

# SUSTAINABLE URBAN MOBILITY PLAN AT LA MANGA DEL MAR MENOR (SPAIN)

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## ABSTRACT

La Manga del Mar Menor is a spit between the Mediterranean Sea and the Minor Sea. The dimensions of this sandbar are about 20 km length and about 100 m of average wide, with only one access at South by landside. Due to its natural attractive, beaches, weather, gastronomy and diversity of leisure options, La Manga is the main seaside tourist town in the Region of Murcia (Spain). It is an attractive area, mainly in July and August, when traffic problems increase significantly. Note that, because of its dimensions there is only one access route and one exit route. This physical limitation makes congestion worse because there is not enough space to alternative routes. Moreover, all external effects related to traffic, such as noise and pollution, also increase. These effects damage the initial quality of life of this area and cast serious doubts on his sustainability.

A Sustainable Urban Mobility Plan (SUMP) has been developed at La Manga in order to encourage sustainable mobility through a rational use of the private car and to ensure and make easier the intermodality among public transport, bicycles and pedestrian areas. Two packages of measures have been developed. Specifically, infrastructural measures focus on improving sustainable mobility. For example, a dissuasive car park near to intermodal area to connect all transport mode easily, measures to improve fluidity of local buses or safe cycle-lines. All these measures are evaluated economically. The other package of measures is focused on economic measures, such as intermodal transport card or environmental taxes. These measures are described qualitatively.

Currently, the local government is studying all proposals in order to agree on clear responsibilities and, allocate budgets to put them into practice, to transform La Manga in a place with quality of life throughout years.

*Keywords: cycle-lines, dissuasive car park, intermodality, La Manga del Mar Menor, pedestrians, public transport, SUMP.*

## 1 INTRODUCTION

La Manga del Mar Menor is a spit between the Mediterranean Sea and the Minor Sea, at the South-East of Iberian Peninsula (see Fig. 1a). The dimensions of this sandbar are about 20 km length and about 100 m of average wide, with only one access at South by landside.

During the 60s and 70s it experienced a great urbanistic growth, and because of its natural attractive, beaches, weather (its annual average temperature is 20°C), gastronomy and diversity of leisure options, La Manga is the main seaside tourist town in the Region of Murcia (Spain).

Due to these features, traffic problems increase significantly in this area, mainly in July and August. Note that, because of its dimensions there is only one access route and one exit route. This physical limitation makes congestion worse because there is not enough space to alternative routes. Moreover, all external effects related to traffic, such as noise and pollution, also increase. These effects damage the initial quality of life of this area and cast serious doubts on his sustainability.

A Sustainable Urban Mobility Plan (SUMP) has been developed at La Manga, in collaboration with the local government, in order to encourage sustainable mobility through a rational use of the private car and to ensure and make easier the intermodality among public transport, bicycles and pedestrian areas. The final objective is to develop strategies that can stimulate a shift towards cleaner and more sustainable transport modes.



Figure 1: a) Geographical location of La Manga del Mar Menor. Source: [www.murciaturistica.es](http://www.murciaturistica.es).  
b) Limits of study area at La Manga del Mar Menor.

This SUMP is explained in the paper. In Section 2 the current situation is characterised. In Section 3 the proposals for improvement mobility are described, and conclusions are enumerated in Section 4.

## 2 CHARACTERISATION OF LA MANGA DEL MAR MENOR

The study area belongs to Cartagena, a medium-sized Spanish city, which is the main town of the zone. Figure 1b shows the limits of the study area at La Manga, about 6 km<sup>2</sup>. Road RM-12 is the one access to it.

Several items have been studied in detail to characterise the area currently. In particular: identification of land uses, equipment and services, inventory of streets, cycle-lanes and parking lots, description of intersections, and inventory of traffic lights and pedestrian crossings. Next, only the main conclusions of the whole study are shown.

### 2.1 Land uses, equipment and services

Land uses are shared between Non-Specialised Soil of Special Protection (43%), mainly due to the salt mines of Marchamalo, and Urban Soil (40%), totally urbanised. The rest of land uses are coast protection soils (15%) and general infrastructures (2%).

In relation to equipment and services (showed in Fig. 2) beaches are the 47% of the study area, that, together with the places of interest (salt mines, lighthouse, viewpoints) are the 75% of the study area. Accommodation is about 18% of the area, points of entertainment are 5% of space and the rest of equipment take up 2% of the study area. Therefore, these uses distribution justify its character the main seaside tourist town in the region.

### 2.2 Road network

Two groups of roads are identified: main roads and access streets.

Main roads are the principal mobility axes. They connect La Manga with other towns and access streets. The roads T01 (red colour – two lanes for each direction), T02 (blue colour – three lanes for each direction) and T04 (pink colour – two lanes for one direction) are main roads, which distribute traffic throughout La Manga (see Fig. 3).

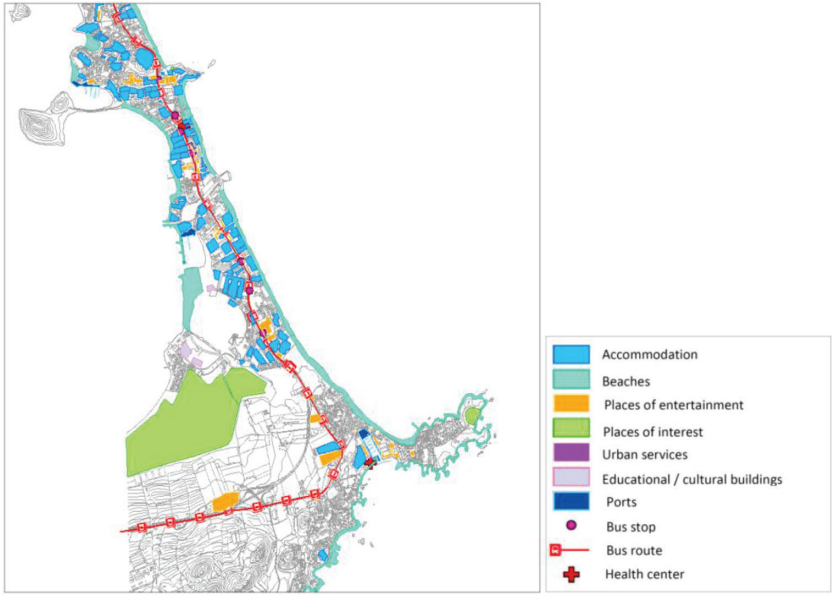


Figure 2: Equipment and services at La Manga del Mar Menor.

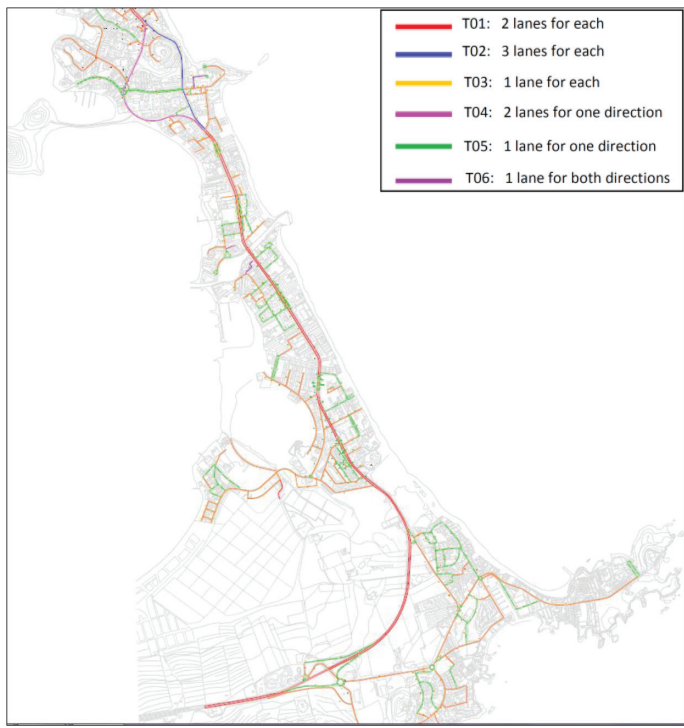


Figure 3: Road network at La Manga del Mar Menor.

Access streets are spread out the study area to link main roads with accommodations, places of entertainment, places of interest and other services. As Figure 3 shows, roads T03 (yellow colour – one lane for each direction), T05 (green colour – one lane for each direction) and T06 (purple colour – one lane for both directions) are access streets.

Note that, although access streets represent the 77% of the road network, the traffic problems are at main roads (23% of road network), mainly at the road T01 (red line) called ‘Gran Vía de La Manga Avenue’.

### 2.3 Parking lots

According to different vehicles and the purpose of parking lots 12 types of parking lots have been identified as shown the legend of Figure 4.

Once inventory has been completed some deficiencies have been identified in the study area:

- Direct parking lots in the main road ‘Gran Vía de La Manga Avenue’ (central axis) which reduces traffic fluidity due to manoeuvres to park.



Figure 4: Types of parking lots at La Manga del Mar Menor.

- Lack of signs inside free parking lot areas and markers to access easily to these parking lot areas.
- Lack of motorcycle parking lots.
- Lack of disabled parking lots (below-recommended ratio).
- Unsuitable use of unequipped parking lots areas due to the lack of signposting, so the area is not used properly.
- Traffic problems at difficult circulation streets to the section reduction (from one lane for each direction to one lane for both directions).

## 2.4 Cycle-lane

In relation to the cycle-lane goes through La Manga three main deficiencies have been identified to improve with the proposals of SUMP:

- Lack of continuity in three stretches of the cycle-lane.
- Lack of vertical and horizontal sign posts.
- Lack of safety to cyclists.

## 2.5 Traffic study

The aim of the traffic study is to know traffic patterns at peak season to quantify the number of vehicles that enter and exit at La Manga, to understand traffic behaviour and, to be able to model current and new traffic situations to check possible changes at congestion levels.

A traffic count device was located at beginning of La Manga (sole access) during a week, from 11th to 18th of July of 2016, and floating car tests also were done during that week. Collected data together with historical traffic data [1] and the methodologies of Highway Capacity Manual 2010 [2] have been the key references considered to analyse traffic patterns.

Figure 5 shows collected data from traffic count device during the study week. On week-days, the number of total vehicles counted is similar in both directions, entry and exit, an average value of 18,000 vehicles. However, during Friday, this trend changes for the entry,

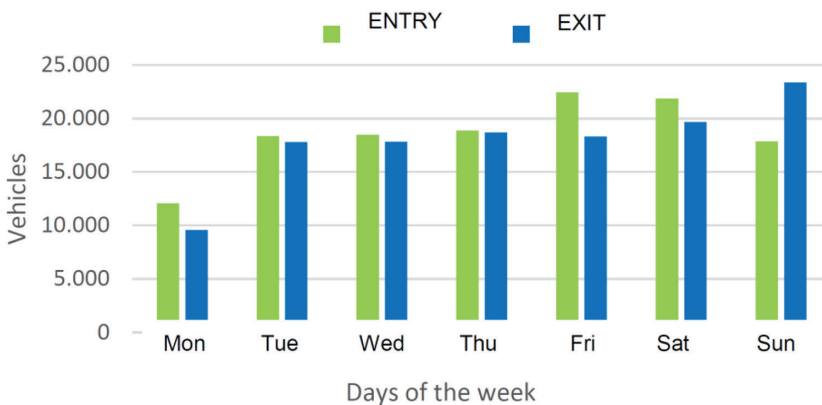


Figure 5: Number of vehicles registered each day, entry and exit at La Manga del Mar Menor, from 11th to 18th of July of 2016.

with a value of 22,500 vehicles. On Saturday, there are values almost the same as Friday at the entrance, but the intensity of traffic at the exit increases slightly. This growth could be for people that only pass the day at La Manga or/and movements between La Manga and the nightlife offer nearby. On Sunday, the movements are opposed to Friday movements, thus, the number of exit vehicles (23,400) are greater than the average value of 18,000 vehicles for entry and exit. Therefore, this pattern shows that about 5,000 vehicles (average value) go to La Manga to spend only the weekend. That is the reason why traffic problems increase at weekends of peak season.

Registered data of floating car tests confirm that the main cause of delay at the main road ‘Gran Vía de La Manga Avenue’ is red traffic lights, although the minimum time fluctuates between 6 and 7 seconds and, the maximum time of delay varies between 60 and 90 seconds, less than that the user expected due to the subjective character of wait time. Delays for congestion only appear on Sunday. An example of registered data from floating car is shown in Figure 6.

The main conclusions of the study traffic are:

- Deficient level of service at ‘Gran Vía de La Manga Avenue’ (Level D according to HCM 2010 [2]) at peak season, thus the road capacity is not enough to make sure light traffic.

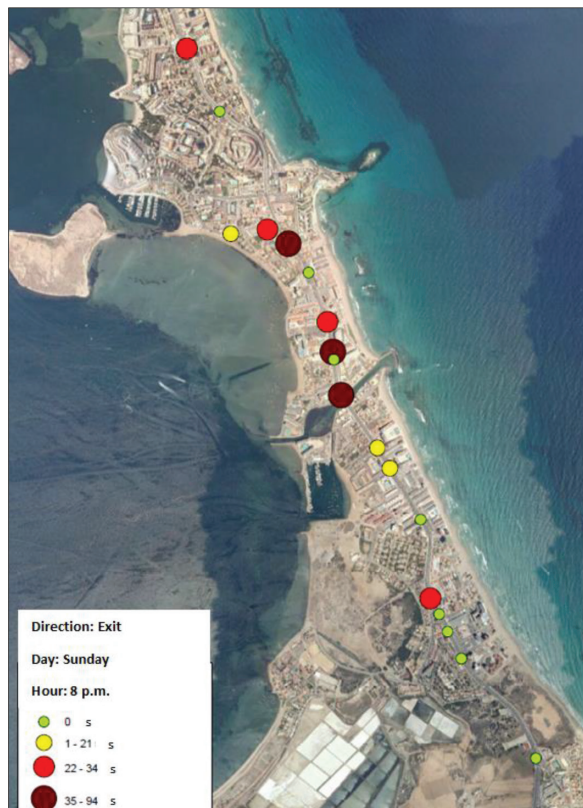


Figure 6: Registered data from floating car on Sunday at 8 p.m. for exit direction. The circles show the registered delay at each control point according to the legend.

- Congestion on Sundays at peak season due to an average growth of 5,000 vehicles (about 30% more than the daily traffic).
- Traffic lights work well, except peak hours, but the registered delays do not exceed 90 seconds.

### 3 PROPOSALS FOR IMPROVEMENT SUSTAINABLE MOBILITY

The starting point for developing a SUMP at La Manga can be summarised in two points: (i) deficient level of service at main access road with congestion problems on Sundays, and (ii) parking lots problems. Obviously, without forgetting other problems identified related to cyclists, pedestrians and public transport.

Therefore, the SUMP should encourage sustainable mobility through a rational use of the private car and ensure and make easier the intermodality among public transport, bicycles and pedestrian areas to minimise the previously identified problems.

Guidelines and examples about SUMP [3, 4], parking lots [5, 6], cycle-lines [7] or e-tickets on public transport [8] have been studied as references for this project.

Two packages of measures to improve sustainable mobility have been developed:

1. **Infrastructural measures.** These measures look for achieving sustainable mobility through creation and improvement of infrastructures in order to promote the use of alternative means of transport to private vehicles. All these measures are evaluated economically.
2. **Economic measures.** These measures have an economic character, which could help to reduce the number of private vehicles through La Manga. These measures are described qualitatively.

#### 3.3 Infrastructural measures

Note that, all infrastructural measures are required, that is, all of them must put into practice at the same time to obtain successful results. Next, the main measures studied are explained briefly, although other complement measures about pedestrians and cabs were evaluated too.

##### 3.3.1 Dissuasive car park with intermodal area

A dissuasive car park is proposed before the only access to La Manga (see Fig. 7) together with an intermodal area to allow users to change to sustainable transport modes such as bicycles or public transport. The main objective is to reduce the number of vehicles entering at La Manga. This measure will improve the road level service and decrease pollution, noise and other negative external items related to traffic. This car park is designed for three stages with a final total capacity of 2, 260 vehicles.

##### 3.3.2 Changes car park at ‘Gran Vía de La Manga Avenue’

A new layout of the parking lots of the ‘Gran Vía de La Manga Avenue’ is designed for removing the non-segregated park lots, that is, to eliminate the direct parking lots at the main road. This measure will increase safety because manoeuvres will not affect the main traffic flow, and pedestrians and cyclists will be the beneficiary as their areas of use will be expanded and better designed. To carry on this measure, the following rules are applied: whenever space is available, wide section, parking lots will be transformed to segregated parking lots and, if this is not possible, parking lots will be eliminated directly. An example is shown in

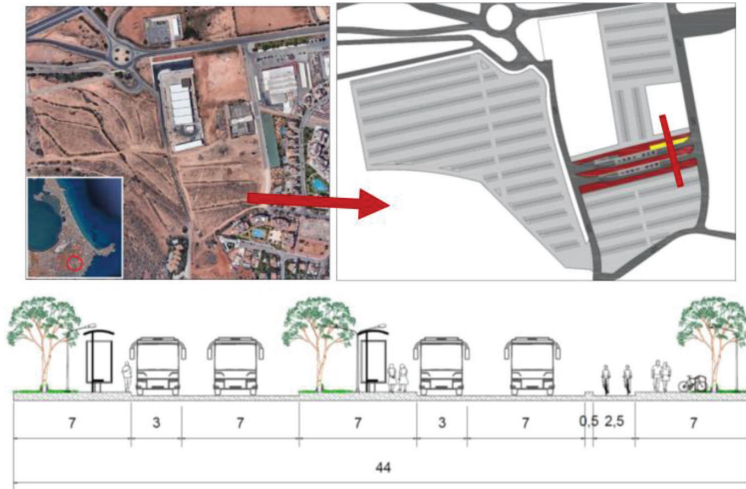


Figure 7: Dissuasive car park with intermodal area before the access to La Manga del Mar Menor. Type section of the intermodal area (measures in metres).

Figure 8 when at the same stretch some parking lots are eliminated in the new proposal layout and others are transformed to safe parking lots, segregated of main traffic flow.

### 3.3.3 Changes and improvements of unequipped parking lot areas and difficult circulation streets

Signalling, through panels of variable information, and ordering, through the painting of road markings, unequipped parking lot areas to allow an optimum use of them by the users. These panels will facilitate the location of the parking area, at the same time as they will inform about the number of free places available to it. In total, 17 parking lot areas in the study area



Figure 8: Example of parking lot changes in a stretch of ‘Gran Vía de La Manga Avenue’. Left: current layout. Right: proposal layout.



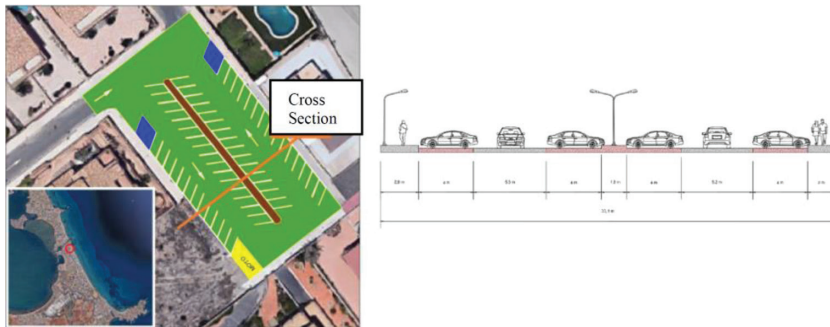


Figure 9: Example of changes in an unequipped parking lot area. Left: plan view. Right: cross section.

have been transformed. Figure 9 shows an example of the new proposal layout in one of these unequipped parking lot areas.

In relation to difficult circulation streets, the solutions have been the prohibition of parking on the street or allowing parking on one side of the street only, signposted correctly.

#### 3.3.4 Reconditioning of bus stops

To improve the mobility within the study area and to reduce the use of the private vehicle, it has been proposed the implantation of new bus stops to get an average distance of 380 m among consecutive bus stops, improvement the current value (600 m). All bus stops are modified in order to make easier, safer and encourage the use of bus line by inhabitants and tourists.

#### 3.3.5 Reconditioning of cycle-lane

The main proposal to improve the current cycle-lane at La Manga are: (i) to give continuity to it throughout the study area, (ii) connection to intermodal area, (iii) correctly horizontal and vertical sign posts, (iv) safe devices to separate cycle-lane and road-lane when it was necessary, (v) rent points of bicycles, and (vi) bike park lots near bus stops. In this way, it is sought to enhance the use of the bike lane, as users perceive it as a safe and comfortable place for their circulation.

To test the impact that these measures will have in traffic congestion, current traffic situation and different traffic situation with different levels of the use of dissuasive car park (20, 40 and 60% of use) have been modelled with VISUM software [9]. Figure 10 shows the example of 20% of use of dissuasive car park, that is, a 20% of registered vehicles do not access to La Manga because of this new infrastructure, at Sunday 8 p.m. when congestion appears at exit itinerary. At the left side, exit itinerary shows red (80–100%) and black (>100%) congestion levels, however, assuming a 20% of the use of dissuasive car park, the congestion levels decrease to 20–40% at exit itinerary. Note that, to obtain an approximate result in reality, all describe measures must apply at the same time.

All these infrastructural measures have been evaluated economically. The main figures are indicated in Table 1. The construction of dissuasive car park and the intermodal area is the 36% of estimated budget that, together with improvements of cycle-lane (31%), are the 64% of the budget. The rest of the budget is shared among changes of car parks at Gran Vía de La Manga Avenue (19%), improvements to bus stops (10%) and improvements of unequipped parking lot areas and difficult circulation streets (7%).

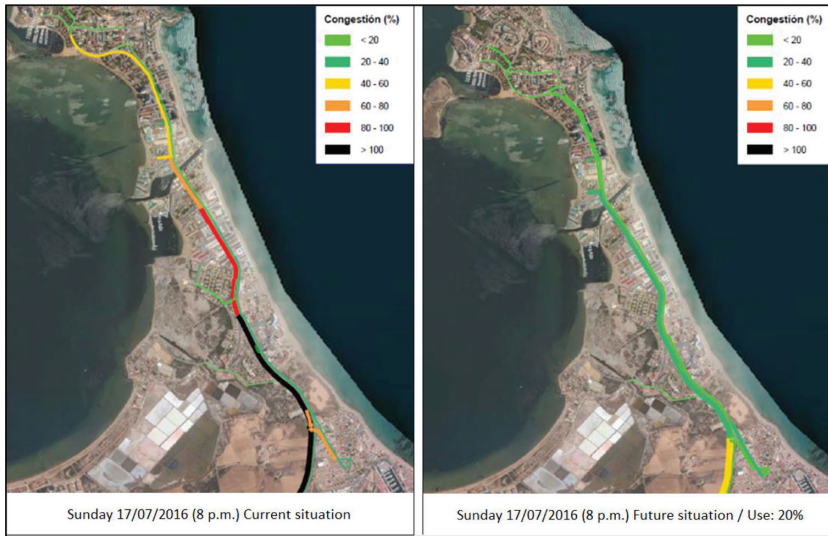


Figure 10: An example of changes at level congestion without (left) and with (right) the dissuasive car park (use estimated of 20%).

Table 1: Cost of infrastructural measures to encourage sustainable mobility.

INFRASTRUCTURAL MEASURES – SUSTAINABLE MOBILITY	
DISSUASIVE CAR PARK (I) + INTERMODAL AREA	1,083,183.36 €
CHANGES OF CAR PARKS AT GRAN VÍA DE LA MANGA AVENUE	589,817.01 €
IMPROVEMENTS OF UNEQUIPPED PARKING LOT AREAS/ DIFFICULT STREETS	101,440.89 €
IMPROVEMENTS OF BUS STOPS	310,660.17 €
IMPROVEMENTS OF CYCLE-LANE	949,440.28 €
<b>TOTAL COST</b>	<b>3,034,541.71 €</b>

### 3.4 Economic measures

A set of economic measures has been proposed to encourage the use of public transport and restrict the use of private vehicles at La Manga, although a detailed economic and feasibility study would be necessary in order to know the adequate tariff in each case for carrying out a correct implementation. These main measures are, on one hand, an intermodal card or computer applications to make easier changes among rent-bikes, dissuasive car park or bus. In this way, it is possible to reduce the time of operation, optimising the bus route, as well as the time of management for the rent of bicycles, transmitting a feeling of fluidity and speed to the users that make use of these benefits. On the other hand, to apply an environmental urban tool, to reduce traffic, congestion and pollution and to help to support new infrastructure requirements and transport services necessary to carry out the proposed actions.

### CONCLUSIONS

A set of infrastructural and economic measures is proposed at La Manga to encourage sustainable urban mobility, improving infrastructure and services for buses and bicycles together with the design of an intermodal area. The implementation cost of infrastructural measures is about three millions of euros. These measures, taken as a whole, will facilitate the reduction of the traffic of private vehicles by La Manga, which can reduce congestion by 60% to 80% based on the use of dissuasive car park. This congestion reduction also reduces the associated pollution or noise, among other negative external issues. All these advantages can turn La Manga into a pleasant place for its inhabitants and tourists, promoting a healthy life that allows enjoying the available leisure offer with more comfort and security.

Currently, the local government is studying all proposals in order to agree on clear responsibilities and allocate budgets to put them into practice, to transform La Manga in a place with quality of life throughout years.

### ACKNOWLEDGEMENTS

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