሐ. ሁለተኛ ደረጃ/9-12

መ. ዲፕሎማ እና ከዛ በላይ

4.0 የስራ ሁኔታ

ሀ. ደምዘተኛ /ተቀጣሪ

ለ. ነጋዴ

ሐ. የቤት እመቤት

መ. ሌላ

5.0 ወደ ግሽን ማርያም በምን መጡ

ሀ. በግል መኪና

ለ. በህዝብ መኪና

ሐ. በእግር

6.0 ወደ ግሽን ማርያም ሲመጡ መነሻዎ ከየት ነው?

7.0 ወደ ግሽን ማርያም ለምን መጡ?

ሀ. ለንግስ /ቤተክርስቲያን ለመሳለም

ለ. ለመነሻ/ሀገር ለማየት

ሐ. ቤተሰብ ለመጠየቅ

መ. ሌላ

8.0 ወደ ግሽን ማርያም ሲመጡ ለስተኛ ጊዜ ነው

ሀ. ለመጀመሪያ ጊዜ

ለ. ለሁለተኛ ጊዜ

ሐ. ለሶስተኛ ጊዜ እና ከዛ በላይ

9.0 ከአስፋልት ማለትም ከደሴ ኩታበር መንገድ ወደ ግሽን ማርያም የሚሄደው የጠጠር መንገድ ሁኔታ እንዴት ይገልጹታል?

ሀ. እጅግ በጣም ጥሩ ለ. በጣም ጥሩ ሐ. ጥሩ መ. አስቸጋሪ ሰ. በጣም አስቸጋሪ

ረ. እጅግ በጣም አስቸጋሪ

10.0 ወደ ግሽን ማርያም ሲመጡ ምን አጋጥሞታል?

11.0 ከዚ በኋላ ወደ ግሽን ማርያም ተመልሰው ይመጣሉ?

ሀ. አዎ ለ. አይ

12.0 በተራ ቁጥር 7.0 ላይ ላለው መልስዎ አይ ከሆነ ለምን?

ሀ. የመንገዱ አስቸጋሪነት ለ. የአቅም ማነስ/በገንዘብ ሐ. የአቅም ማነስ/በጉልበት

መ. የትራንስፖርት አቅርቦት እጥረት

13.0 ከደሴ ወደ ኩታብር በሚወስደው አስፋልት መንገድ ላይ ፣ልዩ ስሙ ቆላዲት ከሚባል ቦታ ተነስቶ ወደ ግሽን ማርያም የሚወስደው የጠጠር መንገድ በመኪና ከመተቀም ይልቅ ተንጠልጣይ መኪና ሆኖ በአጠረ ርዝመት ቢሰራ ይጠቀማሉ?

ሀ. አዎ ለ. አይ

14.0 በተራ ቁጥር 13.0 ላይ ላለው መልስዎ አይ ከሆነ ለምን?

ሀ. በአስቸጋሪው መንገድ መሄድ በረከት ያስገኝልኛል ብዬ ስለማስብ

ለ. ተንጠልጣይ መኪና ተጠቅሜ ስለማላውቅ ያስፈራኛል

ሐ. የመሬት ከፍታ ያስፈራኛል

መ. ውድ ይሆናል ብዬ ስለማስብ

ሰ.ሌላ

ስለትብብርዎ ምስጋናዬን አቀርባለሁ።

ለአካባቢ ነዋሪዎች የተዘጋጀ መጠይቅ

1.0 እድሜ

ሀ. 0 – 18

ሐ. 31 – 42

ሰ. 63 – 70

ለ. 19 – 30

መ. 42 – 62

ረ. 71 ና በላይ

2.0 የሃይማኖት ሁኔታ

ሀ. ኦርቶዶክስ

ሐ. ካቶሊክ

ሰ. ሌላ

ለ. ሙስሊም

መ. ፕሮቴስታንት

3.0 የትምህርት ደረጃ

ሀ. ያልተማረ/ያልተማች

ለ. አንደኛ ደረጃ/1-8 ክፍል

ሐ. ሁለተኛ ደረጃ/9-12

መ. ዲፕሎማ እና ከዛ በላይ

4.0 የስራ ሁኔታ

ሀ. ደሞዘተኛ /ተቀጣሪ

ለ. ነጋዴ

ሐ. የቤት እመቤት

መ. በቀን ገቢ የምተዳደር

5.0 የየት አካባቢ ነዋሪ ነዎት

ሀ. ከቆላዲት እስከ ግሸን ማርያም ባለው የጠጠር መንገድ አካባቢ

ለ. ከሌላ አካባቢ

ሐ. ሌላ

6.0 ወደ ግሸን ማርያም ቤተክርስቲያን በምን ይሄዳሉ?

ሀ. በግል መኪና

ለ. በህዝብ መኪና

ሐ. በእግር

7.0 ከቆላዲት እስከ ግሸን ማርያም ያለውን የጠጠር መንገድ በቀን ስንት ጊዜ ይመላለሳሉ?

ሀ. አንድ ጊዜ

ለ. ሁለት ጊዜ

ሐ. ከሁለት በላይ

8.0 ከቆላዲት እስከ ግሸን ማርያም የጠጠር መንገድ ሲመላለሱ ያጋጠመዎት ካለ?



9.0 ከአስፋልት ማለትም ከደሴ ኩታበር መንገድ ወደ ግሸን ማርያም የሚሄደው የጠጠር መንገድ ሁኔታ እንዴት ይገልጹታል?

ሀ. እጅግ በጣም ጥሩ ለ. በጣም ጥሩ ሐ. ጥሩ መ. አስቸጋሪ ሰ. በጣም አስቸጋሪ

ረ. እጅግ በጣም አስቸጋሪ

10.0 በተራ ቁጥር 9.0 ላይ ላለው መልስዎ ከመ እስከ ረ ድረስ ከሆነ ተቀያሪ ወይም ተለዋጭ የትራንስፖርት አይነት ቢሰራ ይጠቀማሉ ወይ?

ሀ. አዎ ለ. አይ

11.0 በተራ ቁጥር 10.0 ላይ ላለው መልስዎ አይ ከሆነ ለምን?

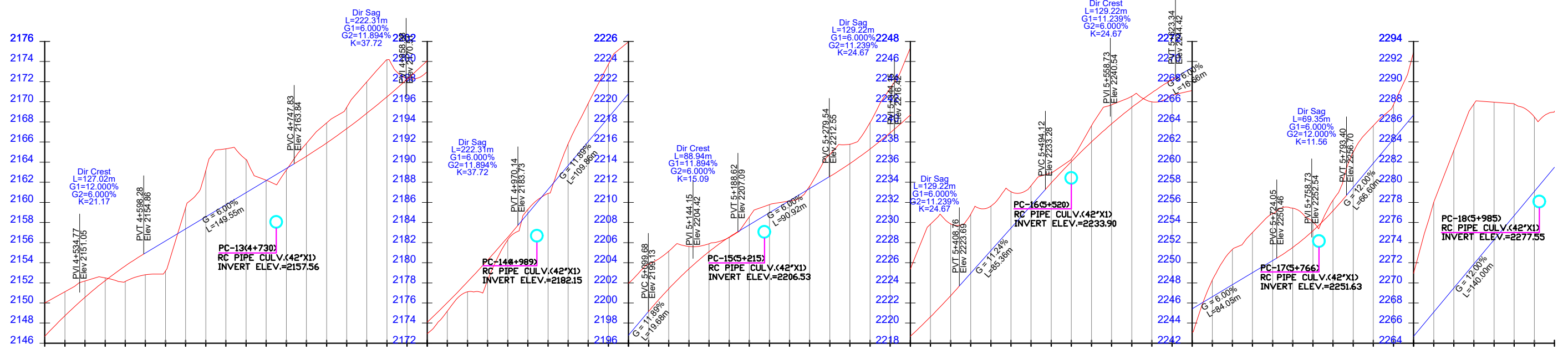
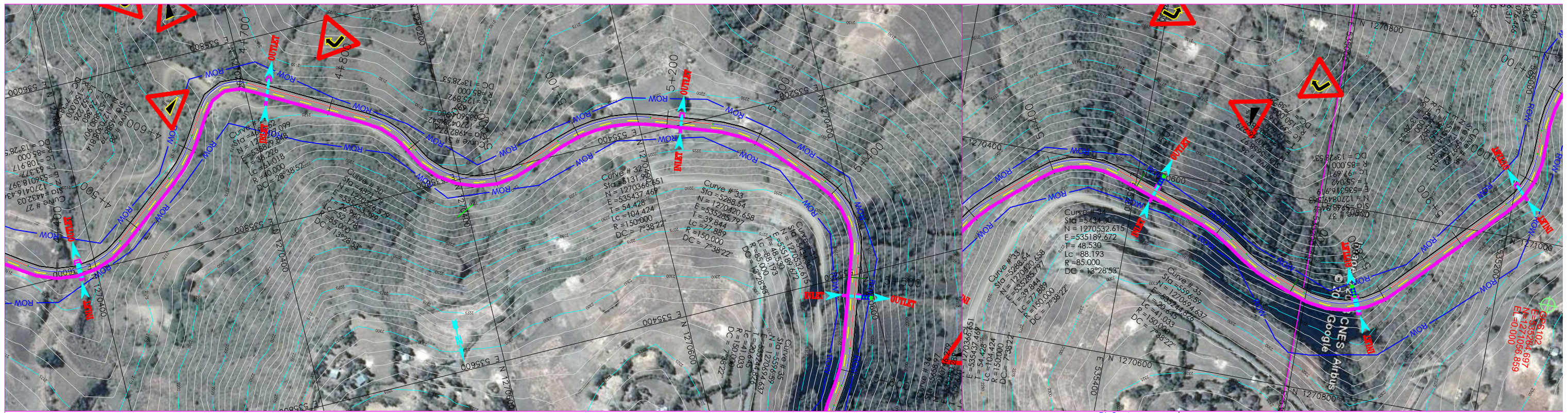
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ለ. ተንጠልጣይ መኪና ተጠቅሜ ስለማላውቅ ያስፈራኛል

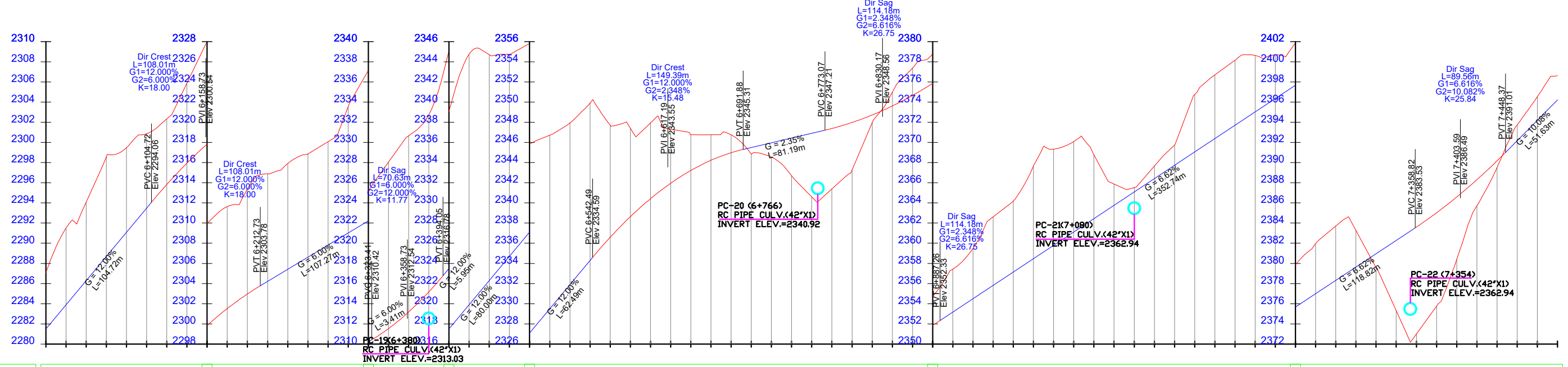
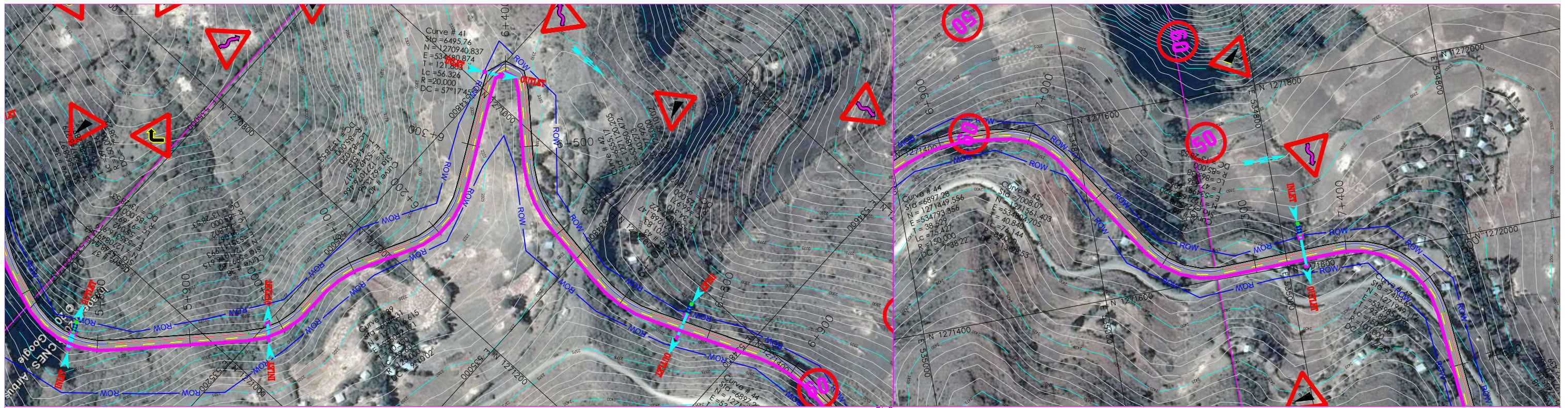
ሐ. የመሬት ከፍታ ያስፈራኛል

መ. ውድ ይሆናል ብዬ ስለማሰብ

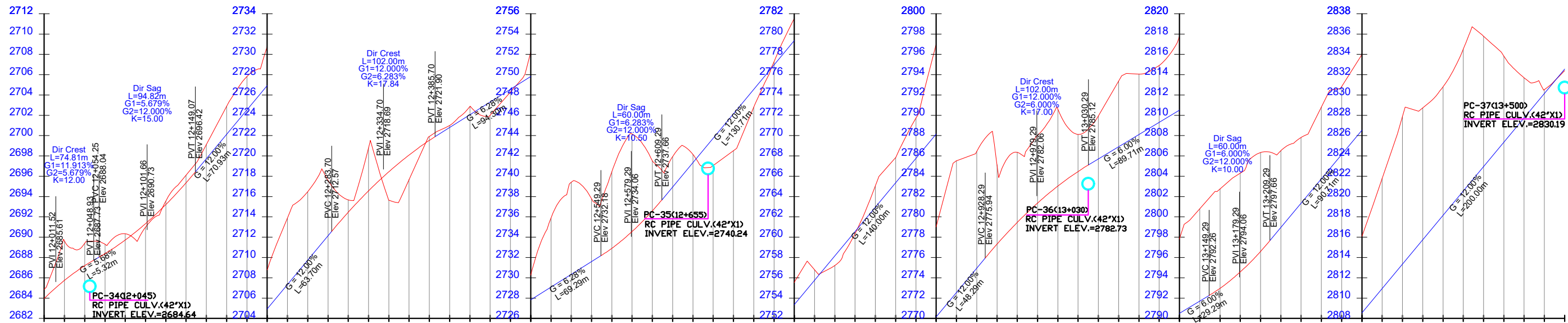
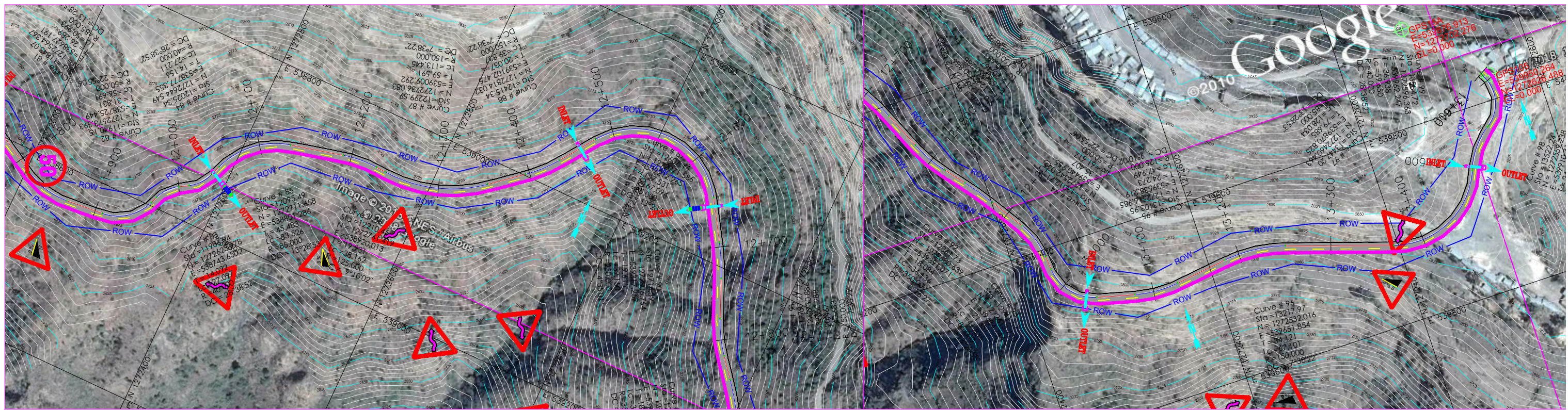
ስለትብብርዎ ምስጋናዬን አቀርባለሁ።



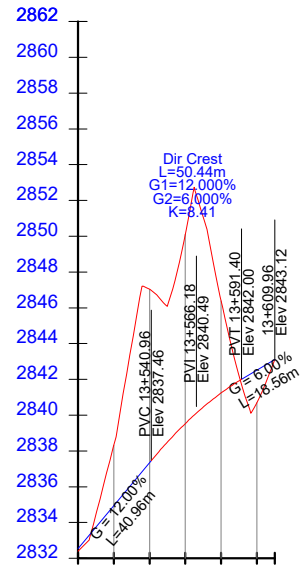
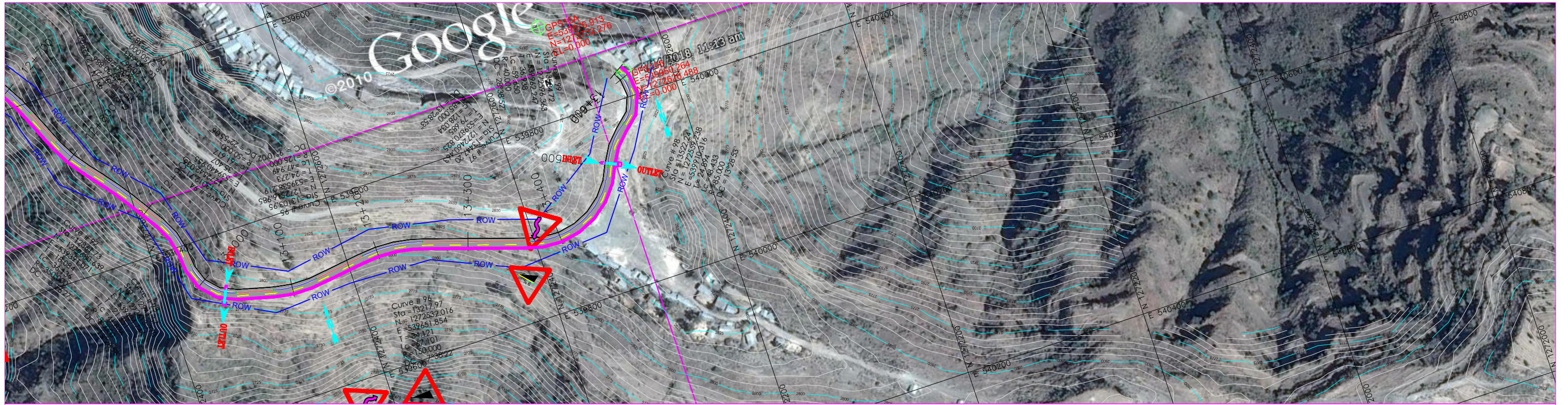
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Proposed:	2146.686	2148.720	2150.565	2152.221	2153.689	2154.968	2156.168	2157.368	2158.568	2159.768	2160.968	2162.168	2163.368	2164.567	2165.767	2166.967	2168.167	2169.367	2170.567	2171.767	2172.967	2174.167	2175.367	2176.567	2177.767	2178.967	2180.167	2181.367	2182.567	2183.767	2184.967	2186.167	2187.367	2188.567	2189.767	2190.967	2192.167	2193.367	2194.567	2195.767	2196.967	2198.167	2199.367	2200.567	2201.767	2202.967	2204.167	2205.367	2206.567	2207.767	2208.967	2210.167	2211.367	2212.567	2213.767	2214.967	2216.167	2217.367	2218.567	2219.767	2220.967	2222.167	2223.367	2224.567	2225.767	2226.967	2228.167	2229.367	2230.567	2231.767	2232.967	2234.167	2235.367	2236.567	2237.767	2238.967	2240.167	2241.367	2242.567	2243.767	2244.967	2246.167	2247.367	2248.567	2249.767	2250.967	2252.167	2253.367	2254.567	2255.767	2256.967	2258.167	2259.367	2260.567	2261.767	2262.967	2264.167	2265.367	2266.567	2267.767	2268.967	2270.167	2271.367	2272.567	2273.767	2274.967	2276.167	2277.367	2278.567	2279.767	2281.492																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																													
Existing:	2150.002	2151.115	2152.185	2153.221	2154.221	2155.185	2156.115	2157.002	2157.844	2158.644	2159.402	2160.115	2160.785	2161.415	2162.002	2162.544	2163.044	2163.502	2163.915	2164.285	2164.615	2164.902	2165.144	2165.344	2165.502	2165.615	2165.685	2165.715	2165.702	2165.644	2165.544	2165.402	2165.215	2165.002	2164.764	2164.492	2164.175	2163.815	2163.415	2162.975	2162.502	2162.002	2161.475	2160.915	2160.315	2159.675	2159.002	2158.292	2157.544	2156.764	2155.915	2155.002	2154.022	2153.002	2151.944	2150.752	2149.522	2148.252	2146.944	2145.592	2144.202	2142.775	2141.315	2139.822	2138.302	2136.752	2135.175	2133.575	2131.944	2130.285	2128.602	2126.892	2125.164	2123.422	2121.664	2119.892	2118.102	2116.292	2114.464	2112.622	2110.764	2108.892	2107.002	2105.092	2103.164	2101.215	2099.244	2097.252	2095.242	2093.212	2091.164	2089.092	2087.002	2084.892	2082.764	2080.615	2078.444	2076.252	2074.042	2071.812	2069.564	2067.292	2065.002	2062.692	2060.364	2058.022	2055.664	2053.285	2050.892	2048.482	2046.052	2043.602	2041.132	2038.642	2036.132	2033.602	2031.052	2028.482	2025.892	2023.282	2020.652	2018.002	2015.332	2012.642	2010.032	2007.402	2004.752	2002.082	1999.492	1996.882	1994.252	1991.602	1988.932	1986.242	1983.532	1980.802	1978.052	1975.282	1972.492	1969.682	1966.852	1963.992	1961.112	1958.212	1955.292	1952.352	1949.392	1946.412	1943.412	1940.392	1937.352	1934.292	1931.212	1928.112	1925.002	1921.872	1918.722	1915.552	1912.362	1909.152	1905.922	1902.672	1899.402	1896.112	1892.802	1889.472	1886.122	1882.752	1879.362	1875.952	1872.522	1869.072	1865.602	1862.112	1858.602	1855.072	1851.522	1847.952	1844.362	1840.752	1837.122	1833.472	1829.802	1826.112	1822.402	1818.672	1814.922	1811.152	1807.362	1803.552	1799.722	1795.872	1792.002	1788.112	1784.202	1780.272	1776.322	1772.352	1768.362	1764.352	1760.322	1756.272	1752.202	1748.112	1744.002	1739.872	1735.722	1731.552	1727.362	1723.152	1718.922	1714.672	1710.402	1706.112	1701.802	1697.472	1693.122	1688.752	1684.362	1679.952	1675.522	1671.072	1666.602	1662.112	1657.602	1653.072	1648.522	1643.952	1639.362	1634.752	1630.122	1625.472	1620.802	1616.112	1611.402	1606.672	1601.922	1597.152	1592.362	1587.552	1582.722	1577.872	1573.002	1568.112	1563.202	1558.272	1553.322	1548.352	1543.362	1538.352	1533.322	1528.272	1523.202	1518.112	1513.002	1507.872	1502.722	1497.552	1492.362	1487.152	1481.922	1476.672	1471.402	1466.112	1460.802	1455.472	1450.122	1444.752	1439.362	1433.952	1428.522	1423.072	1417.602	1412.112	1406.602	1401.072	1395.522	1389.952	1384.362	1378.752	1373.122	1367.472	1361.802	1356.112	1350.402	1344.672	1338.922	1333.152	1327.362	1321.552	1315.722	1309.872	1304.002	1298.112	1292.202	1286.272	1280.322	1274.352	1268.362	1262.352	1256.322	1250.272	1244.202	1238.112	1232.002	1225.872	1219.722	1213.552	1207.362	1201.152	1194.922	1188.672	1182.402	1176.112	1169.802	1163.472	1157.122	1150.752	1144.362	1137.952	1131.522	1125.072	1118.602	1112.112	1105.602	1099.072	1092.522	1085.952	1079.362	1072.752	1066.122	1059.472	1052.802	1046.112	1039.402	1032.672	1025.922	1019.152	1012.362	1005.552	998.722	991.872	985.002	978.112	971.202	964.272	957.322	950.352	943.362	936.352	929.322	922.272	915.202	908.112	901.002	893.872	886.722	879.552	872.362	865.152	857.922	850.672	843.402	836.112	828.802	821.472	814.122	806.752	799.362	791.952	784.522	777.072	769.602	762.112	754.602	747.072	739.522	731.952	724.362	716.752	709.122	701.472	693.802	686.112	678.402	670.672	662.922	655.152	647.362	639.552	631.722	623.872	616.002	608.112	600.202	592.272	584.322	576.352	568.362	560.352	552.322	544.272	536.202	528.112	520.002	511.872	503.722	495.552	487.362	479.152	470.922	462.672	454.402	446.112	437.802	429.472	421.122	412.752	404.362	395.952	387.522	379.072	370.602	362.112	353.602	345.072	336.522	327.952	319.362	310.752	302.122	293.472	284.802	276.112	267.402	258.672	249.922	241.152	232.362	223.552	214.722	205.872	197.002	188.112	179.202	170.272	161.322	152.352	143.362	134.352	125.322	116.272	107.202	98.112	89.002	79.872	70.722	61.552	52.362	43.152	33.922	24.672	15.402	6.112	-3.172	-13.472	-23.802	-34.152	-44.522	-54.922	-65.352	-75.762	-86.152	-96.522	-106.872	-117.202	-127.512	-137.802	-148.072	-158.322	-168.552	-178.762	-188.952	-199.122	-209.272	-219.402	-229.512	-239.602	-249.672	-259.722	-269.752	-279.762	-289.752	-299.722	-309.672	-319.602	-329.512	-339.402	-349.272	-359.122	-368.952	-378.762	-388.552	-398.322	-408.072	-417.802	-427.512	-437.202	-446.872	-456.522	-466.152	-475.762	-485.352	-494.922	-504.472	-514.002	-523.512	-533.002	-542.472	-551.922	-561.352	-570.762	-580.152	-589.522	-598.872	-608.202	-617.512	-626.802	-636.072	-645.322	-654.552	-663.762	-672.952	-682.122	-691.272	-700.402	-709.512	-718.602	-727.672	-736.722	-745.752	-754.762	-763.752	-772.722	-781.672	-790.602	-799.512	-808.402	-817.272	-826.122	-834.952	-843.762	-852.552	-861.322	-870.072	-878.802	-887.512	-896.202	-904.872	-913.522	-922.152	-930.762	-939.352	-947.922	-956.472	-965.002	-973.512	-982.002	-990.472	-998.922	-1007.352	-1015.762	-1024.152	-1032.522	-1040.872	-1049.202	-1057.512	-1065.802	-1074.072	-1082.322	-1090.552	-1098.762	-1106.952	-1115.122	-1123.272	-1131.402	-1139.512	-1147.602	-1155.672	-1163.722	-1171.752	-1179.762	-1187.752	-1195.722	-1203.672	-1211.602	-1219.512	-1227.402	-1235.272	-1243.122	-1250.952	-1258.762	-1266.552	-1274.322	-1282.072	-1289.802	-1297.512	-1305.202	-1312.872	-1320.522	-1328.152	-1335.762	-1343.352	-1350.922	-1358.472	-1366.002	-1373.512	-1381.002	-1388.472	-1395.922	-1403.352	-1410.762	-1418.152	-1425.522	-1432.872	-1440.202	-1447.512	-1454.802	-1462.072	-1469.322	-1476.552	-1483.762	-1490.952	-1498.122	-1505.272	-1512.402	-1519.512	-1526.602	-1533.672	-1540.722	-1547.752	-1554.762	-1561.752	-1568.722	-1575.672	-1582.602	-1589.512	-1596.402	-1603.272	-1610.122	-1616.952	-1623.762	-1630.552	-1637.322	-1644.072	-1650.802	-1657.512	-1664.202	-1670.872	-1677.522	-1684.152	-1690.762	-1697.352	-1703.922	-1710.472	-1717.002	-1723.512	-1730.002	-1736.472	-1742.922	-1749.352	-1755.762	-1762.152	-1768.522	-1774.872	-1781.202	-1787.512	-1793.802	-1800.072	-1806.322	-1812.552	-1818.762	-1824.952	-1831.122	-1837.272	-1843.402	-1849.512	-1855.602	-1861.672	-1867.722	-1873.752	-1879.762	-1885.752	-1891.722	-1897.672	-1903.602	-1909.512	-1915.402	-1921.272	-1927.122	-1932.952	-1938.762	-1944.552	-1950.322	-1956.072	-1961.802	-1967.512	-1973.202	-1978.872	-1984.522	-1990.152	-1995.762	-2001.352	-2006.922	-2012.472	-2018.002	-2023.512	-2029.002	-2034.472	-2039.922	-2045.352	-2050.762	-2056.152	-2061.522	-2066.872	-2072.202	-2077.512	-2082.802	-2088.072	-2093.322	-2098.552	-2103.762	-2108.952	-2114.122	-2119.272	-2124.402	-2129.512	-2134.602	-2139.672	-2144.722	-2149.752	-2154.762	-2159.752	-2164.722	-2169.672	-2174.602	-2179.512	-2184.402	-2189.272	-2194.122	-2198.952	-2203.762	-2208.552	-2213.322	-2218.072	-2222.802	-2227.512	-2232.202	-2236.872	-2241.522	-2246.152	-2250.762	-2255.352	-2259.922



Station:	6+000	6+020	6+040	6+060	6+080	6+100	6+120	6+140	6+160	6+180	6+200	6+220	6+240	6+260	6+280	6+300	6+320	6+340	6+360	6+380	6+400	6+420	6+440	6+460	6+480	6+500	6+520	6+540	6+560	6+580	6+600	6+620	6+640	6+660	6+680	6+700	6+720	6+740	6+760	6+780	6+800	6+820	6+840	6+860	6+880	6+900	6+920	6+940	6+960	6+980	7+000	7+020	7+040	7+060	7+080	7+100	7+120	7+140	7+160	7+180	7+200	7+220	7+240	7+260	7+280	7+300	7+320	7+340	7+360	7+380	7+400	7+420	7+440	7+460	7+480	7+500																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							
Proposed:	2281.492	2283.892	2286.292	2288.692	2291.092	2293.492	2295.827	2297.946	2299.843	2301.518	2302.971	2304.216	2305.416	2306.616	2307.816	2309.016	2310.216	2311.532	2313.184	2315.176	2317.492	2319.892	2322.292	2324.692	2327.092	2329.492	2331.892	2334.292	2336.692	2339.092	2341.492	2343.892	2346.292	2348.692	2351.092	2353.492	2355.892	2358.292	2360.692	2363.092	2365.492	2367.892	2370.292	2372.692	2375.092	2377.492	2379.892	2382.292	2384.692	2387.092	2389.492	2391.892	2394.292	2396.692	2399.092	2401.492	2403.892	2406.292	2408.692	2411.092	2413.492	2415.892	2418.292	2420.692	2423.092	2425.492	2427.892	2430.292	2432.692	2435.092	2437.492	2439.892	2442.292	2444.692	2447.092	2449.492	2451.892	2454.292	2456.692	2459.092	2461.492	2463.892	2466.292	2468.692	2471.092	2473.492	2475.892	2478.292	2480.692	2483.092	2485.492	2487.892	2490.292	2492.692	2495.092	2497.492	2499.892	2502.292	2504.692	2507.092	2509.492	2511.892	2514.292	2516.692	2519.092	2521.492	2523.892	2526.292	2528.692	2531.092	2533.492	2535.892	2538.292	2540.692	2543.092	2545.492	2547.892	2550.292	2552.692	2555.092	2557.492	2559.892	2562.292	2564.692	2567.092	2569.492	2571.892	2574.292	2576.692	2579.092	2581.492	2583.892	2586.292	2588.692	2591.092	2593.492	2595.892	2598.292	2600.692	2603.092	2605.492	2607.892	2610.292	2612.692	2615.092	2617.492	2619.892	2622.292	2624.692	2627.092	2629.492	2631.892	2634.292	2636.692	2639.092	2641.492	2643.892	2646.292	2648.692	2651.092	2653.492	2655.892	2658.292	2660.692	2663.092	2665.492	2667.892	2670.292	2672.692	2675.092	2677.492	2679.892	2682.292	2684.692	2687.092	2689.492	2691.892	2694.292	2696.692	2699.092	2701.492	2703.892	2706.292	2708.692	2711.092	2713.492	2715.892	2718.292	2720.692	2723.092	2725.492	2727.892	2730.292	2732.692	2735.092	2737.492	2739.892	2742.292	2744.692	2747.092	2749.492	2751.892	2754.292	2756.692	2759.092	2761.492	2763.892	2766.292	2768.692	2771.092	2773.492	2775.892	2778.292	2780.692	2783.092	2785.492	2787.892	2790.292	2792.692	2795.092	2797.492	2799.892	2802.292	2804.692	2807.092	2809.492	2811.892	2814.292	2816.692	2819.092	2821.492	2823.892	2826.292	2828.692	2831.092	2833.492	2835.892	2838.292	2840.692	2843.092	2845.492	2847.892	2850.292	2852.692	2855.092	2857.492	2859.892	2862.292	2864.692	2867.092	2869.492	2871.892	2874.292	2876.692	2879.092	2881.492	2883.892	2886.292	2888.692	2891.092	2893.492	2895.892	2898.292	2900.692	2903.092	2905.492	2907.892	2910.292	2912.692	2915.092	2917.492	2919.892	2922.292	2924.692	2927.092	2929.492	2931.892	2934.292	2936.692	2939.092	2941.492	2943.892	2946.292	2948.692	2951.092	2953.492	2955.892	2958.292	2960.692	2963.092	2965.492	2967.892	2970.292	2972.692	2975.092	2977.492	2979.892	2982.292	2984.692	2987.092	2989.492	2991.892	2994.292	2996.692	2999.092	3001.492	3003.892	3006.292	3008.692	3011.092	3013.492	3015.892	3018.292	3020.692	3023.092	3025.492	3027.892	3030.292	3032.692	3035.092	3037.492	3039.892	3042.292	3044.692	3047.092	3049.492	3051.892	3054.292	3056.692	3059.092	3061.492	3063.892	3066.292	3068.692	3071.092	3073.492	3075.892	3078.292	3080.692	3083.092	3085.492	3087.892	3090.292	3092.692	3095.092	3097.492	3099.892	3102.292	3104.692	3107.092	3109.492	3111.892	3114.292	3116.692	3119.092	3121.492	3123.892	3126.292	3128.692	3131.092	3133.492	3135.892	3138.292	3140.692	3143.092	3145.492	3147.892	3150.292	3152.692	3155.092	3157.492	3159.892	3162.292	3164.692	3167.092	3169.492	3171.892	3174.292	3176.692	3179.092	3181.492	3183.892	3186.292	3188.692	3191.092	3193.492	3195.892	3198.292	3200.692	3203.092	3205.492	3207.892	3210.292	3212.692	3215.092	3217.492	3219.892	3222.292	3224.692	3227.092	3229.492	3231.892	3234.292	3236.692	3239.092	3241.492	3243.892	3246.292	3248.692	3251.092	3253.492	3255.892	3258.292	3260.692	3263.092	3265.492	3267.892	3270.292	3272.692	3275.092	3277.492	3279.892	3282.292	3284.692	3287.092	3289.492	3291.892	3294.292	3296.692	3299.092	3301.492	3303.892	3306.292	3308.692	3311.092	3313.492	3315.892	3318.292	3320.692	3323.092	3325.492	3327.892	3330.292	3332.692	3335.092	3337.492	3339.892	3342.292	3344.692	3347.092	3349.492	3351.892	3354.292	3356.692	3359.092	3361.492	3363.892	3366.292	3368.692	3371.092	3373.492	3375.892	3378.292	3380.692	3383.092	3385.492	3387.892	3390.292	3392.692	3395.092	3397.492	3399.892	3402.292	3404.692	3407.092	3409.492	3411.892	3414.292	3416.692	3419.092	3421.492	3423.892	3426.292	3428.692	3431.092	3433.492	3435.892	3438.292	3440.692	3443.092	3445.492	3447.892	3450.292	3452.692	3455.092	3457.492	3459.892	3462.292	3464.692	3467.092	3469.492	3471.892	3474.292	3476.692	3479.092	3481.492	3483.892	3486.292	3488.692	3491.092	3493.492	3495.892	3498.292	3500.692	3503.092	3505.492	3507.892	3510.292	3512.692	3515.092	3517.492	3519.892	3522.292	3524.692	3527.092	3529.492	3531.892	3534.292	3536.692	3539.092	3541.492	3543.892	3546.292	3548.692	3551.092	3553.492	3555.892	3558.292	3560.692	3563.092	3565.492	3567.892	3570.292	3572.692	3575.092	3577.492	3579.892	3582.292	3584.692	3587.092	3589.492	3591.892	3594.292	3596.692	3599.092	3601.492	3603.892	3606.292	3608.692	3611.092	3613.492	3615.892	3618.292	3620.692	3623.092	3625.492	3627.892	3630.292	3632.692	3635.092	3637.492	3639.892	3642.292	3644.692	3647.092	3649.492	3651.892	3654.292	3656.692	3659.092	3661.492	3663.892	3666.292	3668.692	3671.092	3673.492	3675.892	3678.292	3680.692	3683.092	3685.492	3687.892	3690.292	3692.692	3695.092	3697.492	3699.892	3702.292	3704.692	3707.092	3709.492	3711.892	3714.292	3716.692	3719.092	3721.492	3723.892	3726.292	3728.692	3731.092	3733.492	3735.892	3738.292	3740.692	3743.092	3745.492	3747.892	3750.292	3752.692	3755.092	3757.492	3759.892	3762.292	3764.692	3767.092	3769.492	3771.892	3774.292	3776.692	3779.092	3781.492	3783.892	3786.292	3788.692	3791.092	3793.492	3795.892	3798.292	3800.692	3803.092	3805.492	3807.892	3810.292	3812.692	3815.092	3817.492	3819.892	3822.292	3824.692	3827.092	3829.492	3831.892	3834.292	3836.692	3839.092	3841.492	3843.892	3846.292	3848.692	3851.092	3853.492	3855.892	3858.292	3860.692	3863.092	3865.492	3867.892	3870.292	3872.692	3875.092	3877.492	3879.892	3882.292	3884.692	3887.092	3889.492	3891.892	3894.292	3896.692	3899.092	3901.492	3903.892	3906.292	3908.692	3911.092	3913.492	3915.892	3918.292	3920.692	3923.092	3925.492	3927.892	3930.292	3932.692	3935.092	3937.492	3939.892	3942.292	3944.692	3947.092	3949.492	3951.892	3954.292	3956.692	3959.092	3961.492	3963.892	3966.292	3968.692	3971.092	3973.492	3975.892	3978.292	3980.692	3983.092	3985.492	3987.892	3990.292	3992.692	3995.092	3997.492	3999.892	4002.292	4004.692	4007.092	4009.492	4011.892	4014.292	4016.692	4019.092	4021.492	4023.892	4026.292	4028.692	4031.092	4033.492	4035.892	4038.292	4040.692	4043.092	4045.492	4047.892	4050.292	4052.692	4055.092	4057.492	4059.892	4062.292	4064.692	4067.092	4069.492	4071.892	4074.292	4076.692	4079.092	4081.492	4083.892	4086.292	4088.692	4091.092	4093.492	4095.892	4098.292	4100.692	4103.092	4105.492	4107.892	4110.292	4112.692	4115.092	4117.492	4119.892	4122.292	4124.692	4127.092	4129.492	4131.892	4134.292	4136.692	4139.092	4141.492	4143.892	4146.292	4148.692	4151.092	4153.492	4155.892	4158.292	4160.692	4163.092	4165.492	4167.892	4170.292	4172.692	4175.092	4177.492	4179.892	4182.292	4184.692	4187.092	4189.492	4191.892	4194.292	4196.692	4199.092	4201.492	4203.892	4206.292	4208.692	4211.092	4213.492	4215.892	4218.292	4220.692	4223.092	4225.492	4227.892	4230.292	4232.692	4235.092	4237.492	4239.892	4242.292	4244.692	4247.092	4249.492	4251.892	4254.292	4256.692	4259.092	4261.492	4263.892	4266.292	4268.692	4271.092	4273.492	4275.892	4278.292	4280.692	4283.092	4285.492	4287.892	4290.292	4292.692	4295.092	4297.492	4299.892	4302.292	4304.692	4307.092	4309.492	4311.892	4314.292	4316.692	4319.092	4321.492	4323.892	4326.292	4328.692	4331.092	4333.492	4335.892	4338.292	4340.692	4343.092	4345.492	4347.8



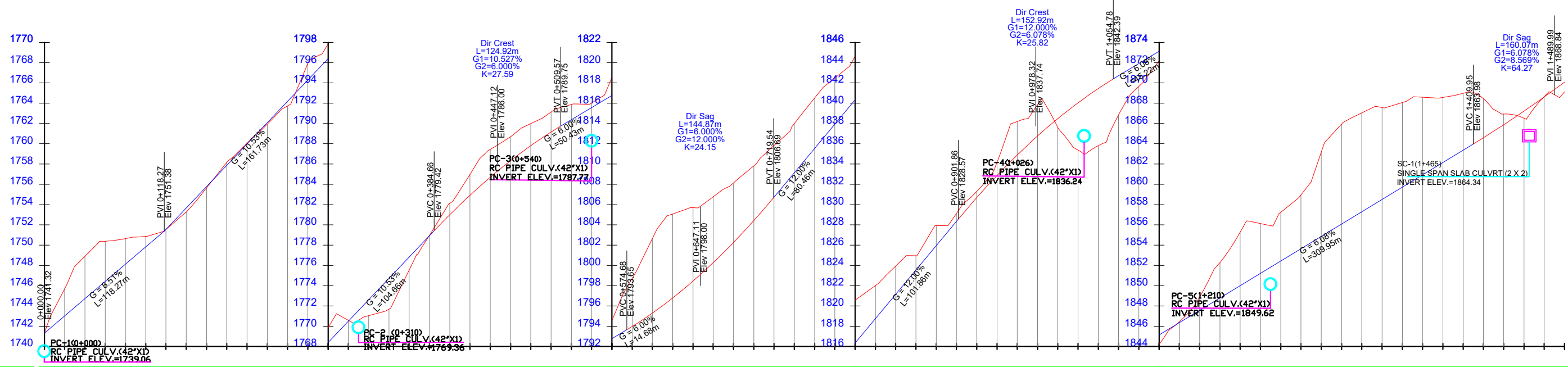
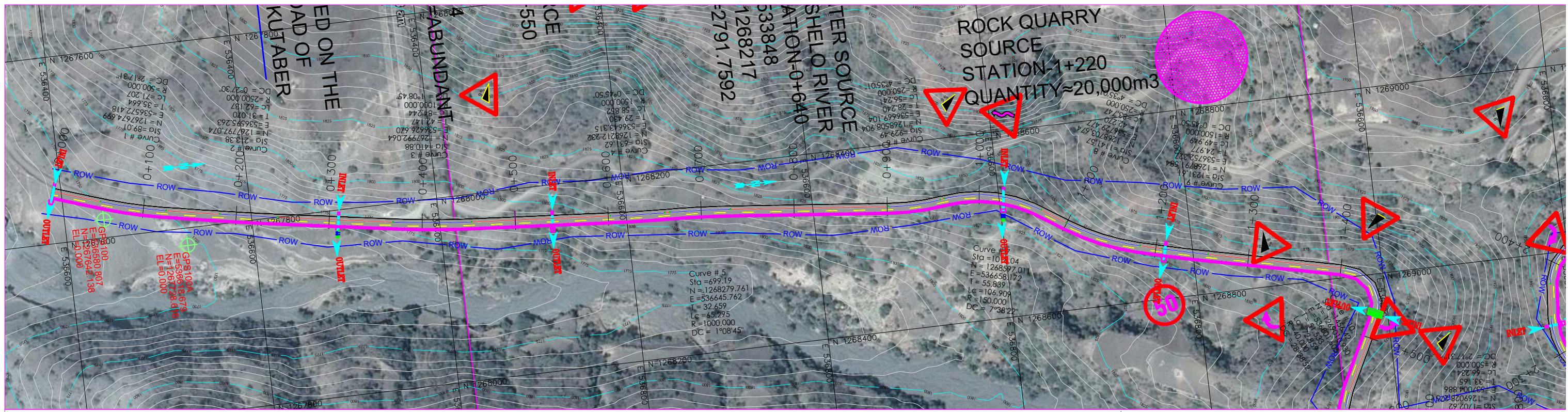
Station:	12+000	12+020	12+040	12+060	12+080	12+100	12+120	12+140	12+160	12+180	12+200	12+220	12+240	12+260	12+280	12+300	12+320	12+340	12+360	12+380	12+400	12+420	12+440	12+460	12+480	12+500	12+520	12+540	12+560	12+580	12+600	12+620	12+640	12+660	12+680	12+700	12+740	12+760	12+780	12+800	12+820	12+840	12+860	12+880	12+900	12+920	12+940	12+960	12+980	13+000	13+020	13+040	13+060	13+080	13+100	13+120	13+140	13+160	13+180	13+200	13+220	13+240	13+260	13+280	13+300	13+320	13+340	13+360	13+380	13+400	13+420	13+440	13+460	13+480	13+500																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																			
Proposed:	2683.958	2685.743	2687.194	2688.374	2689.720	2691.332	2693.211	2695.357	2697.730	2700.130	2702.530	2704.930	2707.330	2709.730	2712.130	2714.455	2716.561	2718.442	2720.099	2721.531	2722.797	2724.054	2725.310	2726.567	2727.824	2729.081	2730.337	2731.594	2732.905	2734.162	2735.369	2736.589	2737.848	2739.148	2740.448	2741.748	2743.048	2744.348	2745.648	2746.948	2748.248	2749.548	2750.848	2752.148	2753.448	2754.748	2756.048	2757.348	2758.648	2759.948	2761.248	2762.548	2763.848	2765.148	2766.448	2767.748	2769.048	2770.348	2771.648	2772.948	2774.248	2775.548	2776.848	2778.148	2779.448	2780.748	2782.048	2783.348	2784.648	2785.948	2787.248	2788.548	2789.848	2791.148	2792.448	2793.748	2795.048	2796.348	2797.648	2798.948	2800.248	2801.548	2802.848	2804.148	2805.448	2806.748	2808.048	2809.348	2810.648	2811.948	2813.248	2814.548	2815.848	2817.148	2818.448	2819.748	2821.048	2822.348	2823.648	2824.948	2826.248	2827.548	2828.848	2830.148	2831.448	2832.748	2834.048	2835.348	2836.648	2837.948	2839.248	2840.548	2841.848	2843.148	2844.448	2845.748	2847.048	2848.348	2849.648	2850.948	2852.248	2853.548	2854.848	2856.148	2857.448	2858.748	2860.048	2861.348	2862.648	2863.948	2865.248	2866.548	2867.848	2869.148	2870.448	2871.748	2873.048	2874.348	2875.648	2876.948	2878.248	2879.548	2880.848	2882.148	2883.448	2884.748	2886.048	2887.348	2888.648	2889.948	2891.248	2892.548	2893.848	2895.148	2896.448	2897.748	2899.048	2900.348	2901.648	2902.948	2904.248	2905.548	2906.848	2908.148	2909.448	2910.748	2912.048	2913.348	2914.648	2915.948	2917.248	2918.548	2919.848	2921.148	2922.448	2923.748	2925.048	2926.348	2927.648	2928.948	2930.248	2931.548	2932.848	2934.148	2935.448	2936.748	2938.048	2939.348	2940.648	2941.948	2943.248	2944.548	2945.848	2947.148	2948.448	2949.748	2951.048	2952.348	2953.648	2954.948	2956.248	2957.548	2958.848	2960.148	2961.448	2962.748	2964.048	2965.348	2966.648	2967.948	2969.248	2970.548	2971.848	2973.148	2974.448	2975.748	2977.048	2978.348	2979.648	2980.948	2982.248	2983.548	2984.848	2986.148	2987.448	2988.748	2990.048	2991.348	2992.648	2993.948	2995.248	2996.548	2997.848	2999.148	3000.448	3001.748	3003.048	3004.348	3005.648	3006.948	3008.248	3009.548	3010.848	3012.148	3013.448	3014.748	3016.048	3017.348	3018.648	3019.948	3021.248	3022.548	3023.848	3025.148	3026.448	3027.748	3029.048	3030.348	3031.648	3032.948	3034.248	3035.548	3036.848	3038.148	3039.448	3040.748	3042.048	3043.348	3044.648	3045.948	3047.248	3048.548	3049.848	3051.148	3052.448	3053.748	3055.048	3056.348	3057.648	3058.948	3060.248	3061.548	3062.848	3064.148	3065.448	3066.748	3068.048	3069.348	3070.648	3071.948	3073.248	3074.548	3075.848	3077.148	3078.448	3079.748	3081.048	3082.348	3083.648	3084.948	3086.248	3087.548	3088.848	3090.148	3091.448	3092.748	3094.048	3095.348	3096.648	3097.948	3099.248	3100.548	3101.848	3103.148	3104.448	3105.748	3107.048	3108.348	3109.648	3110.948	3112.248	3113.548	3114.848	3116.148	3117.448	3118.748	3120.048	3121.348	3122.648	3123.948	3125.248	3126.548	3127.848	3129.148	3130.448	3131.748	3133.048	3134.348	3135.648	3136.948	3138.248	3139.548	3140.848	3142.148	3143.448	3144.748	3146.048	3147.348	3148.648	3149.948	3151.248	3152.548	3153.848	3155.148	3156.448	3157.748	3159.048	3160.348	3161.648	3162.948	3164.248	3165.548	3166.848	3168.148	3169.448	3170.748	3172.048	3173.348	3174.648	3175.948	3177.248	3178.548	3179.848	3181.148	3182.448	3183.748	3185.048	3186.348	3187.648	3188.948	3190.248	3191.548	3192.848	3194.148	3195.448	3196.748	3198.048	3199.348	3200.648	3201.948	3203.248	3204.548	3205.848	3207.148	3208.448	3209.748	3211.048	3212.348	3213.648	3214.948	3216.248	3217.548	3218.848	3220.148	3221.448	3222.748	3224.048	3225.348	3226.648	3227.948	3229.248	3230.548	3231.848	3233.148	3234.448	3235.748	3237.048	3238.348	3239.648	3240.948	3242.248	3243.548	3244.848	3246.148	3247.448	3248.748	3250.048	3251.348	3252.648	3253.948	3255.248	3256.548	3257.848	3259.148	3260.448	3261.748	3263.048	3264.348	3265.648	3266.948	3268.248	3269.548	3270.848	3272.148	3273.448	3274.748	3276.048	3277.348	3278.648	3279.948	3281.248	3282.548	3283.848	3285.148	3286.448	3287.748	3289.048	3290.348	3291.648	3292.948	3294.248	3295.548	3296.848	3298.148	3299.448	3300.748	3302.048	3303.348	3304.648	3305.948	3307.248	3308.548	3309.848	3311.148	3312.448	3313.748	3315.048	3316.348	3317.648	3318.948	3320.248	3321.548	3322.848	3324.148	3325.448	3326.748	3328.048	3329.348	3330.648	3331.948	3333.248	3334.548	3335.848	3337.148	3338.448	3339.748	3341.048	3342.348	3343.648	3344.948	3346.248	3347.548	3348.848	3350.148	3351.448	3352.748	3354.048	3355.348	3356.648	3357.948	3359.248	3360.548	3361.848	3363.148	3364.448	3365.748	3367.048	3368.348	3369.648	3370.948	3372.248	3373.548	3374.848	3376.148	3377.448	3378.748	3380.048	3381.348	3382.648	3383.948	3385.248	3386.548	3387.848	3389.148	3390.448	3391.748	3393.048	3394.348	3395.648	3396.948	3398.248	3399.548	3400.848	3402.148	3403.448	3404.748	3406.048	3407.348	3408.648	3409.948	3411.248	3412.548	3413.848	3415.148	3416.448	3417.748	3419.048	3420.348	3421.648	3422.948	3424.248	3425.548	3426.848	3428.148	3429.448	3430.748	3432.048	3433.348	3434.648	3435.948	3437.248	3438.548	3439.848	3441.148	3442.448	3443.748	3445.048	3446.348	3447.648	3448.948	3450.248	3451.548	3452.848	3454.148	3455.448	3456.748	3458.048	3459.348	3460.648	3461.948	3463.248	3464.548	3465.848	3467.148	3468.448	3469.748	3471.048	3472.348	3473.648	3474.948	3476.248	3477.548	3478.848	3480.148	3481.448	3482.748	3484.048	3485.348	3486.648	3487.948	3489.248	3490.548	3491.848	3493.148	3494.448	3495.748	3497.048	3498.348	3499.648	3500.948	3502.248	3503.548	3504.848	3506.148	3507.448	3508.748	3510.048	3511.348	3512.648	3513.948	3515.248	3516.548	3517.848	3519.148	3520.448	3521.748	3523.048	3524.348	3525.648	3526.948	3528.248	3529.548	3530.848	3532.148	3533.448	3534.748	3536.048	3537.348	3538.648	3539.948	3541.248	3542.548	3543.848	3545.148	3546.448	3547.748	3549.048	3550.348	3551.648	3552.948	3554.248	3555.548	3556.848	3558.148	3559.448	3560.748	3562.048	3563.348	3564.648	3565.948	3567.248	3568.548	3569.848	3571.148	3572.448	3573.748	3575.048	3576.348	3577.648	3578.948	3580.248	3581.548	3582.848	3584.148	3585.448	3586.748	3588.048	3589.348	3590.648	3591.948	3593.248	3594.548	3595.848	3597.148	3598.448	3599.748	3601.048	3602.348	3603.648	3604.948	3606.248	3607.548	3608.848	3610.148	3611.448	3612.748	3614.048	3615.348	3616.648	3617.948	3619.248	3620.548	3621.848	3623.148	3624.448	3625.748	3627.048	3628.348	3629.648	3630.948	3632.248	3633.548	3634.848	3636.148	3637.448	3638.748	3640.048	3641.348	3642.648	3643.948	3645.248	3646.548	3647.848	3649.148	3650.448	3651.748	3653.048	3654.348	3655.648	3656.948	3658.248	3659.548	3660.848	3662.148	3663.448	3664.748	3666.048	3667.348	3668.648	3669.948	3671.248	3672.548	3673.848	3675.148	3676.448	3677.748	3679.048	3680.348	3681.648	3682.948	3684.248	3685.548	3686.848	3688.148	3689.448	3690.748	3692.048	3693.348	3694.648	3695.948	3697.248	3698.548	3699.848	3701.148	3702.448	3703.748	3705.048	3706.348	3707.648	3708.948	3710.248	3711.548	3712.848	3714.148	3715.448	3716.748	3718.048	3719.348	3720.648	3721.948	3723.248	3724.548	3725.848	3727.148	3728.448	3729.748	3731.048	3732.348	3733.648	3734.948	3736.248	3737.548	3738.848	3740.148	3741.448	3742.748	3744.048	3745.348	3746.648	3747.948	3749.248	3750.548	3751.848	3753.148	3754.448	3755.748	3757.048	3758.348	3759.648	3760.948	3762.248	3763.548	3764.848	3766.148	3767.448	3768.748	3770.048	3771.348	3772.648	3773.948	3775.248	3776.548	3777.848	3779.148	3780.448	3781.748	3783.048	3784.348	3785.648	3786.948	3788.248	3789.548	3790.848	3792.148	3793.448	3794.748	3796.048	3797.348	3798.648	3799.948	3801.248	3802.548	3803.848	3805.148	3806.448	3807.748	3809.048	3810.348	3811.648	3812.948	3814.248	



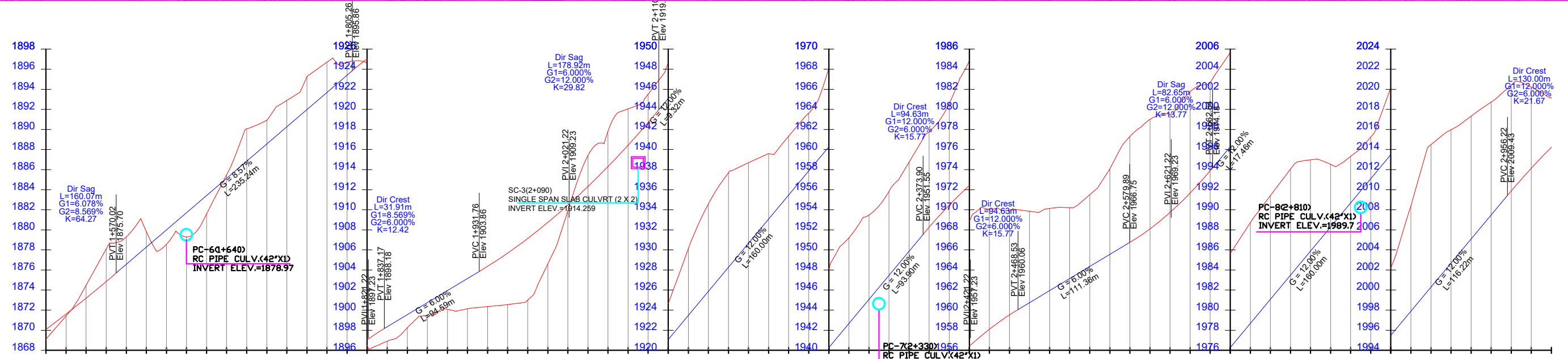
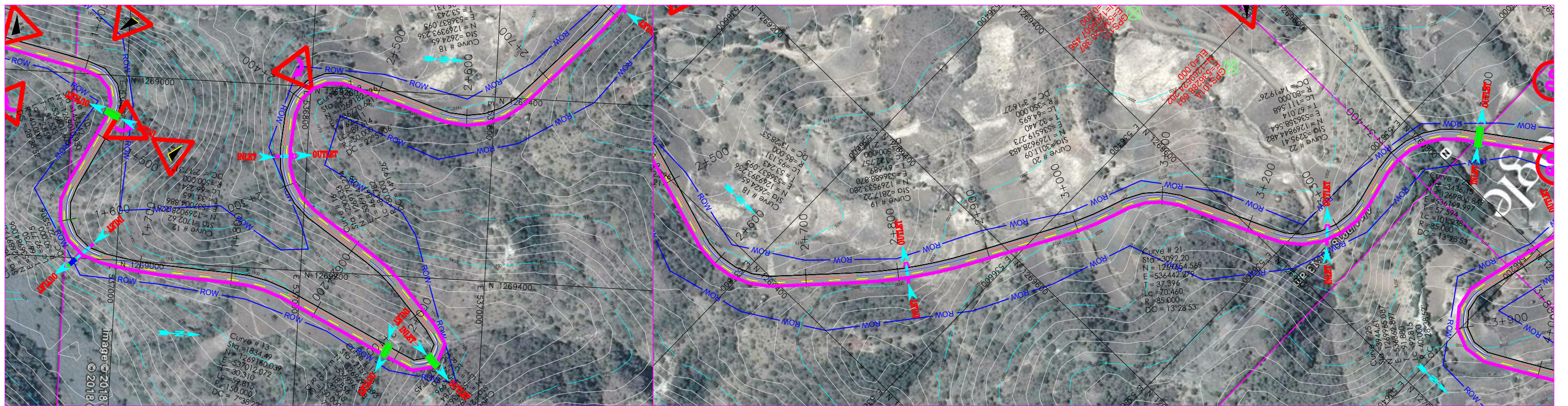
Station:	13+500	13+520	13+540	13+560	13+580	13+600	13+610	
Proposed:	2832.548	2834.948	2837.348	2839.532	2841.241	2842.519	2843.116	
Existing:	2832.397	2838.323	2847.035	2850.105	2846.384	2840.697	2843.116	
Curvature:	R 85.00							L 2.00 R -40.00 L 2.53
Vertical:	L=33.87 G=12.00%							L=50.44 R=841 G=6.00%
Superelevation:	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	

TITLE

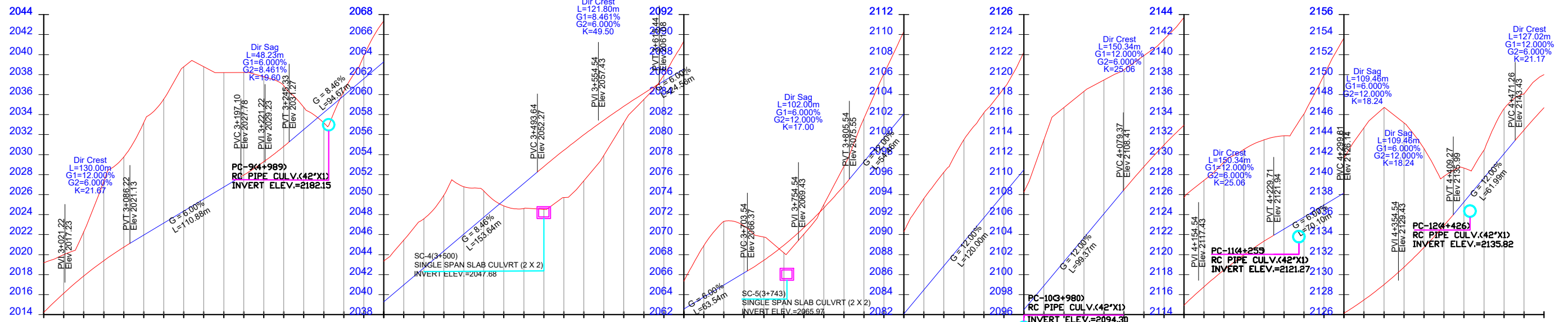
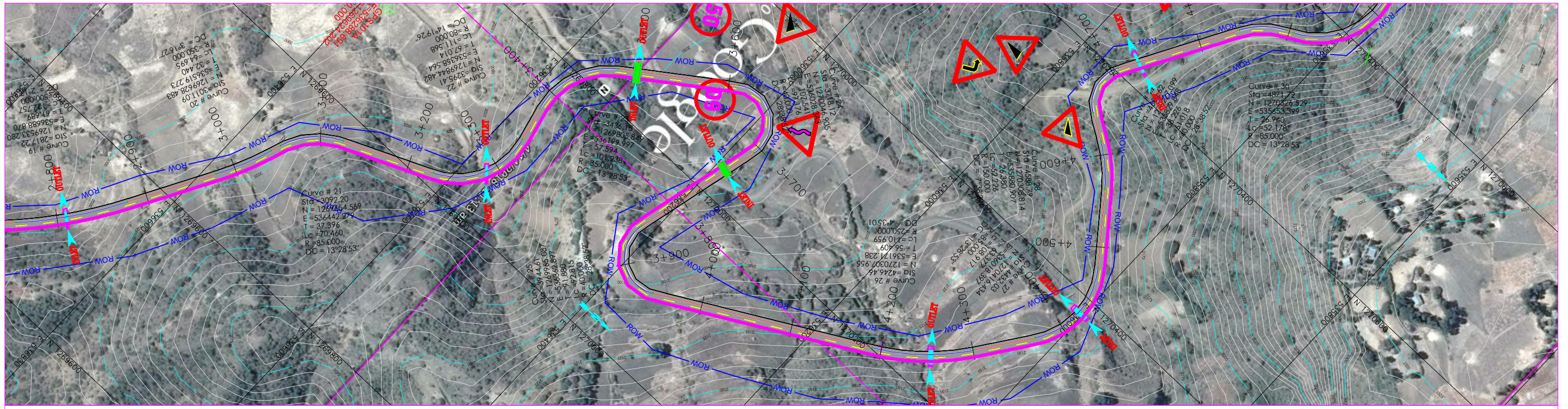
Km 13+500 TO Km 13+610



Station:	0+000	0+020	0+040	0+060	0+080	0+100	0+120	0+140	0+160	0+180	0+200	0+220	0+240	0+260	0+280	0+300	0+320	0+340	0+360	0+380	0+400	0+420	0+440	0+460	0+480	0+500	0+520	0+540	0+560	0+580	0+600	0+620	0+640	0+660	0+680	0+700	0+720	0+740	0+760	0+780	0+800	0+820	0+840	0+860	0+880	0+900	0+920	0+940	0+960	0+980	1+000	1+020	1+040	1+060	1+080	1+100	1+120	1+140	1+160	1+180	1+200	1+220	1+240	1+260	1+280	1+300	1+320	1+340	1+360	1+380	1+400	1+420	1+440	1+460	1+480	1+500																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																	
Proposed:	1741.316	1743.017	1744.719	1746.421	1748.123	1749.825	1751.526	1753.228	1754.930	1756.632	1768.334	1770.036	1771.738	1773.440	1775.142	1776.844	1778.546	1780.248	1781.950	1783.652	1785.354	1787.056	1788.758	1790.460	1792.162	1793.864	1795.566	1797.268	1798.970	1800.672	1802.374	1804.076	1805.778	1807.480	1809.182	1810.884	1812.586	1814.288	1815.990	1817.692	1819.394	1821.096	1822.798	1824.500	1826.202	1827.904	1829.606	1831.308	1833.010	1834.712	1836.414	1838.116	1839.818	1841.520	1843.222	1844.924	1846.626	1848.328	1850.030	1851.732	1853.434	1855.136	1856.838	1858.540	1860.242	1861.944	1863.646	1865.348	1867.050	1868.752	1870.454	1872.156	1873.858	1875.560	1877.262	1878.964	1880.666	1882.368	1884.070	1885.772	1887.474	1889.176	1890.878	1892.580	1894.282	1895.984	1897.686	1899.388	1901.090	1902.792	1904.494	1906.196	1907.898	1909.600	1911.302	1913.004	1914.706	1916.408	1918.110	1919.812	1921.514	1923.216	1924.918	1926.620	1928.322	1930.024	1931.726	1933.428	1935.130	1936.832	1938.534	1940.236	1941.938	1943.640	1945.342	1947.044	1948.746	1950.448	1952.150	1953.852	1955.554	1957.256	1958.958	1960.660	1962.362	1964.064	1965.766	1967.468	1969.170	1970.872	1972.574	1974.276	1975.978	1977.680	1979.382	1981.084	1982.786	1984.488	1986.190	1987.892	1989.594	1991.296	1992.998	1994.700	1996.402	1998.104	1999.806	2001.508	2003.210	2004.912	2006.614	2008.316	2010.018	2011.720	2013.422	2015.124	2016.826	2018.528	2020.230	2021.932	2023.634	2025.336	2027.038	2028.740	2030.442	2032.144	2033.846	2035.548	2037.250	2038.952	2040.654	2042.356	2044.058	2045.760	2047.462	2049.164	2050.866	2052.568	2054.270	2055.972	2057.674	2059.376	2061.078	2062.780	2064.482	2066.184	2067.886	2069.588	2071.290	2072.992	2074.694	2076.396	2078.098	2079.800	2081.502	2083.204	2084.906	2086.608	2088.310	2090.012	2091.714	2093.416	2095.118	2096.820	2098.522	2099.924	2101.326	2102.728	2104.130	2105.532	2106.934	2108.336	2109.738	2111.140	2112.542	2113.944	2115.346	2116.748	2118.150	2119.552	2120.954	2122.356	2123.758	2125.160	2126.562	2127.964	2129.366	2130.768	2132.170	2133.572	2134.974	2136.376	2137.778	2139.180	2140.582	2141.984	2143.386	2144.788	2146.190	2147.592	2148.994	2150.396	2151.798	2153.200	2154.602	2156.004	2157.406	2158.808	2160.210	2161.612	2163.014	2164.416	2165.818	2167.220	2168.622	2170.024	2171.426	2172.828	2174.230	2175.632	2177.034	2178.436	2179.838	2181.240	2182.642	2184.044	2185.446	2186.848	2188.250	2189.652	2191.054	2192.456	2193.858	2195.260	2196.662	2198.064	2199.466	2200.868	2202.270	2203.672	2205.074	2206.476	2207.878	2209.280	2210.682	2212.084	2213.486	2214.888	2216.290	2217.692	2219.094	2220.496	2221.898	2223.300	2224.702	2226.104	2227.506	2228.908	2230.310	2231.712	2233.114	2234.516	2235.918	2237.320	2238.722	2240.124	2241.526	2242.928	2244.330	2245.732	2247.134	2248.536	2249.938	2251.340	2252.742	2254.144	2255.546	2256.948	2258.350	2259.752	2261.154	2262.556	2263.958	2265.360	2266.762	2268.164	2269.566	2270.968	2272.370	2273.772	2275.174	2276.576	2277.978	2279.380	2280.782	2282.184	2283.586	2284.988	2286.390	2287.792	2289.194	2290.596	2291.998	2293.400	2294.802	2296.204	2297.606	2299.008	2300.410	2301.812	2303.214	2304.616	2306.018	2307.420	2308.822	2310.224	2311.626	2313.028	2314.430	2315.832	2317.234	2318.636	2320.038	2321.440	2322.842	2324.244	2325.646	2327.048	2328.450	2329.852	2331.254	2332.656	2334.058	2335.460	2336.862	2338.264	2339.666	2341.068	2342.470	2343.872	2345.274	2346.676	2348.078	2349.480	2350.882	2352.284	2353.686	2355.088	2356.490	2357.892	2359.294	2360.696	2362.098	2363.500	2364.902	2366.304	2367.706	2369.108	2370.510	2371.912	2373.314	2374.716	2376.118	2377.520	2378.922	2380.324	2381.726	2383.128	2384.530	2385.932	2387.334	2388.736	2390.138	2391.540	2392.942	2394.344	2395.746	2397.148	2398.550	2400.000	2401.402	2402.804	2404.206	2405.608	2407.010	2408.412	2409.814	2411.216	2412.618	2414.020	2415.422	2416.824	2418.226	2419.628	2421.030	2422.432	2423.834	2425.236	2426.638	2428.040	2429.442	2430.844	2432.246	2433.648	2435.050	2436.452	2437.854	2439.256	2440.658	2442.060	2443.462	2444.864	2446.266	2447.668	2449.070	2450.472	2451.874	2453.276	2454.678	2456.080	2457.482	2458.884	2460.286	2461.688	2463.090	2464.492	2465.894	2467.296	2468.698	2470.100	2471.502	2472.904	2474.306	2475.708	2477.110	2478.512	2479.914	2481.316	2482.718	2484.120	2485.522	2486.924	2488.326	2489.728	2491.130	2492.532	2493.934	2495.336	2496.738	2498.140	2499.542	2500.944	2502.346	2503.748	2505.150	2506.552	2507.954	2509.356	2510.758	2512.160	2513.562	2514.964	2516.366	2517.768	2519.170	2520.572	2521.974	2523.376	2524.778	2526.180	2527.582	2528.984	2530.386	2531.788	2533.190	2534.592	2535.994	2537.396	2538.798	2540.200	2541.602	2543.004	2544.406	2545.808	2547.210	2548.612	2550.014	2551.416	2552.818	2554.220	2555.622	2557.024	2558.426	2559.828	2561.230	2562.632	2564.034	2565.436	2566.838	2568.240	2569.642	2571.044	2572.446	2573.848	2575.250	2576.652	2578.054	2579.456	2580.858	2582.260	2583.662	2585.064	2586.466	2587.868	2589.270	2590.672	2592.074	2593.476	2594.878	2596.280	2597.682	2599.084	2600.486	2601.888	2603.290	2604.692	2606.094	2607.496	2608.898	2610.300	2611.702	2613.104	2614.506	2615.908	2617.310	2618.712	2620.114	2621.516	2622.918	2624.320	2625.722	2627.124	2628.526	2629.928	2631.330	2632.732	2634.134	2635.536	2636.938	2638.340	2639.742	2641.144	2642.546	2643.948	2645.350	2646.752	2648.154	2649.556	2650.958	2652.360	2653.762	2655.164	2656.566	2657.968	2659.370	2660.772	2662.174	2663.576	2664.978	2666.380	2667.782	2669.184	2670.586	2671.988	2673.390	2674.792	2676.194	2677.596	2678.998	2680.400	2681.802	2683.204	2684.606	2686.008	2687.410	2688.812	2690.214	2691.616	2693.018	2694.420	2695.822	2697.224	2698.626	2700.028	2701.430	2702.832	2704.234	2705.636	2707.038	2708.440	2709.842	2711.244	2712.646	2714.048	2715.450	2716.852	2718.254	2719.656	2721.058	2722.460	2723.862	2725.264	2726.666	2728.068	2729.470	2730.872	2732.274	2733.676	2735.078	2736.480	2737.882	2739.284	2740.686	2742.088	2743.490	2744.892	2746.294	2747.696	2749.098	2750.500	2751.902	2753.304	2754.706	2756.108	2757.510	2758.912	2760.314	2761.716	2763.118	2764.520	2765.922	2767.324	2768.726	2770.128	2771.530	2772.932	2774.334	2775.736	2777.138	2778.540	2779.942	2781.344	2782.746	2784.148	2785.550	2786.952	2788.354	2789.756	2791.158	2792.560	2793.962	2795.364	2796.766	2798.168	2799.570	2800.972	2802.374	2803.776	2805.178	2806.580	2807.982	2809.384	2810.786	2812.188	2813.590	2814.992	2816.394	2817.796	2819.198	2820.600	2822.002	2823.404	2824.806	2826.208	2827.610	2829.012	2830.414	2831.816	2833.218	2834.620	2836.022	2837.424	2838.826	2840.228	2841.630	2843.032	2844.434	2845.836	2847.238	2848.640	2850.042	2851.444	2852.846	2854.248	2855.650	2857.052	2858.454	2859.856	2861.258	2862.660	2864.062	2865.464	2866.866	2868.268	2869.670	2871.072	2872.474	2873.876	2875.278	2876.680	2878.082	2879.484	2880.886	2882.288	2883.690	2885.092	2886.494	2887.896	2889.298	2890.700	2892.102	2893.504	2894.906	2896.308	2897.710	2899.112	2900.514	2901.916	2903.318	2904.720	2906.122	2907.524	2908.926	2910.328	2911.730	2913.132	2914.534	2915.936	2917.338	2918.740	2920.142	2921.544	2922.946	2924.348	2925.750	2927.152	2928.554	2929.956	2931.358	2932.760	2934.162	2935.564	2936.966	2938.368	2939.770	2941.172	2942.574	2943.976	2945.378	2946.780	2948.182	2949.584	2950.986	2952.388	2953.790	2955.192	2956.594	2957.996	2959.398	2960.800	2962.202	2963.604	2965.006	2966.408	2967.810	2969.212	2970.614	2972.016	2973.418	2974.820	2976.222	2977.624	2979.026	2980.428	2981.830	2983.232	2984.634	2986.036	2987.438	2988.840	2990.242	2991.644	2993.046	2994.448	2995.850	2997.252	2998.654	3000.056	3001.458	3002.860	3004.262	3005.664	3007.066	3008.468	3009.870	3011.272	3012.674	3014.076	3015.478	3016.880	3



Station:	1+500	1+520	1+540	1+560	1+580	1+600	1+620	1+640	1+660	1+680	1+700	1+720	1+740	1+760	1+780	1+800	1+820	1+840	1+860	1+880	1+900	1+920	1+940	1+960	1+980	2+000	2+020	2+040	2+060	2+080	2+100	2+120	2+140	2+160	2+180	2+200	2+220	2+240	2+260	2+280	2+300	2+320	2+340	2+360	2+380	2+400	2+420	2+440	2+460	2+480	2+500	2+520	2+540	2+560	2+580	2+600	2+620	2+640	2+660	2+680	2+700	2+720	2+740	2+760	2+780	2+800	2+820	2+840	2+860	2+880	2+900	2+920	2+940	2+960	2+980	3+000																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																												
Proposed:	1870.082	1871.609	1873.199	1874.850	1876.566	1878.270	1879.983	1881.697	1883.411	1885.125	1886.838	1888.552	1890.266	1891.980	1893.693	1895.407	1897.033	1898.352	1899.562	1900.752	1901.952	1903.152	1904.364	1905.566	1906.766	1907.966	1909.166	1910.366	1911.566	1912.766	1913.966	1915.166	1916.366	1917.566	1918.766	1920.166	1921.566	1922.966	1924.366	1925.766	1927.166	1928.566	1929.966	1931.366	1932.766	1934.166	1935.566	1936.966	1938.366	1939.766	1941.166	1942.566	1943.966	1945.366	1946.766	1948.166	1949.566	1950.966	1952.366	1953.766	1955.166	1956.566	1957.966	1959.366	1960.766	1962.166	1963.566	1964.966	1966.366	1967.766	1969.166	1970.566	1971.966	1973.366	1974.766	1976.166	1977.566	1978.966	1980.366	1981.766	1983.166	1984.566	1985.966	1987.366	1988.766	1990.166	1991.566	1992.966	1994.366	1995.766	1997.166	1998.566	1999.966	2001.366	2002.766	2004.166	2005.566	2006.966	2008.366	2009.766	2011.166	2012.566	2013.966	2015.366	2016.766	2018.166	2019.566	2020.966	2022.366	2023.766	2025.166	2026.566	2027.966	2029.366	2030.766	2032.166	2033.566	2034.966	2036.366	2037.766	2039.166	2040.566	2041.966	2043.366	2044.766	2046.166	2047.566	2048.966	2050.366	2051.766	2053.166	2054.566	2055.966	2057.366	2058.766	2060.166	2061.566	2062.966	2064.366	2065.766	2067.166	2068.566	2069.966	2071.366	2072.766	2074.166	2075.566	2076.966	2078.366	2079.766	2081.166	2082.566	2083.966	2085.366	2086.766	2088.166	2089.566	2090.966	2092.366	2093.766	2095.166	2096.566	2097.966	2099.366	2100.766	2102.166	2103.566	2104.966	2106.366	2107.766	2109.166	2110.566	2111.966	2113.366	2114.766	2116.166	2117.566	2118.966	2120.366	2121.766	2123.166	2124.566	2125.966	2127.366	2128.766	2130.166	2131.566	2132.966	2134.366	2135.766	2137.166	2138.566	2139.966	2141.366	2142.766	2144.166	2145.566	2146.966	2148.366	2149.766	2151.166	2152.566	2153.966	2155.366	2156.766	2158.166	2159.566	2160.966	2162.366	2163.766	2165.166	2166.566	2167.966	2169.366	2170.766	2172.166	2173.566	2174.966	2176.366	2177.766	2179.166	2180.566	2181.966	2183.366	2184.766	2186.166	2187.566	2188.966	2190.366	2191.766	2193.166	2194.566	2195.966	2197.366	2198.766	2200.166	2201.566	2202.966	2204.366	2205.766	2207.166	2208.566	2209.966	2211.366	2212.766	2214.166	2215.566	2216.966	2218.366	2219.766	2221.166	2222.566	2223.966	2225.366	2226.766	2228.166	2229.566	2230.966	2232.366	2233.766	2235.166	2236.566	2237.966	2239.366	2240.766	2242.166	2243.566	2244.966	2246.366	2247.766	2249.166	2250.566	2251.966	2253.366	2254.766	2256.166	2257.566	2258.966	2260.366	2261.766	2263.166	2264.566	2265.966	2267.366	2268.766	2270.166	2271.566	2272.966	2274.366	2275.766	2277.166	2278.566	2279.966	2281.366	2282.766	2284.166	2285.566	2286.966	2288.366	2289.766	2291.166	2292.566	2293.966	2295.366	2296.766	2298.166	2299.566	2300.966	2302.366	2303.766	2305.166	2306.566	2307.966	2309.366	2310.766	2312.166	2313.566	2314.966	2316.366	2317.766	2319.166	2320.566	2321.966	2323.366	2324.766	2326.166	2327.566	2328.966	2330.366	2331.766	2333.166	2334.566	2335.966	2337.366	2338.766	2340.166	2341.566	2342.966	2344.366	2345.766	2347.166	2348.566	2349.966	2351.366	2352.766	2354.166	2355.566	2356.966	2358.366	2359.766	2361.166	2362.566	2363.966	2365.366	2366.766	2368.166	2369.566	2370.966	2372.366	2373.766	2375.166	2376.566	2377.966	2379.366	2380.766	2382.166	2383.566	2384.966	2386.366	2387.766	2389.166	2390.566	2391.966	2393.366	2394.766	2396.166	2397.566	2398.966	2400.366	2401.766	2403.166	2404.566	2405.966	2407.366	2408.766	2410.166	2411.566	2412.966	2414.366	2415.766	2417.166	2418.566	2419.966	2421.366	2422.766	2424.166	2425.566	2426.966	2428.366	2429.766	2431.166	2432.566	2433.966	2435.366	2436.766	2438.166	2439.566	2440.966	2442.366	2443.766	2445.166	2446.566	2447.966	2449.366	2450.766	2452.166	2453.566	2454.966	2456.366	2457.766	2459.166	2460.566	2461.966	2463.366	2464.766	2466.166	2467.566	2468.966	2470.366	2471.766	2473.166	2474.566	2475.966	2477.366	2478.766	2480.166	2481.566	2482.966	2484.366	2485.766	2487.166	2488.566	2489.966	2491.366	2492.766	2494.166	2495.566	2496.966	2498.366	2499.766	2501.166	2502.566	2503.966	2505.366	2506.766	2508.166	2509.566	2510.966	2512.366	2513.766	2515.166	2516.566	2517.966	2519.366	2520.766	2522.166	2523.566	2524.966	2526.366	2527.766	2529.166	2530.566	2531.966	2533.366	2534.766	2536.166	2537.566	2538.966	2540.366	2541.766	2543.166	2544.566	2545.966	2547.366	2548.766	2550.166	2551.566	2552.966	2554.366	2555.766	2557.166	2558.566	2559.966	2561.366	2562.766	2564.166	2565.566	2566.966	2568.366	2569.766	2571.166	2572.566	2573.966	2575.366	2576.766	2578.166	2579.566	2580.966	2582.366	2583.766	2585.166	2586.566	2587.966	2589.366	2590.766	2592.166	2593.566	2594.966	2596.366	2597.766	2599.166	2600.566	2601.966	2603.366	2604.766	2606.166	2607.566	2608.966	2610.366	2611.766	2613.166	2614.566	2615.966	2617.366	2618.766	2620.166	2621.566	2622.966	2624.366	2625.766	2627.166	2628.566	2629.966	2631.366	2632.766	2634.166	2635.566	2636.966	2638.366	2639.766	2641.166	2642.566	2643.966	2645.366	2646.766	2648.166	2649.566	2650.966	2652.366	2653.766	2655.166	2656.566	2657.966	2659.366	2660.766	2662.166	2663.566	2664.966	2666.366	2667.766	2669.166	2670.566	2671.966	2673.366	2674.766	2676.166	2677.566	2678.966	2680.366	2681.766	2683.166	2684.566	2685.966	2687.366	2688.766	2690.166	2691.566	2692.966	2694.366	2695.766	2697.166	2698.566	2699.966	2701.366	2702.766	2704.166	2705.566	2706.966	2708.366	2709.766	2711.166	2712.566	2713.966	2715.366	2716.766	2718.166	2719.566	2720.966	2722.366	2723.766	2725.166	2726.566	2727.966	2729.366	2730.766	2732.166	2733.566	2734.966	2736.366	2737.766	2739.166	2740.566	2741.966	2743.366	2744.766	2746.166	2747.566	2748.966	2750.366	2751.766	2753.166	2754.566	2755.966	2757.366	2758.766	2760.166	2761.566	2762.966	2764.366	2765.766	2767.166	2768.566	2769.966	2771.366	2772.766	2774.166	2775.566	2776.966	2778.366	2779.766	2781.166	2782.566	2783.966	2785.366	2786.766	2788.166	2789.566	2790.966	2792.366	2793.766	2795.166	2796.566	2797.966	2799.366	2800.766	2802.166	2803.566	2804.966	2806.366	2807.766	2809.166	2810.566	2811.966	2813.366	2814.766	2816.166	2817.566	2818.966	2820.366	2821.766	2823.166	2824.566	2825.966	2827.366	2828.766	2830.166	2831.566	2832.966	2834.366	2835.766	2837.166	2838.566	2839.966	2841.366	2842.766	2844.166	2845.566	2846.966	2848.366	2849.766	2851.166	2852.566	2853.966	2855.366	2856.766	2858.166	2859.566	2860.966	2862.366	2863.766	2865.166	2866.566	2867.966	2869.366	2870.766	2872.166	2873.566	2874.966	2876.366	2877.766	2879.166	2880.566	2881.966	2883.366	2884.766	2886.166	2887.566	2888.966	2890.366	2891.766	2893.166	2894.566	2895.966	2897.366	2898.766	2899.966	2901.366	2902.766	2904.166	2905.566	2906.966	2908.366	2909.766	2911.166	2912.566	2913.966	2915.366	2916.766	2918.166	2919.566	2920.966	2922.366	2923.766	2925.166	2926.566	2927.966	2929.366	2930.766	2932.166	2933.566	2934.966	2936.366	2937.766	2939.166	2940.566	2941.966	2943.366	2944.766	2946.166	2947.566	2948.966	2950.366	2951.766	2953.166	2954.566	2955.966	2957.366	2958.766	2960.166	2961.566	2962.966	2964.366	2965.766	2967.166	2968.566	2969.966	2971.366	2972.766	2974.166	2975.566	2976.966	2978.366	2979.766	2981.166	2982.566	2983.966	2985.366	2986.766	2988.166	2989.566	2990.966	2992.366	2993.766	2995.166	2996.566	2997.966	2999.366	3000.766
Existing:	1889.116	1871.428	1874.478	1878.115	1879.289	1878.566	1879.818	1878.270	1879.983	1881.697	1883.411	1885.125	1886.838	1888.552	1890.266	1891.980	1893.693	1895.407	1897.033	1898.352	1899.562	1900.752	1901.952	1903.152	1904.364	1905.566	1906.766	1907.966	1909.166	1910.366	1911.566	1912.766	1913.966	1915.166	1916.366	1917.566	1918.766	1920.166	1921.5																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																	



Station:	3+000	3+020	3+040	3+060	3+080	3+100	3+120	3+140	3+160	3+180	3+200	3+220	3+240	3+260	3+280	3+300	3+320	3+340	3+360	3+380	3+400	3+420	3+440	3+460	3+480	3+500	3+520	3+540	3+560	3+580	3+600	3+620	3+640	3+660	3+680	3+700	3+720	3+740	3+760	3+780	3+800	3+820	3+840	3+860	3+880	3+900	3+920	3+940	3+960	3+980	4+000	4+020	4+040	4+060	4+080	4+100	4+120	4+140	4+160	4+180	4+200	4+220	4+240	4+260	4+280	4+300	4+320	4+340	4+360	4+380	4+400	4+420	4+440	4+460	4+480	4+500																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																	
Proposed:	2014.237	2016.140	2017.859	2019.394	2020.743	2021.952	2023.152	2024.352	2025.552	2026.752	2027.954	2029.286	2030.822	2032.506	2034.199	2035.891	2037.583	2039.275	2040.967	2042.659	2044.351	2046.043	2047.736	2049.428	2051.120	2052.808	2054.494	2056.179	2057.864	2059.549	2061.234	2062.919	2064.604	2066.289	2067.974	2069.659	2071.344	2073.029	2074.714	2076.399	2078.084	2079.769	2081.454	2083.139	2084.824	2086.509	2088.194	2089.879	2091.564	2093.249	2094.934	2096.619	2098.304	2099.989	2101.674	2103.359	2105.044	2106.729	2108.414	2110.099	2111.784	2113.469	2115.154	2116.839	2118.524	2120.209	2121.894	2123.579	2125.264	2126.949	2128.634	2130.319	2131.999	2133.684	2135.369	2137.054	2138.739	2140.424	2142.109	2143.794	2145.479	2147.164	2148.849	2150.534	2152.219	2153.904	2155.589	2157.274	2158.959	2160.644	2162.329	2164.014	2165.699	2167.384	2169.069	2170.754	2172.439	2174.124	2175.809	2177.494	2179.179	2180.864	2182.549	2184.234	2185.919	2187.604	2189.289	2190.974	2192.659	2194.344	2196.029	2197.714	2199.399	2201.084	2202.769	2204.454	2206.139	2207.824	2209.509	2211.194	2212.879	2214.564	2216.249	2217.934	2219.619	2221.304	2222.989	2224.674	2226.359	2228.044	2229.729	2231.414	2233.099	2234.784	2236.469	2238.154	2239.839	2241.524	2243.209	2244.894	2246.579	2248.264	2249.949	2251.634	2253.319	2255.004	2256.689	2258.374	2260.059	2261.744	2263.429	2265.114	2266.799	2268.484	2270.169	2271.854	2273.539	2275.224	2276.909	2278.594	2280.279	2281.964	2283.649	2285.334	2287.019	2288.704	2290.389	2292.074	2293.759	2295.444	2297.129	2298.814	2300.499	2302.184	2303.869	2305.554	2307.239	2308.924	2310.609	2312.294	2313.979	2315.664	2317.349	2319.034	2320.719	2322.404	2324.089	2325.774	2327.459	2329.144	2330.829	2332.514	2334.199	2335.884	2337.569	2339.254	2340.939	2342.624	2344.309	2345.994	2347.679	2349.364	2351.049	2352.734	2354.419	2356.104	2357.789	2359.474	2361.159	2362.844	2364.529	2366.214	2367.899	2369.584	2371.269	2372.954	2374.639	2376.324	2378.009	2379.694	2381.379	2383.064	2384.749	2386.434	2388.119	2389.804	2391.489	2393.174	2394.859	2396.544	2398.229	2399.914	2401.599	2403.284	2404.969	2406.654	2408.339	2410.024	2411.709	2413.394	2415.079	2416.764	2418.449	2420.134	2421.819	2423.504	2425.189	2426.874	2428.559	2430.244	2431.929	2433.614	2435.299	2436.984	2438.669	2440.354	2442.039	2443.724	2445.409	2447.094	2448.779	2450.464	2452.149	2453.834	2455.519	2457.204	2458.889	2460.574	2462.259	2463.944	2465.629	2467.314	2468.999	2470.684	2472.369	2474.054	2475.739	2477.424	2479.109	2480.794	2482.479	2484.164	2485.849	2487.534	2489.219	2490.904	2492.589	2494.274	2495.959	2497.644	2499.329	2501.014	2502.699	2504.384	2506.069	2507.754	2509.439	2511.124	2512.809	2514.494	2516.179	2517.864	2519.549	2521.234	2522.919	2524.604	2526.289	2527.974	2529.659	2531.344	2533.029	2534.714	2536.399	2538.084	2539.769	2541.454	2543.139	2544.824	2546.509	2548.194	2549.879	2551.564	2553.249	2554.934	2556.619	2558.304	2560.089	2561.774	2563.459	2565.144	2566.829	2568.514	2570.199	2571.884	2573.569	2575.254	2576.939	2578.624	2580.309	2581.994	2583.679	2585.364	2587.049	2588.734	2590.419	2592.104	2593.789	2595.474	2597.159	2598.844	2600.529	2602.214	2603.899	2605.584	2607.269	2608.954	2610.639	2612.324	2614.009	2615.694	2617.379	2619.064	2620.749	2622.434	2624.119	2625.804	2627.489	2629.174	2630.859	2632.544	2634.229	2635.914	2637.599	2639.284	2640.969	2642.654	2644.339	2646.024	2647.709	2649.394	2651.079	2652.764	2654.449	2656.134	2657.819	2659.504	2661.189	2662.874	2664.559	2666.244	2667.929	2669.614	2671.299	2672.984	2674.669	2676.354	2678.039	2679.724	2681.409	2683.094	2684.779	2686.464	2688.149	2689.834	2691.519	2693.204	2694.889	2696.574	2698.259	2699.944	2701.629	2703.314	2704.999	2706.684	2708.369	2710.054	2711.739	2713.424	2715.109	2716.794	2718.479	2720.164	2721.849	2723.534	2725.219	2726.904	2728.589	2730.274	2731.959	2733.644	2735.329	2737.014	2738.699	2740.384	2742.069	2743.754	2745.439	2747.124	2748.809	2750.494	2752.179	2753.864	2755.549	2757.234	2758.919	2760.604	2762.289	2763.974	2765.659	2767.344	2769.029	2770.714	2772.399	2774.084	2775.769	2777.454	2779.139	2780.824	2782.509	2784.194	2785.879	2787.564	2789.249	2790.934	2792.619	2794.304	2795.989	2797.674	2799.359	2801.044	2802.729	2804.414	2806.099	2807.784	2809.469	2811.154	2812.839	2814.524	2816.209	2817.894	2819.579	2821.264	2822.949	2824.634	2826.319	2828.004	2829.689	2831.374	2833.059	2834.744	2836.429	2838.114	2839.799	2841.484	2843.169	2844.854	2846.539	2848.224	2849.909	2851.594	2853.279	2854.964	2856.649	2858.334	2860.019	2861.704	2863.389	2865.074	2866.759	2868.444	2870.129	2871.814	2873.499	2875.184	2876.869	2878.554	2880.239	2881.924	2883.609	2885.294	2886.979	2888.664	2890.349	2892.034	2893.719	2895.404	2897.089	2898.774	2900.459	2902.144	2903.829	2905.514	2907.199	2908.884	2910.569	2912.254	2913.939	2915.624	2917.309	2918.994	2920.679	2922.364	2924.049	2925.734	2927.419	2929.104	2930.789	2932.474	2934.159	2935.844	2937.529	2939.214	2940.899	2942.584	2944.269	2945.954	2947.639	2949.324	2951.009	2952.694	2954.379	2956.064	2957.749	2959.434	2961.119	2962.804	2964.489	2966.174	2967.859	2969.544	2971.229	2972.914	2974.599	2976.284	2977.969	2979.654	2981.339	2983.024	2984.709	2986.394	2988.079	2989.764	2991.449	2993.134	2994.819	2996.504	2998.189	2999.874	3001.559	3003.244	3004.929	3006.614	3008.299	3009.984	3011.669	3013.354	3015.039	3016.724	3018.409	3020.094	3021.779	3023.464	3025.149	3026.834	3028.519	3030.204	3031.889	3033.574	3035.259	3036.944	3038.629	3040.314	3041.999	3043.684	3045.369	3047.054	3048.739	3050.424	3052.109	3053.794	3055.479	3057.164	3058.849	3060.534	3062.219	3063.904	3065.589	3067.274	3068.959	3070.644	3072.329	3074.014	3075.699	3077.384	3079.069	3080.754	3082.439	3084.124	3085.809	3087.494	3089.179	3090.864	3092.549	3094.234	3095.919	3097.604	3099.289	3100.974	3102.659	3104.344	3106.029	3107.714	3109.399	3111.084	3112.769	3114.454	3116.139	3117.824	3119.509	3121.194	3122.879	3124.564	3126.249	3127.934	3129.619	3131.304	3132.989	3134.674	3136.359	3138.044	3139.729	3141.414	3143.099	3144.784	3146.469	3148.154	3149.839	3151.524	3153.209	3154.894	3156.579	3158.264	3159.949	3161.634	3163.319	3165.004	3166.689	3168.374	3170.059	3171.744	3173.429	3175.114	3176.799	3178.484	3180.169	3181.854	3183.539	3185.224	3186.909	3188.594	3190.279	3191.964	3193.649	3195.334	3197.019	3198.704	3200.389	3202.074	3203.759	3205.444	3207.129	3208.814	3210.499	3212.184	3213.869	3215.554	3217.239	3218.924	3220.609	3222.294	3223.979	3225.664	3227.349	3229.034	3230.719	3232.404	3234.089	3235.774	3237.459	3239.144	3240.829	3242.514	3244.199	3245.884	3247.569	3249.254	3250.939	3252.624	3254.309	3255.994	3257.679	3259.364	3261.049	3262.734	3264.419	3266.104	3267.789	3269.474	3271.159	3272.844	3274.529	3276.214	3277.899	3279.584	3281.269	3282.954	3284.639	3286.324	3288.009	3289.694	3291.379	3293.064	3294.749	3296.434	3298.119	3299.804	3301.489	3303.174	3304.859	3306.544	3308.229	3309.914	3311.599	3313.284	3314.969	3316.654	3318.339	3319.924	3321.609	3323.294	3324.979	3326.664	3328.349	3330.034	3331.719	3333.404	3335.089	3336.774	3338.459	3340.144	3341.829	3343.514	3345.199	3346.884	3348.569	3350.254	3351.939	3353.624	3355.309	3356.994	3358.679	3360.364	3362.049	3363.734	3365.419	3367.104	3368.789	3370.474	3372.159	3373.844	3375.529	3377.214	3378.899

APPENDIX 05