The information in this Case Study has been provided by DGT. The A-4 highway connects the Andalusian cities of Seville and Córdoba and the responsible road authority is “Ministerio de Transportes, Movilidad y Agenda Urbana”, part of the Spanish National Government. The current coded road stretch is located between the road sections: CH. 384+400 and CH. 536+700, in other words between Jaen/Cordoba provinces border and Seville city. It was selected as a case study after Crash Risk Mapping and local road safety intelligence suggested that that it may be worthy of further study.

The first case study is located at CH. 529+700 (drive direction from Seville to Córdoba) close to interchange of Sevilla airport on a gently curved. The road section has a divided carriageway with two lanes in each traffic direction and the speed limit is 120 km/h. The Annual Average Daily Traffic (AADT) in 2018 was around 54,500 vehicles per day, at the location of the case study (northeast access of Seville city – see Figure 1).
Countermeasures Implemented

Figure 2 shows the same point at two different times. At the left image (2008) the median had an unprotected safety barrier. In 2016, Spanish National Government ("Ministerio de Transportes, Movilidad y Agenda Urbana") carried out a metal safety barrier improvement on various different road sections. In the right-hand photo, the median shows the extended replacement continuous metal safety barrier that was installed. The metal safety barrier improvement budget was around 50,000 €/km and was implemented as a part of a general programme of improving roadside protection.

The following images show more detail of where this improvement was implemented. In Figures 3 and 4, the guardrails have been placed at the driver side, and at Figures 5 and 6 the guardrail have been placed at the passenger side. Figure 7 shows an aerial view of the road at CH. 529+700.
Road Assessment

Star Rating protocol has been utilized for the assessment of the road before and after network upgrading, and the crash data evolution in last 10 years. Figure 8 shows the SRS in 2008 year (before the implementation in 2016) and then the current situation.

Before the network upgrading, the Star Rating Score (SRS – the raw score that combines the individual risk components in the iRAP model and is then used in setting band thresholds when allocating stars in the Star Rating – the higher the SRS the higher the risk) was 5.81 for vehicle occupants, 40.04 for motorcycles, and not applicable for pedestrians and bicyclists.

The Star Rating in the before situation was 3 stars for vehicle occupants and 1 star for motorcycles.

And after the network upgrading, the Star Rating Score was 4.08 for vehicle occupants, 12.78 for motorcycles, and not applicable for pedestrians and bicyclists (Figure 9). So, after the network upgrading, the Star Rating for vehicle occupants is 4 stars and for motorcycles is 2 stars. Improving the Star Rating by one star is associated on average with a halving in each star improvement in the crash costs per kilometre travelled for vehicle occupants and step-changes in safety benefits too for other road users.

Case Study

Crash Data

Crash and injury data have been analysed to evaluate the influence of the network upgrading in 2016.

The following chart shows the severity of injuries (fatality, serious and slight) from 2009-2019 on the 4 km of road length that includes the upgraded section.

The trend in total crashes from 2009-2019 on the 4 km of length that includes the upgrading section shows fewer crashes on average in 2016-2019 than earlier years (Figure 11). The numbers are small but the trend over recent years, fitted with a polynomial regression, is downward.

![Figure 10. Injury severity history:: A-4 CH. 529+700](image)

![Figure 11. Total crash trend evolution around A-4 CH. 529+700](image)

Conclusion

The iRAP Star Rating Score shows a reduction in risk for both vehicle occupants and motorcyclists as a result of barrier improvements and the Star Rating rises from 3 to 4 for car occupants and from 1 to 2 for motorcyclists. At this location there has been year-to-year variation in the number of injuries both before and after 2016 when the metal safety barrier improvements were made. The average annual number of crashes and injuries is lower in the “after” period (2016-19) than the “before”.

A more complete picture of the crash pattern could be developed by using additional analysis of different crash types before and after implementation and by using a control group of road sections.