



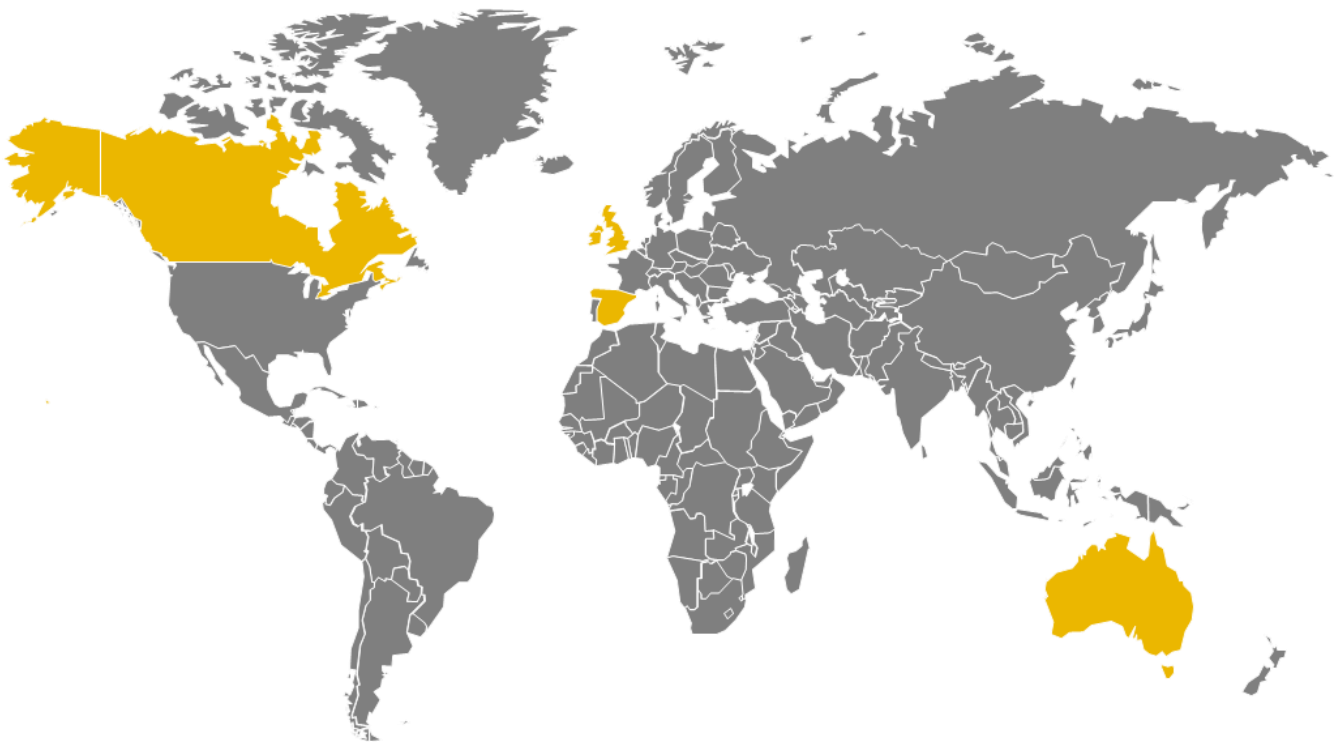
Catalogue of biodiversity initiatives

Flora 2022

ferrovial

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Tunnel de Padornelo (Zamora)

On the Padornelo High Speed Tunnel site, the landfills of the Requejo and Hedroso sites have been restored. In the more than 80,000 m² of surface area of both landfills, more than 10,000 trees have been planted.

10,000 trees of the following species: rowan (*Sorbus aucuparia*), oak (*Quercus pyrenaica*) and birch (*Betula alba*).

Aim of the project: to optimise the irrigation to be carried out, ensuring that irrigation is only carried out when necessary and in the appropriate quantities, in the most efficient way for the survival of the plantations.

Soil study: the soil in which the plantation is to be planted is physically and chemically characterized. This determines the composition of the soil, its drainage capacity and water retention capacity (low in this case).

Water Retention Parameters: According to the analyses carried out, the water contents for field capacity and permanent wilting point give values in the order of 18% and 4% respectively. In addition, with the calculation of the Useful Water Reserve (UWR) it is known that below 10% humidity, some plants can start to have significant water stress problems.

Interpretation of results: The high drainage capacity of the soils, together with the low field capacity, means that in order to try to achieve success for the plant species in the rooting phase, it is necessary to maintain the water content measured by the sensors above 10% by means of very frequent irrigation without excessive water content, since if more water were used, it would drain quickly, considerably increasing the Water Footprint, runoff and nutrient leaching, without significantly improving the results.

Environmental benefits:



Water consumption savings



Increasing the efficiency of plantations

Placement of Sensors: Sensors have been installed at 3 different points on the landfill to monitor variations in soil moisture content:

1. High platform
2. Talud
3. Low platform

Moisture meters have been placed in each of them at different depths (20 and 40 cm), and it is also possible to receive conductivity and temperature data. The information is accessible via a web platform.



Conclusions: Soil moisture data from June to September provided continuous information on the useful water reserve. On this basis, irrigation was adjusted to the right moment in order to prevent water stress in the plantation. Irrigation was reduced to less than 10 l/plant, although the initially planned frequency was increased. The survival rate of the plantation is significantly higher than expected.



Detail of the humidity sensors placed in the landfill.

RESCUE AND RELOCATION OF WILD FLORA

CORREDOR VIAL BUCARAMANGA-BARRANCABERMEJA-YONDO (COLOMBIA)

INTRODUCTION

As part of the "Bucaramanga-Barrancabermeja-Yondo Road Corridor" project located in the municipalities of Barrancabermeja, Betulia, San Vicente de Chucuri, Girón and Lebrija, in the department of Santander-Colombia, activities are being carried out to rescue and relocate the wild flora (Bromeliads, orchids and brinzales) identified in the areas of intervention of the project, as compensation associated with the permit to lift the ban on wild flora species with threat category affected by the development of the project, permission granted by the Ministry of Environment and Sustainable Development by Resolution No. 1048 of the Ministry of Environment and Sustainable Development. 1048 of 5 June 2017.

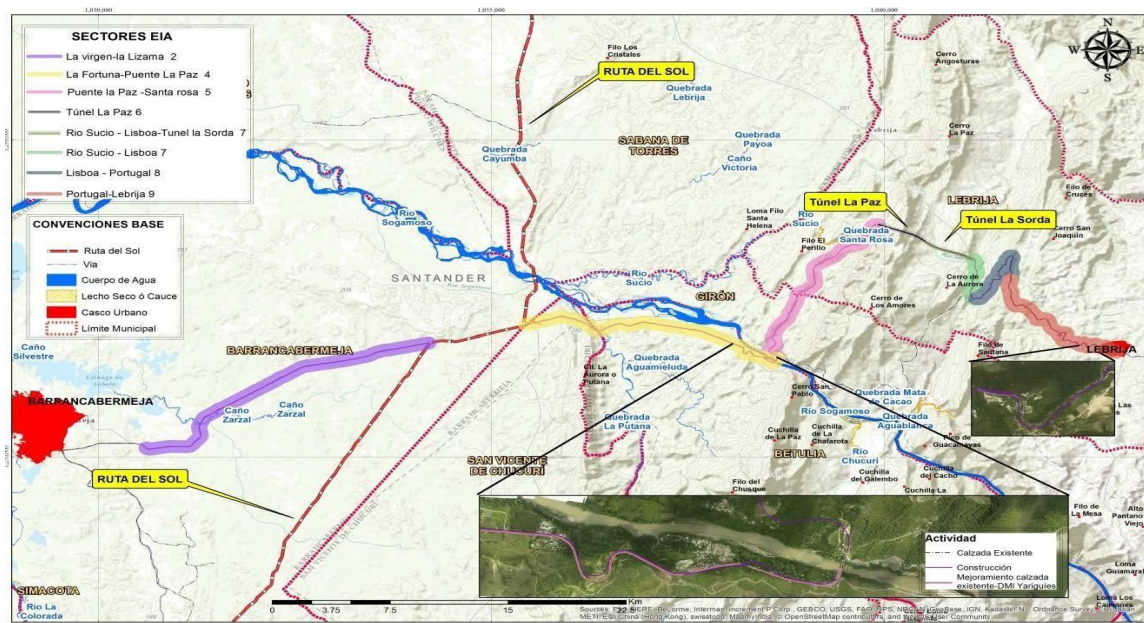


Figure 1. Project location

The project is being implemented in an area of 382.97 ha, mainly in the tropical rainforest life zone, at altitudes of 200 to 1000 m above sea level with temperatures above 24°C and rainfall between 2,000 and 4,000, this life zone is characterised by a greater diversity of fauna and flora.

METHODOLOGY

Before logging activities are carried out, epiphytes and brinzales are identified and rescued. Compensation activities consist of the rescue, transfer and relocation of 100% of the abundance of individuals of all Bromeliad species and 100% of the abundance of individuals of Orchid species.



Orchid: *Dimerandra emarginata*

Bromeliads: *Thillandsia fendleri* *Thillandsia* sp.

The rescued individuals meet the characteristics according to the selection criteria such as phytosanitary, reproductive and senescence status.

The compensation also includes the rescue of saplings or seedlings with a maximum height of 50 cm, these seedlings are placed in temporary nurseries for monitoring and maintenance, while they are transferred to the final sites for relocation.



Seedling rescue, transport and disposal in temporary nurseries

Seedlings of *Cedrela odorata*

ADVANCES

Rescue of Epiphytes (Bromeliads and Orchids): In the intervened areas, 4801 Epiphytes between bromeliads and orchids (aerial and terrestrial) have been rescued, including bromeliad species such as: *Thillandsia elongata*, *Thillandsia fasciculata*, *Thillandsia flexuosa*. Among the orchids rescued, the following species stand out: *Oeceoclades maculata*, *Cattleya warscewiczii*, *Dimerandra emarginata*, *Laelia undulata*, among others.



Oeceoclades maculata

Rescue, transfer and identification of epiphyte species (Bromeliads and orchids).

Rescue of seedlings: 15,794 seedlings such as Cedar (*Cedrela odorata*), Sapán (*Clathrotropis brunnea*), Snail (*Anacardium excelsum*), some coconuts such as *Lecythis* sp, among others, have also been rescued.



Rescue, transfer and identification of epiphyte species (Bromeliads and orchids.)

Temporary nurseries: Rescued epiphytes (Bromeliads and Orchids) and saplings are moved to seven temporary nurseries. (7) temporary nurseries built and suitable for the maintenance and monitoring of the flora species during the adaptation period for their final relocation.



Definitive relocation: The epiphytes (bromeliads and orchids) and saplings will be relocated to areas with similar ecological characteristics to where they were rescued, guaranteeing their survival. Each of the relocated species will be maintained and monitored for a period of three (3) years after their relocation.



Pacifico Acciona Ferrovial JV

During the **preconstruction phase** of the project it was identified that flocculation trailers would assist in the treatment of sediment basins to allow for adequate mixing of materials required for sediment basin management during dewatering activities onsite.

During the **procurement process** it was identified that cost savings could be made by designing the flocculation trailers onsite and that the engagement of a metal fabrication company to build the trailers could result in significant savings.

During the **design phase** it was also identified that with changes to the design that the units could also be utilised for the application of soil binders and hydromulch to assist with stabilisation of exposed areas during earthwork operations.



Environmental benefits:

The units assist the project to meet environmental best practice in terms of:

- ✓ Stabilisation
- ✓ Dust suppression
- ✓ Treatment of sediment basins post wet weather onsite

Flocculation and hydromulching units to assist site workforce in the treatment of basin post wet weather events. The trailers were also identified to have the potential to **assist with stabilisation** of exposed areas during earthwork and landscaping operations with the ability to be utilised for the application of soil binders on exposed areas and for hydromulching of areas during landscaping and soil stabilisation operations onsite.

By incorporating safety features into the design such as a larger access into the tank, hand rails and working room at the front of the units would **reduce the risk of injury** to workers.

The unit would also **reduce the distance and quantity of dewatering equipment** (pumps, hoses, etc.) which would need to be transported by foot to basin locations onsite reducing the risk of injury to workers.

The design also incorporated removable inlet and outlet hoses to allow maintenance and replacement of damaged parts to occur quickly.



Short description:

Design and Construction of two flocculation and hydromulching trailers for the Project.

- Saving of time and cost
- Improved work productivity
- Stabilisation of exposed areas (hydromulching and dust suppression purposes)
- Faster Treatment of basins.



Development of construction solutions for the reinforcement of slopes in cut-and-cover tunnels.

New Madrid-Levante high-speed railway access. Section: El Carrús - Elche. Alicante.

The objective is to increase safety against possible landslides and instability of cut-and-cover tunnel slopes as a consequence of natural disasters, accidents, erosion, water penetration, etc.

The aim is to investigate the behaviour and development of slope reinforcement of cut-and-cover tunnels in order to prevent erosion and ensure safety during track installation and maintenance.

In the cuttings of the cut-and-cover tunnels, as this is the area of greatest risk due to the possible impact on the road, a breakwater footing will be placed up to a height of 1.50 metres to provide greater stability to the slope. To protect the slopes against erosion, a volumetric polymer geogrid will be installed, reinforced with a triple twist mesh.

The whole will be anchored to the ground by means of "staples" (16 mm diameter B500S quality steel bolts bent into an inverted U-shape), not less than 1 metre in length, injected with cement grout.

On top of this geogrid an enriched substrate of 10 mm, consisting of Hortofibra wood fibres, Landscaping substrate, Stable Plus organic stabiliser, Azolon slow release fertiliser and Humi-Pro humic acids, together with hydroseeding and maintenance irrigation.

Colorock, a technically advanced and environmentally safe product that simulates a natural layer of rock, will be installed in the gunite grouting as a visual integration measure. After this and as a natural long-term measure, climbing plants and ground cover will be placed around the perimeter.

Through these actions, the integrity of the slope is better preserved throughout the life of the infrastructure and protection against the degrading and erosive effects of rainfall is improved.



The innovative nature of this Project has been accredited by an External Entity, by obtaining certification as an R&D&I Project according to the UNE 166.001 standard.

Autor: Fran Ciurana

Environmental advantages:

- The integrity of the slope is better preserved over the lifetime of the infrastructure.
- There is better environmental integration.
- Greater protection against the degrading and erosive effects of rainfall is achieved.



Appearance of the slopes to be restored



Tunnel embankment with riprap footing and hydroseeding substrate



Tunnel outlet stabilisation work

Restoration and revegetation

2016



Ecological restoration of slopes and recovery of populations of *Maytenus senegalensis*

Mediterranean Motorway (A-7). Section: Polopos junction-Albuñol junction. Granada

The complex orography and tectonics of the site soils involve large clearings in arid terrain, the recovery of which is particularly difficult. The presence of protected endemisms reinforces the need for revegetation work.

The work carried out includes several actions:

- Land compensation to reduce the need for soils affected by landfills and borrowing of materials.
- Adaptation of the slope surfaces to favour the implantation of species typical of the dry coastal area.
- An attempt has been made to adapt the morphology of the slopes to the pre-existing reliefs as far as possible, maintaining the slopes and orientations.
- The lack of topsoil that characterises the area is compensated for with micro-slopes and roughness of the finishes of the slope surfaces, which allows the spontaneous implantation of autochthonous seeds and their attachment to the land during periods of intense rainfall.
- Recovery of the Arto population, an Ibero-African endemism of warm coastal areas.

Although no corrective measures have been established for the affected units, they multiply by vegetative propagation and by seed as follows:



Spring de 2007: 5 transplant
Winter 2009: 30,000 cutting
Spring 2009: 5,000 seeds
Spring 2010: 4,000 seeds
November 2013: trasplante de 1,000 individuals
October 2013/March 2014: 11,237 cutting

Specimen of *Maytenus senegalensis*

It demonstrates the viability of ecological restoration techniques in such an arid ecosystem, with revegetation results far superior to conventional ones in terms of species diversity, as well as landscape integration. It has been possible to revegetate large embankment slopes and cuttings without using topsoil or complex hydroseeding techniques.

In addition, the different reproduction techniques are put into practice. of *Maytenus senegalensis*, evaluating their results.



Taludes restaurados con vegetación autóctona



Planting work (detail of cuttings)

Environmental benefits:

- Recovery of endemism populations. Planting has been increased by **467%** compared to the initial project.
- Recovery of slopes of up to **130 m** with vegetation from the surrounding area using ecological restoration techniques.
- Minimisation of earthworks and material contributions to the site. All the excavated earth has been reused, including a surplus of **3M m³** that was not contemplated.



Dismantling in the process of recovery



General view of the construction site

In collaboration with :



Restoration and revegetation



Environmental protection in a Biosphere Reserve.

Ferreries variant. Menorca, Balearic Islands.

The ME-1 road is Menorca's main communication route. Before the works, this road crossed Ferreries, causing significant traffic disruption and negatively affecting the safety and quality of life of its inhabitants. The project makes it possible to bypass Ferreries by means of a newly built 4.8 km road..

The project was conditioned by Menorca's status as a Biosphere Reserve. In addition, the work bordered two areas included in the Natura Network.

Numerous protection measures were carried out, including the transplanting of holm oak and wild olive trees, raids for the capture and transfer of turtles, the replacement of 9,200 metres of dry stone walls and the installation of more than 200 escape devices for fauna.

From the point of view of habitat restoration, it should be noted that the plants used in the revegetation work were obtained from seeds collected in the area itself, with all production certified as organic farming. The sowings used species characteristic of the island, such as enclova, with different treatments designed according to the type of surface area to be restored.

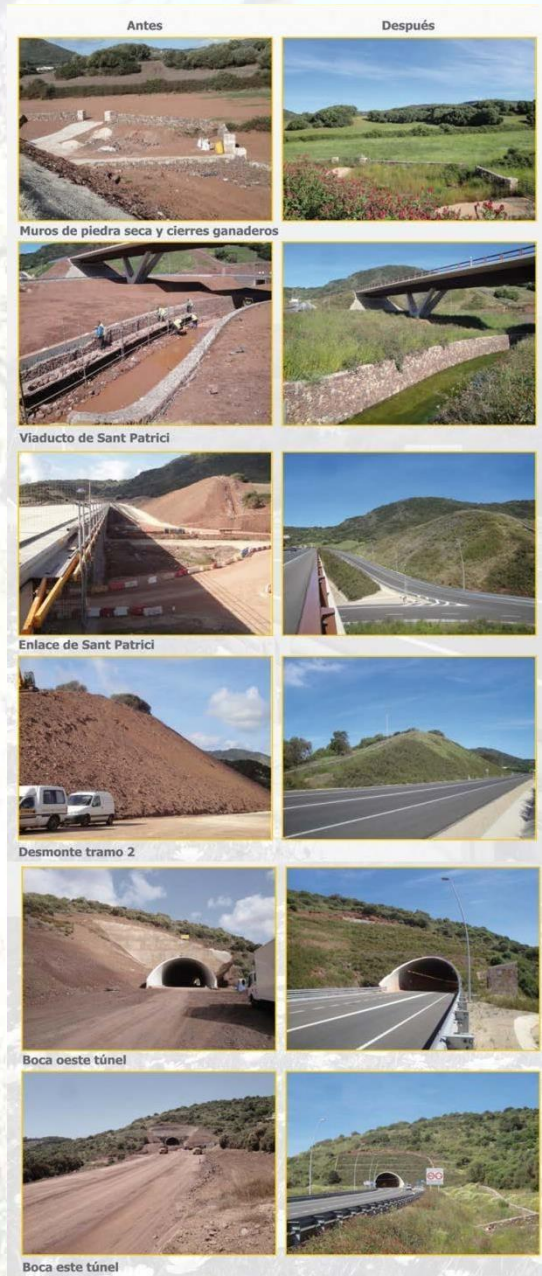
In addition, another series of actions were carried out:

- Execution of hydroseeding with specific hydraulic mulches according to the type of slope.
- Development of a specific project for the landscape integration of the tunnel's tunnel portals.
- Execution of landscape notes that act as acoustic barriers.
- Installation of an energy efficient lighting system on the junctions.
- Use of bituminous mixes from rubber powder from recycled tyres from tyre recycling.

The construction of the Ferreries bypass is an example of how the environmental variable can and should be integrated into a civil works project, especially when it is a project in a Biosphere Reserve.

Environmental advantages:

- Adaptation of the road layout to the natural relief of the terrain, minimising earthworks and the need for borrowing and landfill.
- Planting of more than **11,700 shrubs and 3,200 trees..**
- Burying of **2,500 m** of power and communications lines.
- Environmental restoration of out-of-use road sections.



Restoration and revegetation



Deposit of excavation leftovers in the Albertia Tunnel. Guipúzcoa.

Vitoria-Bilbao-San Sebastián High Speed Line. Section: Legutiano Eskoriatza. Subsection II.

The project requires treating the excavation earth for a 2,090 and 2,080 metre twin-tube tunnel with the least possible environmental and landscape impact.

The Azkorartuzieta stream crosses the site of the planned landfill. The initial solution included two diversions of the riverbed and exposed the stream to possible contamination by the dragging of materials and clouding.

In the Technical Project for the landfill, drawn up at the start of the work to comply with the EIS, a diversion of the stream was proposed around the periphery of the landfill, facilitating the work of executing the landfill itself and avoiding the fact that the stream crosses it. In addition, the proposed solution facilitated the environmental integration of the new channelling and the landfill itself.

In order to implement this solution, the Technical Project was approved by the Vice-Ministry of the Environment of the Basque Government. The development phases were as follows:

Provisional channelling of the watercourse while the new channelling was being carried out. This greatly facilitates the work and avoids contamination of the water, which flows through the pipes without any contact with external agents.

Backfilling. At present, the backfill has a volume of about 640,000 m³ (the excavation of the tunnel is not completely finished).

Construction of the new channel. The final naturalised channelling using stone and a stepped slope, so as to facilitate the establishment of aquatic vegetation and fish fauna..

Infill revegetation. After the construction of the breakwater at the foot of the fill, topsoil is spread as the embankment is consolidated. Hydroseeding is used to support the slopes and native tree and shrub species are planted.

The project fulfils the objective of accommodating the approximately **700,000 m³** of materials from the excavation of the tunnel while respecting the landscape integrity of the environment and promoting its natural recovery using biological diversity criteria (facilitating the natural revegetation of the channelling and the circulation of fauna through it).

Environmental advantages:

- The water of the stream will not be affected during the execution of the works.
- On-site reuse of leftover building site materials.
- It facilitates the natural revegetation of the channel and the circulation of fauna along it.



Ejecución del nuevo encauzamiento junto al vertedero de tierras en uso



Situación final del nuevo cauce, mediante bajante escalonada



Situación final del nuevo cauce

The innovative nature of this Project has been accredited by an External Entity, by obtaining certification as an R&D&I Project according to the UNE 166.001 standard.

