JABALPUR SMART CITY LIMITED

Development of Aerial Passenger Ropeway System between Sangram Sagar and Madan Mahal Fort, Jabalpur

Volume II

Project Information Memorandum

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INTRODUCTION

INTRODUCTION

BACKGROUND

Jabalpur Smart City Limited JSCL proposes to develop an aerial ropeway on Madan Mahal Hill, on EPC basis. Madan Mahal is situated on foothills of Vindhya Plateau Range in Jabalpur district of Madhya Pradesh. The area has rocky terrain throughout the Madan Mahal Eco-tourism Zone. The area is home to some extremely rare species of fauna. There are two religious structures atop the hill in the area along with several tourist attractions which can be developed as key elements in the ecotourism zone. The area is intended to be developed as Ecotourism site with the vision of *"**Responsible travel to natural areas that conserves the environment and improves the well-being of local community.**"*

Since, the area has rocky terrain throughout the Madan Mahal Eco-tourism Zone, it is difficult to access via the stairs, especially for differently abled, infirm and aged visitors, an aerial ropeway to facilitate access to the Madan Mahal Eco Tourism Zone, to be setup on a public private partnership basis has been proposed. In addition to facilitating ease of access, the ropeway would also promote the destination for religious cultural & adventurous tourism and enable integrated development of the project site, in line with the overall tourism developmental vision of Jabalpur Smart City.

The Jabalpur Smart City Limited **("JSCL" or the "Authority")** is a nodal agency under the Government of Madhya Pradesh engaged in the conceptualizing and development of infrastructure in the city of Jabalpur in Madhya Pradesh through various development models. JSCL, as part of this endeavor and in the role of transaction advisor to the Government in this instance, is in the process of selection of a private developer to undertake development and operation & maintenance of the Aerial Passenger Ropeway System between Sangram Sagar and Madan Mahal Fort, Jabalpur **(the "Project")** on EPC basis, and has, therefore, decided to carry out the bidding process for selection of the bidder to whom the Project may be awarded. A brief description of the Project may be seen in the Information Memorandum **(the "Information Memorandum")** of the Project that is an integral part of the Bidding Documents and is also available at the Transaction Authority's website http://jscljabalpur.org/ & https://www.mpeproc.gov.in/

As part of this endeavor, the Authority has decided to undertake the Development of Aerial Passenger Ropeway System between Sangram Sagar and Madan Mahal Fort, Jabalpur (the "**Project Site**") under an appropriate EPC Mode with maintenance for a period of 5 (five) years (the **"Project"**).

OBJECTIVE OF THIS PROJECT REPORT

Jabalpur Smart City Limited JSCL proposes to develop an aerial ropeway on Madan Mahal Hill, on EPC basis. Madan Mahal is situated on foothills of Vindhya Plateau Range in Jabalpur district of Madhya Pradesh. The area has rocky terrain throughout the Madan

Mahal Eco-tourism Zone. The area is home to some extremely rare species of fauna. There are two religious structures atop the hill in the area along with several tourist attractions which can be developed as key elements in the ecotourism zone.

Since, the area has rocky terrain throughout the Madan Mahal Eco-tourism Zone, it is difficult to access via the stairs, especially for differently abled, infirm and aged visitors, an aerial ropeway to facilitate access to the Madan Mahal Eco Tourism Zone, to be setup on a public private partnership basis has been proposed. In addition to facilitating ease of access, the ropeway would also promote the destination for religious cultural & adventurous tourism and enable integrated development of the project site, in line with the overall tourism developmental vision of Jabalpur Smart City.

JSCL intends to develop the an aerial ropeway to facilitate access to the Madan Mahal Eco Tourism Zone,

i. Provide varied experience to the tourists.
ii. Attract footfalls, encourage extended stays and provide a wholesome experience to the tourists.
iii. Promote sustainable/ eco tourism.
iv. Encourage entrepreneurship and livelihood opportunities for the locals.
v. Encourage and promote Private Sector Participation in the development of tourism sector.

JSCL would act as a catalyst to promote development of tourism infrastructure and related facilities. The utmost importance would hence be given to the developments under EPC Mode

NEED FOR THE PROJECT

i. Identified location is a popular tourist destination and attract large footfalls.
ii. Making already established tourist destinations more attractive
iii. Located on hills, environmentally sensitive zones. Improving the Tourism Infrastructure Scenario
iv. The locations have high or medium footfalls which causes huge amount of vehicular movement in and around these destinations disturbing flora, fauna and causing pollution simultaneously
v. Cable car is a convenient, time saving, eco – friendly, sustainable solution as well as a tourist attraction itself
vi. Rising Middle Class, Increased Affordability & increased demand for weekend gateways
vii. Encourage livelihood opportunities for the local population

TOURISM, HERITAGE & CONSERVATION

Madhya Pradesh is centrally located state which represents various cultural and historic places. Jabalpur has many symbolic heritage sites in the city with natural and manmade structures.

MP tourism organizes various information and tourist events for the Jabalpur city. Jabalpur is strategically connected with various nearby forest and tourist places to visit which are Bhedaghat, Kanha forest reserve, Amarkantak, Bandhavgarh etc. MP Tourism also organize and facilitate Navratri and Durga Puja Utsav at Jabalpur. There are various locations which MP tourism highlighted in Jabalpur and surrounding areas.

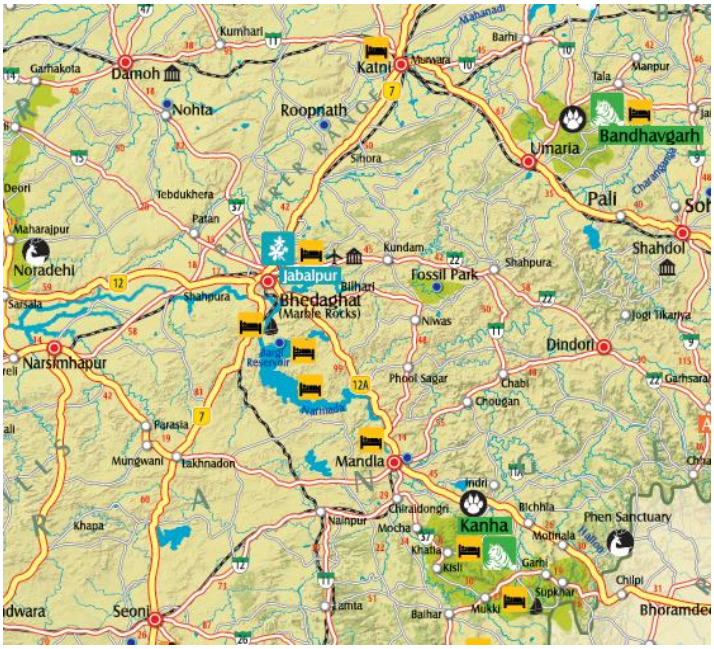
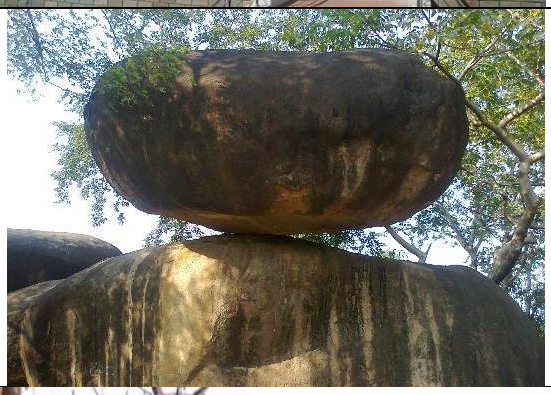


Figure 1 MP Tourism Near Jabalpur

Identified locations that are rich in cultural heritage of the city in Madan Mahal Eco Tourism Zone

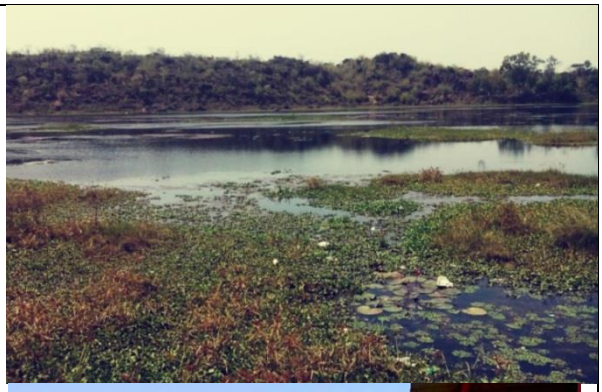
Source: MP Tourism

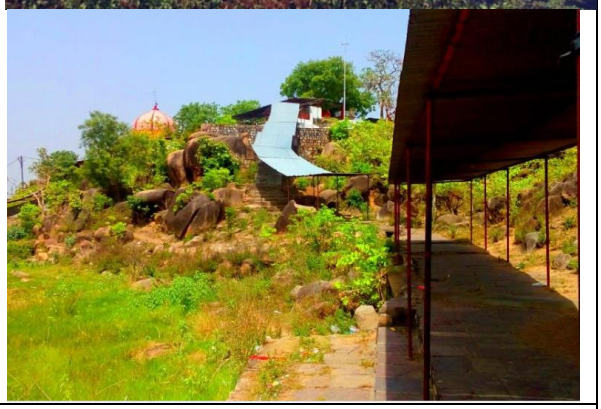
MADAN MAHAL FORT Madan Mahal fort belongs to the Gond rulers in the 17th Century. It is an ASI protected monument with an aura of being compact and fully equipped fort. The fort is situated at a height of 500 m on the hill.	

DEVTAL Devtal is a garden situated in Jabalpur area famous for natural beauty. Devtal consists of lush garden and various rocks which is recreational area for citizens. Osho ashram is also situated near Devtal and people meditate and enjoy the natural beauty within the city limits.	
PISANHARI KI MADHIYA Pisanhari ki madiya is a famous Jain pilgrimage which is built 500 years ago built by a god loving women. The Pisanhari Ki Madiya is full of lush greenery and eye catching beautiful hilly area. The surrounding is perfect for meditation and other rituals. It is a very popular Digambar Jain pilgrimage.	
BALANCING ROCK Balancing rock of Jabalpur is an independent rock balancing over another rock, It is one of the two big balancing rocks in India, balancing rock mahabalipuram being other.	
OSHO ASHRAM Osho Amritdham Ashram situated amidst the hill tops of Madan Mahal at Jabalpur in Madhya Pradesh. These hilltops of Madan Mahal are the Tapobhumi {Sanctified ground} of Osho. Osho often used to come to these hilltops in search of his inner truth. Osho trod this hilly terrain and transformed it into a sanctified ground by his unique presence.	

SANGRAM SAGAR

Sangram Sagar Lake is yet another important attraction of Jabalpur. This lake and its adjoining structures were built by King Sangram Shah, a Gond ruler in the 15th century. This place showcases some great medieval architecture and the lake surrounding them adds to the beauty of the place. Sangram Sagar Lake is also famous for the aquatic animals that inhabit this lake and for the migratory birds. The temperature of the water is such that it attracts exotic species of migratory birds like pin-tailed ducks, coots and red-perched pochards from the central and western parts of Asia.





The following are the other destinations within the city limits which is good tourist attraction point.

- SHELPARN TAL,
- SANGRAM SAGAR GHATI
- HANUMAN TAL
- BARGI HILLS

PROJECT DESIGN

According to the technical definition of the Indian Bureau of Technical Standards, an "aerial ropeway is a special form of transportation system where passengers/materials are carried above the ground. A ropeway uses a tensioned wire rope supported above the ground. Aerial ropeways are particularly useful in regions where the facility in surmounting natural barriers gives them a great advantage over railways or roads, both of which may need the heavy civil engineering work to secure easy gradient. They are inexpensive to maintain; pollution free; environment friendly; requires minimum tree cutting; does not affect aesthetics; their power demand is modest; and, they are not seriously affected by adverse climatic conditions".

Evolution of Cable Cars – Globally

Andrew Hallidie is considered the father of the cable car, although he was not the only inventor to dabble in the use of cable as a means of transportation. Hallidie and his father both held several patents for the manufacture and use of cable, or wire rope as it was called.

The Powerhouse

Each of the different cable car lines once had its own powerhouse —or sometimes several—to drive the cable used on the line. The first power sources were steam engines powered by enormous amounts of coal each day, thus each powerhouse was equipped with boilers to heat the water needed to produce steam.

The Slot

Out on the street along their routes, the cable cars travel on steel tracks set above a channel enclosing the cable. At the top of the channel is a slot through which the cable car's grip grabs the cable moving below.

The Grip

Cable Cars Worldwide have gone through a series of evolutionary changes since the first line opened. These have involved the mechanical equipment and design of the cars themselves, as well as those along the track and in the powerhouses. One of the first changes was made to the grip itself.

The Brakes

The cable cars employ a series of mechanisms to assist in braking the car and regulating its speed. The three parts of this system are the wheel brakes, track brakes, and an emergency brake.

The Cars

The original cable car line on Clay Street employed a dummy car containing the gripping and braking mechanisms that pulled a passenger trailer.

DESIGN CONSIDERATIONS AND ASSUMPTIONS

The design requirements/ principles which have been kept in consideration while designing the project. These include:

a) Design of the Aerial Ropeway shall be strictly in line with the guidelines issued by Bureau of Indian Standards, MoEF (GoI) and any other guidelines issues by Central/ State Government

b) The structure and the overall system should be built considering the climate in the region

c) An appropriate balance needs to be maintained in the cost of the ropeway system selected and the ability to carry maximum tourists.

d) The numbers considered for design evaluation are approximate and based on on-ground information provided by officials.

e) It has been assumed that every day an estimated 300 tourists will visit the Madan Mahal Eco Tourism Zone a day, except weekends when the numbers will increase to 1,000 tourists.

f) It has been assumed that of the total number of tourists coming to Madan Mahal Eco Tourism Zone, only about 50% would opt for the aerial ropeway with return trips.

DESIGN OPTIONS

The first aerial tram was built more than 350 years ago but this method of moving people and goods popular in 1800s only. Since then, many systems of aerial ropeways have been implemented based on the project's needs and salient features. These include cost factors, terrain, carrying capacity, rate of transfer and climatic conditions. In the case of Madan Mahal Eco Tourism Zones there are three ropeway systems which will best suit the requirements. These include:

Mono-cable ropeway system

Bi-cable & Tri-cable ropeway systems

Jig-back system (Mono-cable)

These ropeway systems are analysed in detail below.

MONO-CABLE ROPEWAY SYSTEMS

A Mono-cable ropeway System comprises basically of a rope which acts both as the carrying as well as the haulage rope to which a number of vehicles (carriages) are attached at regular intervals. These vehicles circulate around the closed system by continuous carrying-cum haulage rope. The vehicles can be in the form of chairs or gondolas (enclosed carriers, also referred colloquially as cabins). Usually the carrying capacity of each vehicle varies from 2

passengers to 8 passengers.

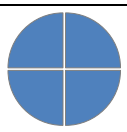
Mono-cable can be either fixed grip or detachable grip. Fixed grip installations are the types of ropeways whose grip is permanently fixed and tight on the rope and is not taken off the rope in the station. Detachable installations are characterized by the possibility of detaching the vehicles in the stations from the rope. This enables a higher speed on the line, a lower speed in the station and makes the boarding and de-boarding more comfortable for the passengers. According to this, a significantly higher transport capacity as well as more comfort for the passenger can be achieved. Fixed grip installations are more inexpensive to install than detachable grip installations.

Capital Costs	*Operating Costs*	*Carrying Capacity*	*Overall Suitability*
			

TRI – BI-CABLE ROPEWAY SYSTEMS

This Ropeway System consists of two/three stationary carrying track ropes with connecting rails and a single endless haulage rope. The support cables are terminated at the two end terminals with one end provided with a counter weight / hydraulic tension unit for extension/contraction. A number of carriages are automatically coupled to or uncoupled from the haulage rope at the station and are transported on the rails for boarding/de-boarding of passengers. Multiple cable solutions offer differentiating advantages from a technical perspective. They guarantee increased wind resistance and are also able to cross spans of over 2,500 meters. This makes for a perfect application over steep and exposed terrain. Tri-cable gondola lifts have one hauling cable and two support cables. In both systems, grips are detachable, meaning that the systems have a very high transport capacity.

This system has high transport capacity up to 6,000 people/h (cabins can carry upto 35 people) with speeds upto 8 m/s

Capital Costs	*Operating Costs*	*Carrying Capacity*	*Overall Suitability*
			

JIGBACK SYSTEM (MONOCABLE)

It is possible to combine the characteristics of a Monocable system and a Jig Back System. Such a system has a carrying-cum-haulage rope to which one or a group of cabins are attached in either direction, attachment being made on diametrically opposite side of the carrying cum- haulage rope. In addition, both of these sub-categories individually can be either be “normal systems”, or “pulsating systems”. In normal systems the vehicles (cabins)

travel and enter the station evenly, while in pulsating systems a group of vehicles travels and enters/exits the terminal station for passenger embarking/disembarking. Pulsed configurations are mainly employed for relatively short ropeways.The Jigback system is simple to operate and less expensive, and is ideally suitable for hilly, undulating terrain. The capital expenditure investment in this system is also relatively low, and is comfortable for the passengers to embark/disembark and ride. The carrying capacity can also be augmented based on increase in demand. This system has relatively less carrying capacity than the other system categories. Transport capacity upto 100 - 500 PPH depending on the route & length.

Capital Costs	*Operating Costs*	*Carrying Capacity*	*Overall Suitability*
			

PROPOSED DESIGN/ TECHNOLOGY

The selection of appropriate ropeway system for the project depends on the following factors:

i. Carrying capacity for which the ropeway system needs to be designed

ii. The topography of the project site

iii. Investment and operating cost required

iv. Comfort factors for the passenger

v. Speed of cabins

Considering all these factors, the Mono cable detachable System will be preferred.is the minimum system for the proposed ropeway. The capacity is 400 PPH. The summary of cabin movement is as follows:

DETACHABLE GRIP MONOCABLE ROPEWAYS.-These are built with a continuously running endless rope to which the carriages are locked automatically when leaving a station and unlocked automatically when entering a station. Inside the station the carriage. by means of its wheels (which are not used along the line), runs from the rope onto the station shunt rail. and proceeds to the loading or unloading position.

Monocable detachable gondola lifts have one rope acting as carrying and hauling rope at the same time. The cabins are available in different designs, e.g., rectangular or round, and always have an aluminum frame.

Monocable Detachable Gondolas (MDG) are likely the most common CPT system you'll encounter as their low cost has made them an attractive addition to public transit systems in the developing world.

Major Characteristics:

Grip: As apparent in the name, an MDG uses a detachable grip. This means cabins can detach from the cable when in the station allowing for intermediary stations and turning (at stations).

Cables: An MDG utilizes a single cable which provides both support and propulsion.

Speed: About 6 m/s, which is equal to 22 km/h. Technological advances now allow speeds of up to 7 m/s.

Capacity: Generally cabins hold 6 passengers with some systems allowing as few as 4 or as many as 15.

Towers: MDG systems are generally supported by cylindrical towers, although custom towers or lattice structures are also possible.

MDG are intermediate capacity systems (and comparable to many urban tram routes). Given their single cable are prone to stoppages due to winds in excess of 70 km/hr. MDGs are therefore most useful in most urban environments with low-medium capacity needs.

As the investment is quite low compared to other technologies, MDGs are excellent "starter" systems for cities .

The advantages of this ropeway system are as follows:

a) This system is designed for a lower range of carrying capacity, and is suitable for carrying 400 passengers/ hour (demand capacity envisaged for Madan Mahal Hills)
b) The proposed project region does not have extreme weather conditions such as high wind factors, excessive rain etc. which makes this system suitable.
c) The investment in this project system at approximately INR. 13 cr. is relatively lower than other systems, and is justified by the return on investment and project IRR.

Developer, as part of the proposal, may choose to propose one of the above ropeway systems or may propose a better ropeway system (like bi cable or tri cable) based on their own assessments.

SWOC Analysis

In order to appreciate and articulate the current situation and present future possibilities in all sectors leading to comprehensive development, herein SWOC analysis is done. The objective of this analysis is to demarcate potentials and drawbacks of the site.

Strengths • A place of faith for Hinduism, Jainism • Serene view of green forest, lakes and ponds • footfall of tourists throughout the year	***Weaknesses*** • Lack of basic infrastructure • Non availability of eateries
Opportunities • Developing as the major tourist destination • Unexplored natural beauty of the area	***Challenge*** • Developing infrastructure to attract tourists

Based on the above analysis, it can be inferred that the development of ropeway at Madan Mahal Hills in Jabalpur has huge potential but the challenges should be addressed in a constructive manner during the implementation of the project.

DETAILED COMPONENTS

The Monocable detachable system is one of the most popular aerial ropeway systems worldwide for transporting passengers. It consists of various sub-components including, but not limited to, the following:

A. Cabins

Cabins are the structural and mechanical assemblage in which the passenger(s) of a ropeway system are transported. The cabin includes the carriage/ grip, hanger, and the passenger cabin. The cabin will consist of medium cabins which can seat 6-8 people. The cabins will be totally enclosed and have a standing room to reach full capacity.

B. Terminals/ Stations

The system will have two terminals: Upper and Lower terminals. The drive machinery may be installed overhead or in an underground vault, based on developer's design and land allocated at upper and lower terminals at the project site.

C. Towers

Towers are intermediate structures that support the track and haulage ropes between terminals. They are often steel framed, and are sometimes pylonshaped. The tower's primary function is to support track ropes and haulage ropes on saddles and line sheaves respectively. Towers must also have guides to keep carriages from hitting them for safety. Towers might not always be necessary depending on the length of the system. For long systems, intermediate towers are necessary to provide support to the system and therefore eliminating the need for long spans. A minimum of two towers will be required for the aerial ropeway.

D. Ropes/ Cables

The rope (cable) is the heart of any Aerial Ropeway Transit system. It is formed by intertwining individual wires to form a strand and then the strands to form a rope. There are many variations of the processes used in manufacturing ropes and in choosing the appropriate rope for any given application.

E. Plant and Machinery

The minimum components of the Plant and Machinery will be a main drive, an auxiliary drive, main gear box, tension trolley, counter-weight trolley, grip system, etc. The developer needs to ensure adherence to the minimum service obligations.

MINIMUM DEVELOPMENT OBLIGATIONS

The developer shall design, finance, construct, and, maintain the proposed facility strictly conforming to the relevant Indian Standards; the best industry practices acceptable norms as laid by Ministry of Tourism, GoI as well as the minimum service obligations. These development obligations are defined below.

Site Development Guidelines

i. Land will be provided by the Department free from all encumbrances.

ii. The internal paving may be done using recycling waste/ eco-friendly materials that helps the environment.

iii. Department will take all the required statutory clearances. The selected bidder will provide all necessary support for these clearances.

Civil, Structural & Environmental Requirements

i. The structures shall be designed to resist wind and seismic forces.

ii. RCC structures shall be designed as per IS 456: 2000.

iii. Steel structures shall be designed in accordance with the provisions of IS 800:1984.

Structural steel shall conform to IS 2062:2006. Tubular sections would conform to IS-

4923. Structural joints shall conform to IS 4000:1992.

iv. Mitigation measures to be considered to reduce the negative impact on the ecology, available resources on site, soil erosion, existing vegetation and habitat, water and air pollution and waste handling as per the Manual on norms and standards for environment clearance of large construction projects.

v. Developer is advised to carry out its own tests and investigations related to soil condition, strata, bearing capacity and other characteristics.

vi. All buildings shall be designed and constructed as earthquake and flood resistant structures.

Services: Electrical, Water Supply, Plumbing, Drainage and Solid Waste Management

1. The planning, design and execution of electrical installation, ventilation, air-conditioning, shall be carried out in accordance with Part VIII-Building Services (Section 2-Electric Installations, Section 3-Air Conditioning) of National Building Code of India, prepared by BIS and as prevalent at the time of execution of the works, as the case may be.
2. The planning, design, construction and installation of water supply distribution system, drainage and sanitation shall be in accordance with the Part IX (Section 1-Plumbing Services, Section 2-Plumbing and Sanitation, Section 3-Gas Supply as the case may be) of NBC of India prepared by BIS and as prevalent at the time of execution of the work.
3. Solid Waste Collection and Disposal System shall be in place by implementation of environmentally sound solid waste collection mechanisms.
4. The Project site shall be maintained as "Plastic Free Zone".
5. Maintain the natural areas and indigenous vegetation to extent possible;
6. Retain the natural drainage characteristics;
7. Incorporate Energy efficient designs & utilities;
8. Efforts shall be made for Water Conservation by implementing innovative practices such as Rain water harvesting methods
9. Usage of non-polluting internal transport system such as battery operated cars etc.

Power Supply

a) Developer may explore more of non-conventional/renewable energy sources of power supply like solar, wind etc. to match the theme of eco-friendly development.

b) The Developer shall ensure:

   i. Un-interrupted power supply to the Project Components;

   ii. Adequate earthling provisions for total protection of equipment;

   iii. 100 % backup through requisite number of DG sets as stand-by

Fire Fighting Facilities

The Developer shall provide the required fire-fighting equipment and facilities including fire exits, fire proof doors, etc. conforming to the relevant BIS standards.

Rain Water Harvesting

The rainwater harvesting shall be adopted as per the rules and regulations laid down by the statutory law applicable for the concerned area.

Facilities for Physically Challenged Persons

The Developer shall provide necessary arrangements for disabled / physically challenged persons for accessing project facilities.

Signage's

The Developer shall provide signages so as to facilitate necessary information to the visitors regarding amenities and their location. The signage would be provided separately;

i. Information Signs,

ii. Facility Signs, and

iii. Other Signs

Parking Area

As per the demand, the developer shall provide parking facilities for the visitors of the proposed project. In that case the specifications to be followed are as below:

Access within the Site

a) The main access to any component shall have adequate width not less than 7.5 m.

b) An unobstructed area of minimum width of 3 m. shall be provided around each built structure in the premise for Fire Tender movement. This shall be within the limit of the site and shall be paved with impervious material above a hard bed.

All the above are minimum requirements subject to the norms of fire services department

Supporting Facilities and Amenities

The developer shall provide all the necessary supporting facilities and amenities confirming to the development controls and meeting the relevant Indian standards.

MINIMUM SERVICE OBLIGATIONS

The developer should ensure adherence to the minimum service obligations. The minimum service obligations are defined, but are not limited to the following:

Pre-operative checks

The daily pre-operative checks should be conducted on the machinery. These include but are not limited to gear box oil checks, whether there is wobbling in the splicing ear, checking of auxiliary drive and main drive, checking for vibration above defined levels in tower etc.

Post-operative checks

There should be a preventive maintenance schedule prepared, and maintenance on the plant and machinery should be conducted once a month. Major maintenance and repair should take place monthly. BIS standards must be mandatorily followed for all plant and machinery equipment.

These obligations are only indicative in nature, and the developer must ensure the safety and security of passengers.

DEMAND ESTIMATION

As per data obtained, visitor arrivals at Madan Mahal exhibit seasonal patterns, depending on festival time (peak season) and normal season (off-peak season).

NO.	MONTH	NO OF TOURIST
1	JAN	12,900
2	FEB	13,500
3	MAR	9,800
4	APR	9,500
5	MAY	9,300
6	JUN	9,000
7	JUL	8,900
8	AUG	8,900
9	SEP	11,000
10	OCT	13,500
11	NOV	14,000
12	DEC	14,500
	Average	**11,233**

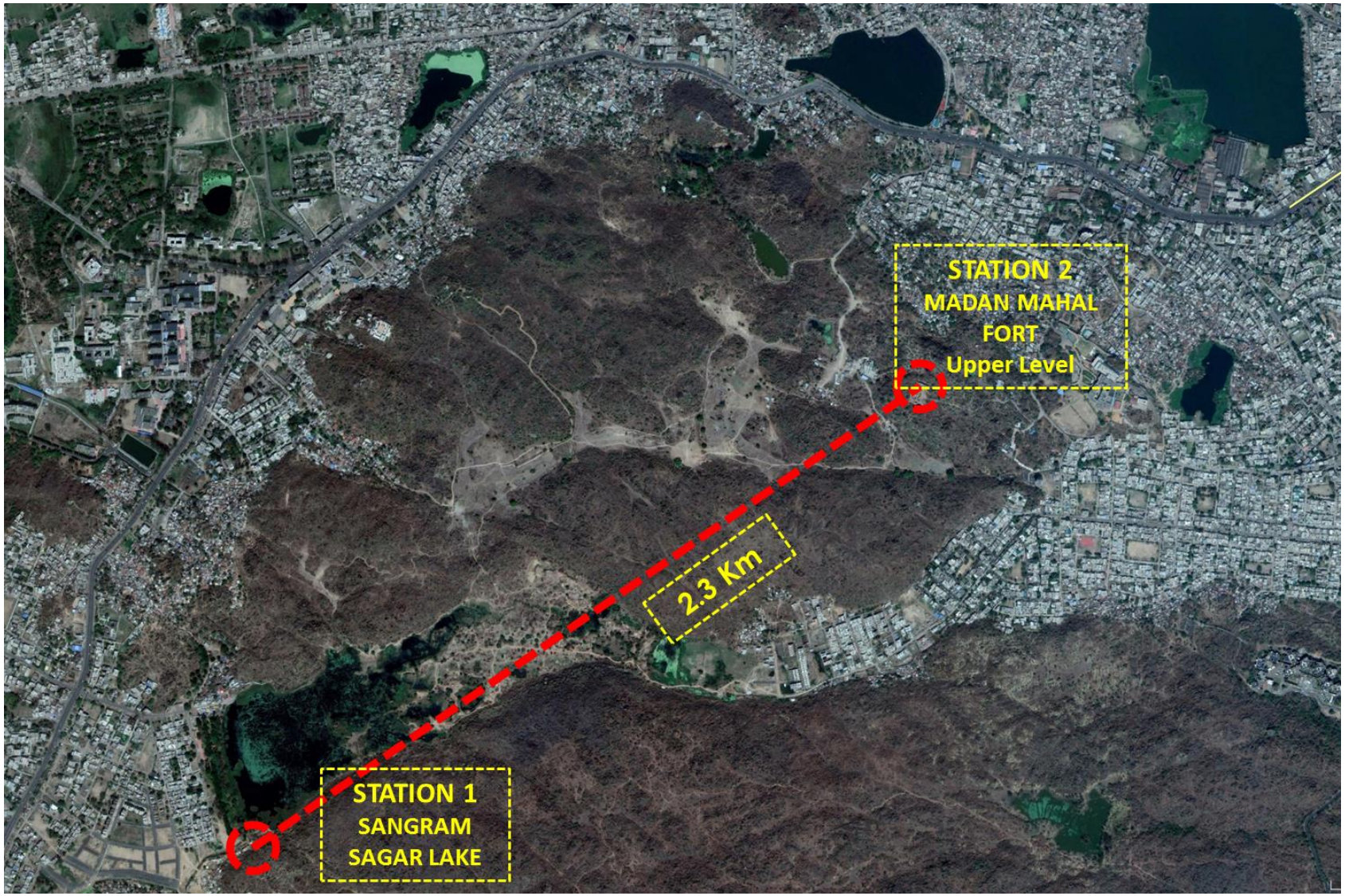
The approximate Monthly visitor footfall estimated is ~ 11300

Based on the average footfall at the site, it can be concluded that the development of the ropeway is a commercially attractive proposition at the site. Additionally the ropeway, once

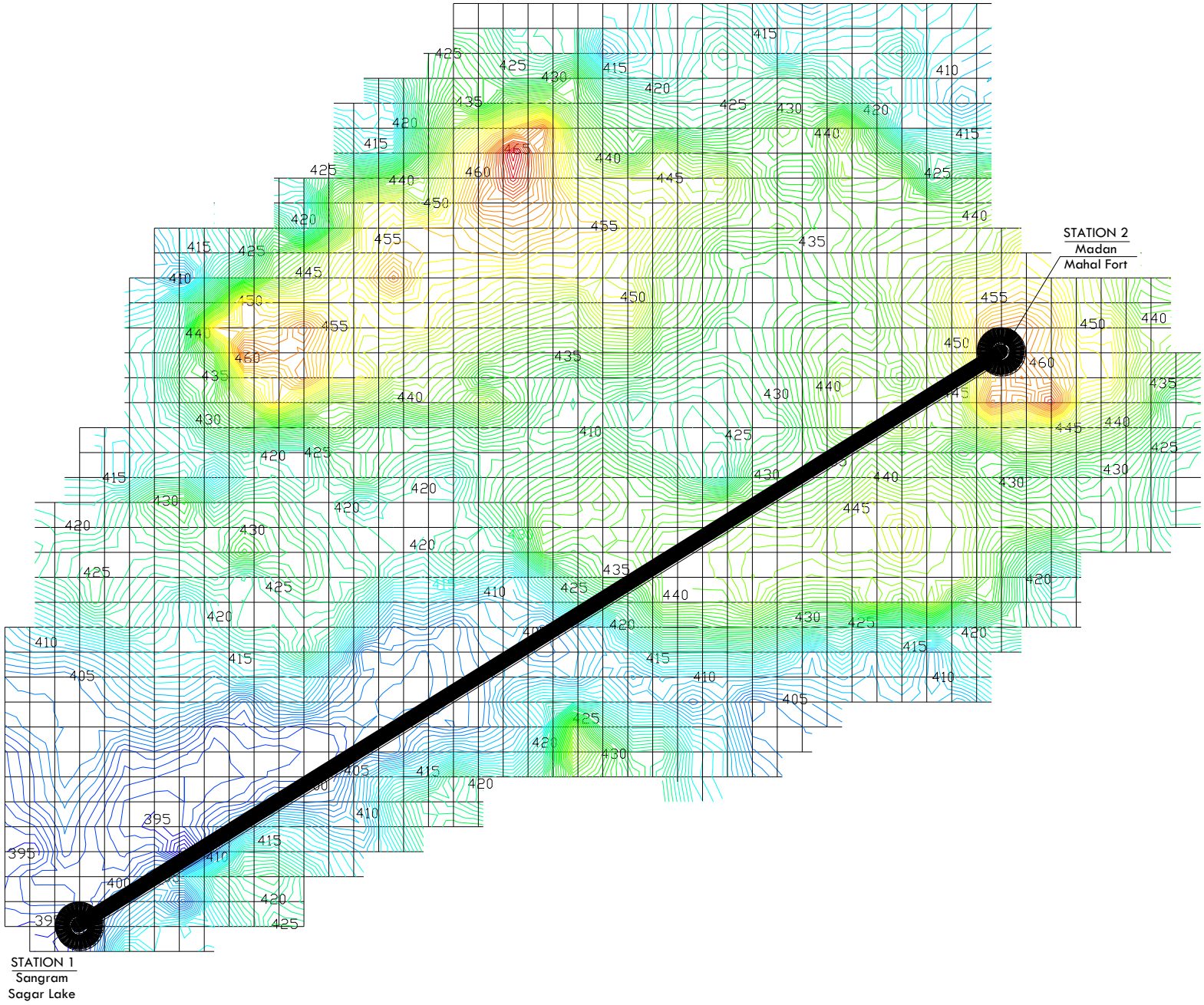
built, would attract more tourists to the site and can act as catalyst for further development at the site, and in nearby areas.

TOURIST ESTIMATIONS

The daily operating hours of the ropeway are assumed to be 10 hours, from 8:00 am in the morning till 6:00 pm in the evening). Total monthly visitors to the Madan Mahal who would use the ropeway is assumed to be **11300** (keeping in mind that significant people come in vehicles, and would switch to the ropeway for the enhanced touristic experience). One day of downtime due to maintenance and repair for the ropeway system is assumed in a month.



Picture 1 Satelite Map Showing the location of Proposed Ropeway Stations


STATION 2
Madan
Mahal Fort
STATION 1
Sangram
Sagar Lake