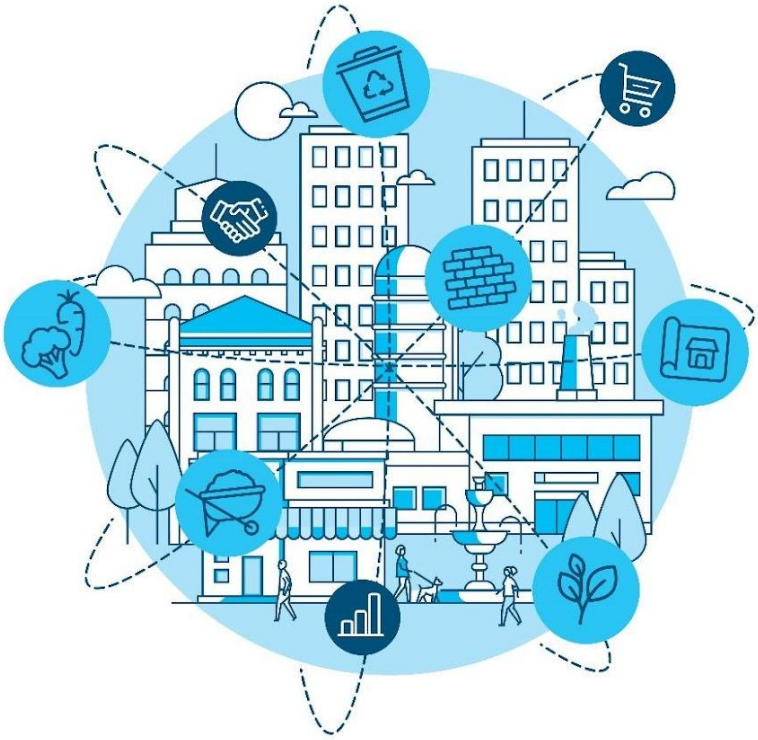
CIRCULAR CDW in Seville

Demonstration Report

Municipality of Seville



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Abstract	This demonstration report explains how the demonstration actions, in the CDW stream, have taken place, how the instruments and activities have been implemented and what benefits, barriers and lessons learned have arisen during the implementation of those actions.
Keywords	CDW; Demonstration; Implementation; Actions, Instruments
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Contents

1. Executive summary

The CityLoops project brought together seven European cities – Apeldoorn, Bodø, Mikkeli, Poto, Seville, Høje-Taastrup and Roskilde - to pilot a series of demonstration actions to close the loop of two of the most important waste streams in Europe: Construction and Demolition Waste, and Bio-waste. The ultimate aim was to become circular cities in which no resource goes to waste, driving the transition to the circular economy. The project started 1.10.2019 and ended 30.9.2023. The project was coordinated by ICLEI – Local Government for Sustainability and it received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 821033.

City Council of Seville, Lipasam, Idener and Emasesa were responsible for the project implementation in Seville. This report presents Seville´s demonstration actions of Construction and Demolition waste (CDW) stream – their implementation, results and lessons learned, as well as replicability and future perspectives.

Introduction

In order to comply with the current European objectives in the field of the municipal waste management, the of Seville is seeking to implement various tools and actions, to advance the circular management of CDW in the city of Seville, its ulterior treatment and valorisation as well as the optimisation of its logistics, awareness of citizens and small generators as well as municipal companies and large constructors. Three demonstration actions were carried out in Seville. Demonstration action 1 was focused on the Renovation of water pipelines with circular material management, Demonstration 2 was focused on Optimising clean points (municipal facilities to specific waste management such as CDW), and Demonstration 3 consisted in the development of IT tool to the data driven decision making and Best Practice Guidelines for CDW Management in Sevilla. All demonstrations were conducted in collaboration with stakeholder groups. The main stakeholders Lipasam, Emasesa, Idener, City Council of Seville, Fermovert (CDW management company), citizens and constructors.

New approaches/instruments

<u>Demonstration action 1: Renovation of water pipelines with circular material management.</u>

In this demonstration action, Emasesa will undertake the circular renovation of old water and sewage pipelines by recycling concrete, road surface, filling, and soil.

In summary they have been:

- Development of a Quality assessment of CDW Instrument

- Strengthened alliances with relevant local and regional actors in the field of CDW circularity.

- The increased amount of material that is recovered/recycled, and therefore reduced amount of material that is deposited in landfills.

- 2 sites in which underground pipe replacement was carried out with recycling of unearthed CDW.

- The usage of material from public construction projects, local re-use of CDW and/or soil for combined climate-adaptation and recreational purposes by Fermovert.

- A circular procurement criterion will be standard in all Emasesa's projects, demanding for reuse and recycling of CDW.

- Development of a Best practices guidelines on CDW management

Demonstration action 2: Optimising clean points.

In this demonstration action, Idener developed a digital tool to optimise the use of Seville's five clean points for the collection of CDW from citizens and small producers. Additionally, Lipasam arranged an awarnesse campaign to increase the users' commitment and increase the use of the clean point.

In summary they have been:

- Advance in the fulfilment of the European, national, and regional objectives, in the selective collection, recycling and not disposal in a landfill, marked by Directive 851/2018 and 850/2018.

- Strengthen the education, awareness and knowledge of citizens and other socio-economic agents related to the basis of the circular economy about the improvement of CDW management.

- Reduced illegal dumping and abandonment of CDW and increased reused and recycled CDW due to the awareness campaign and improved management and clean points.

Demonstration action 3: Data-driven decision-making and Best Practice Guidelines for CDW Management in Sevilla.

In this demonstration action, Idener developed a digital tool to analyse the Well-Being of the districts in Seville city. Additionally, Idener also developed a web city platform to allocate all the IT tools developed in the CityLoops project implementation in Seville.

In summary, they have been:

- Advance in the fulfilment of the European, national, and regional objectives, in the selective collection, recycling and not disposal in a landfill, marked by Directive 851/2018 and 850/2018.

- Strengthen the education, awareness and knowledge of citizens and other socio-economic agents related to the bases of the circular economy concerning the improvement of biowaste management.

- Increase the amount of material that can be recovered/recycled/recovered, and therefore, reduce the amount of material that is deposited in landfills.

- Contribute to the decision-making process of the municipality managers to develop circularity plans and prioritize actions in the city to increase Well-Being.

Results and lessons learned.

Seville achieved the expected outcomes associated with demonstration actions:

At the end of the report, there is a specific section on results and lessons learned. The most relevant are listed below.

In demonstration 1:

- It has gone from including the circular criterion in 25% of the procurements to 100% in the procurements currently.

- A positive interest shown by the local stakeholders in the engagement strategy has been critical.

- Offers submitted in the tendering processes during CityLoops implementation have gone from 98% to 100%.

- It must be considered that it has gone from 25% of tenders that include the circular clause to 100% and that makes a significant increase.

- A standardisation of the methodology to circular CDW management has been identified as a requirement.

- Emasesa has developed a Best Practices Guidelines.

In demonstration 2:

- Distributed presence of clean points around the city.

- Separate collection of as many fractions as possible and the possibility to drop off professional CDW, under the limits established.

- Training of the staff of clean points to maximize CDW recycling and appropriate management.

- Proximity of the sites to citizens (e.g., easily accessible with a car and nearby to residential areas).

- Long opening hours to enhance convenience for citizens.

- Regular inspection of “frequent” areas where waste is abandoned.

- Try to implicate the neighbourhood of the surrounding areas.

- Inform recurrently about possible sanctions for CDW abandonment.

- Maximise the divulgation of CDW collection service and facilitate users' actual information of the clean points (IT tool)

- Optimise the infrastructure and facilities according to actual requirements (including machine learning methodology to analyse available data)

- IT tools could increase the users' commitment, 6,824 visits to the tool in the last 12 months.

In demonstration 3:

- There are a lot of socio-economic and environmental indicators related to the wellbeing of a city. A good understanding of the impact of those indicators on well-being can facilitate the transition to a circular economy.

- Further analysis and a frequent update of the dataset as well as the selected indicators is required in order to help in the decision-making process on circular economy and required mechanisms.

- The good monitoring of the implementation actions made during CityLoops implementation as well as keeping fluent communication with the other municipal companies of the municipality as well as private stakeholders will allow to scale up the circular economy approach in the city.

- From results, it has been highlighted that the municipal waste management as well as the house renting pressure in the city have a critical impact on the wellbeing of citizens.

- For this reason, in September of 2023 Lipasam will establish specific meetings with different associations a municipal stakeholders in order to adapt the municipal waste collection service in those districts with higher house rent pressure.

- CityLoops results contribute to the development of the Local waste prevention and management Plan of Seville (currently in draft status).

- In a society in which an inexhaustible amount of information is within reach of a click on your mobile phone, there is a growing need to use different means of dissemination to reach the widest range of people with information that helps make the transition to a circular economy as successful as possible.

- The development of IT tools that help municipal managers make decisions is of great help, since they analyse a large amount of data and can advance data analysis and different future scenarios, thanks to the methodologies of Machine Learning.

- The deployment of these tools with public information for citizens and users of public services not only helps maximize the dissemination of the actions carried out by the municipality in the circular economy but also contributes to increasing the social commitment of citizens and the increase in the use of services at their disposal.

Scalability and replicability

Many tools and activities demonstrated in Seville can be replicated in other cities.

Recommendations for replicating both demonstrations in other cities are given at the end of this report. In that section you can find recommendations at a general level, related to the organization and planning of demonstration actions, as well as specific ones related to:

- Best practices guidelines for CDW management.
- Communication campaigns.
- IT tools for data-driven decision-making process.

In Seville, the results of CityLoops demonstrations have been disseminated at the city level, as well as regionally and nationally. Upscaling and replication of the results and practices continue in other collaboration initiatives with stakeholders.

2. City context

Seville is the fourth most populous city in Spain (684.234 inhabitants in 2021) and the most populous in the region of Andalusia, in the south of Spain, being its capital. It is A large monocentric city and part of a polycentric agglomeration, the metropolitan area of Seville. The extension of the city is 141,42 km^2 and has a density of 4.818 of Inhabitants per km^2. The main economic sectors of the city are commerce, food, and restaurants, mainly due to tourism. Also, the agriculture sector has a significant importance, if moreover of the city of Seville it is taking into consideration the metropolitan area.

The construction sector employs 5.4% of employees in Seville. The corresponding percentage for the whole country of Spain is 6.4%. The most significant employment sectors in Seville are the Service sector (78.6%). Construction accounts for about 5.6% of Seville's GDP. Based on turnover, the most significant industries in Seville are wholesale and retail trade (11%) and the manufacturing industry (9.75%). (Data of Statistics Andalucia region) Data is from the year 2018 (GPD and employee's data from the reference year 2019 was not available). In Seville, the largest construction projects are often managed by national companies and employees can also come from outside the area. According to the 2018 statistics, the number of new building Licenses in Seville was 1,602 and the total floor area was 266,266 m^2.

Construction and Demolition Waste (CDW) represents up to 45% of the total amount of waste generated in the city, i.e., 270,547 tonnes of CDW and 1,309,501 tonnes of excavated soil annually. Currently, only 16.1% of CDW is recycled, mostly for building works and road fillings.

The demonstration actions of the CityLoops project represent another step towards advancing Seville's path towards a more circular city, which is aligned with the declaration that the city itself led in 2017, together with more than 200 municipalities in Spain which underlines the importance of Local Governments to put into practice the commitment, the need to implement the Circular Economy.

Seville's declaration for the Circular Economy is also aligned with its City Model of the Seville 2030 Strategic Plan.

On the other hand, the city of Seville understands its commitment to the 2030 Agenda for sustainable development of the United Nations. It assumes it as the standard of its strategic and sectoral planning. Likewise, the Seville 2030 Strategic Plan is aligned with the Sustainable Development Goals (SDG).

Other local and sectoral initiatives and plans converge in the Seville 2030 Strategic Plan, such as the Local Waste Management Program, currently the draft, which will incorporate, if the results are satisfactory, the actions piloted within the framework of the project CityLoops.

Seville has three complementary demonstrations in CityLoops to make CDW handling more circular. Quality assessment and procurement guidelines will facilitate the use of recovered CDW from water infrastructure works. Optimisation of municipal clean points will support citizens and small producers of CDW to deposit construction materials in a suitable site for further processing, thus avoiding dumping and landfilling of potentially recoverable materials. Finally, digital tools for both citizens and city managers will support data-driven decision-making and analysis of the sustainability impacts of pilot projects and policies, to see what impacts these have on CDW generation and citizen wellbeing.

3. Implementation

3.1 Implementation Activities Demo Action 1: Renovation of water pipelines with circular material management

Emasesa, as the public entity responsible for water and wastewater infrastructure and management in Seville, will undertake the circular renovation of old water and sewage pipelines by recycling concrete, road surface, filling, and soil. The demo action focuses on water network infrastructures and the materials are concrete pipes, road surfaces, soil, and filling material. The CDW quality and technical properties of the dug-up pipes in the demonstration sites will be analysed and compared to the required specifications, which must be met for the recovered material to be used again in construction. If it meets the quality standards, the CDW will be used to replace primary raw materials such as filling under the pavements in pipe replacement works, and/or to improve soil quality in nearby municipal sites. The piloted material management approach will be incorporated into green procurement criteria that can be used in other similar public works, to ensure as much CDW as possible can be reused or recycled instead of dumped. Emasesa will work to engage construction stakeholders to mainstream the use of circular considerations in public contracts and will also publish a practical guide for quality classification and handling of CDW according to the waste hierarchy.

After end the of demo action 1, the outcomes expected are:

- Strengthened alliances with relevant local and regional actors in the field of CDW circularity.
- The increased amount of material that is recovered/recycled, and therefore reduced amount of material that is deposited in landfills.
- 2 sites in which underground pipe replacement was carried out with recycling of unearthed CDW.
- By using material from public construction projects, local re-use of CDW and/or soil for combined climate-adaptation and recreational purposes by Fermovert.
- A circular procurement criterion will be standard in all Emasesa's projects, demanding for reuse and recycling of CDW.

▪ 3.1.1 Preparation – of Quality assessment of CDW Instrument, identification and engagement with stakeholders.

Construction waste demolition (CDW) are substances or objects generated from construction and demolition sites that need to be disposed of in some other place. Most of these wastes are inert or non-hazardous materials, its main components are concrete, bricks, aggregates, asphalt and in some cases excavation soil. These CDW may have impurities such as gypsum, wood, paper, glass and plastics, organic wastes, packing rests, and parts of the existing constructions such as doors and windows are also CDW.

Legislation approved by the public authorities enhances in the first place the minimization and reuse of CDW, in the second place the production of recycled aggregates using authorized treatment plants, and in the third place the valorisation of those wastes that are not suitable for recycling, it must be always considered as a last option its elimination in an authorized landfill. According to the Waste Framework Directive (2008/98/EC) of the European Union and the EU Parliament, by 2020 a minimum of 70% of CDW should be recovered (European Parliament and Council of the European Union, 2008).

Instrument for Quality Assessment of CDW

The recycled rate of CDW in Spain is between 30-40%, it is still low and far from the 70% threshold. In Spain, CDW are being treated inappropriately. Project designers and construction managers do not consider in most cases the recycled aggregates of CDW as valid materials for new constructions, the main reason for this besides the lack of legal regulations, is the scarce knowledge of recycled aggregates and their use as granular layers in pavements and as recycled sand in pipelines.

World aggregate production increased from 21 billion tons in 2007 to 40 billion tons in 2014 (Tam et al., 2018). Natural aggregate extraction harms the environment, and the mineral resource depletion and waste generated per cubic meter of natural aggregate obtained was over 2400 kg (Marinković et al., 2010). Total aggregate production in the European Union (EU) was 2660 million tons, and the total waste generated from construction was 868 million tons in 2014 (European Union, 2017)

Recycled aggregates (RA) production can play an important role in this objective because it can help to reduce the production of natural aggregates (NA) and avoid CDW from filling lands. According to the European National Aggregates Association, Spain produced 96 million tons of NA in 2015, while only one million tons of RA were produced and sold in commercial plants (European Aggregates Association, 2016) from the 20 million tons of CDW. Recycled mixed aggregates (RMA) and recycled concrete aggregates (RCA) productions were 80% and 12%, respectively, of the total amount of CDW generated in Spain (CEDEX, 2010). The substitution of NA with RA in water and sewage infrastructures is a plausible solution to meet the 70% recovery rate for CDW (European Parliament and Council of the European Union, 2008).

This Instrument aims to provide a best practice guide for the use of recycled aggregates in water and sewage infrastructures.

CDW in building works

For the proper management and control of the CDW generated in building works, it is necessary to have data applicable to the construction, depending on its characteristics. In this way, it could be known the volumes of the different types of waste produced, the cost, and the destination.

In this way, it has to be identified which different types of waste will be generated. To classify the generated residues, it has to be chosen from the European waste catalogue and hazardous waste list.

In the case of Emasesa the most common waste could be classified in:

- Non-contaminated materials, come from excavation.
- Waste from the construction activity.
- Hazardous waste.

The most common waste that can be produced from building works is seen below.

Excavation and stone materials.		
17 01 Concrete, bricks, tiles and ceramics.		
Concrete	17 01 01	X
Bricks	17 01 02	X
Tiles and ceramics	17 01 03	
Mixture of concrete, bricks, tiles and ceramics other than those mentioned in 17 01 06	17 01 07	X
17 05 Soil (including excavated soil from contaminated sites), stones and dredging spoil		
Soil and stones other than those mentioned in 17 05 03	17 05 04	X
dredging spoil other than those mentioned 17 05 05	17 05 06	
17 09 Other construction and demolition waste		
Mixed construction and demolition waste other than those mentioned in 17 09 01, 17 09 02 and 17 09 03	17 09 04	

CDW: Hazarous		
Potentially dangerous and other.		
Waste paint and varnish containing organic solvents or other dangerous substances	08 01 11*	
Mineral-based non-chlorinated engine, gear and lubricating oils	13 02 05*	x
Other fuels (including mixtures)	13 07 03*	
Packaging containing residues of or contaminated by dangerous substances	15 01 10*	x
Metallic packaging containing a dangerous solid porous matrix (for example asbestos), including empty pressure containers	15 01 11*	
Absorbents, filter materials (including oil filters not otherwise specified), wiping cloths, protective clothing contaminated by dangerous substances	15 02 02*	x
Oil filters	16 01 07*	x
Lead batteries	16 06 01*	
Mercury-containing batteries	16 06 03*	
Alkaline batteries (except 16 06 03)	16 06 04*	
Mixtures of, or separate fractions of concrete, bricks, tiles and ceramics containing dangerous substances	17 01 06*	
Glass, plastic and wood containing or contaminated with dangerous substances	17 02 04*	
Bituminous mixtures containing coal tar	17 03 01*	
Coal tar and tarred products	17 03 03*	
Metal waste contaminated with dangerous substances	17 04 09*	
Cables containing oil, coal tar and other dangerous substances	17 04 10*	
Soil and stones containing dangerous substances	17 05 03*	
Soil and stones other than those mentioned in 17 05 03	17 05 04*	
Insulation materials containing asbestos	17 06 01*	
Other insulation materials consisting of or containing dangerous substances	17 06 03*	
Mixed construction and demolition wastes other than those mentioned in 17 09 01, 17 09 02 and 17 09 03	17 06 04*	
Construction materials containing asbestos	17 06 05*	
Gypsum-based construction materials contaminated with dangerous substances	17 08 01*	
Construction and demolition wastes containing pcb (for example pcb-containing sealants, pcb-containing resin-based flooring, pcb-containing sealed glazing units, pcb-containing capacitors)	17 09 02*	
Other construction and demolition wastes (including mixed wastes) containing dangerous substances	17 09 03*	
Fluorescent tubes and other mercury-containing waste	20 01 21*	

Non-stony materials		
17 02 Wood, glass and plastic		
Wood	17 02 01	**X**
Glass	17 02 02	
Plastic	17 02 03	**X**
17 03 Bituminous mixtures, coal tar and tarred products		
Bituminous mixtures containing other than those mentioned in 17 03 01	17 03 02	
17 04 Metals (including their alloys)		
Copper, bronze, brass	17 04 01	
Aluminium	17 04 02	
Lead	17 04 03	
Zinc	17 04 04	
Iron and steel	17 04 05	
Tin	17 04 06	
Mixed metals	17 04 07	**X**
Cables other than those mentioned in 17 04 10	17 04 11	
17 08 Gypsum-based construction material		
Gypsum-based construction materials other than those mentioned in 17 08 01	17 08 02	
20 MUNICIPAL WASTES (HOUSEHOLD WASTE AND SIMILAR COMMERCIAL, INDUSTRIAL AND INSTITUTIONAL WASTES) INCLUDING SEPARATELY COLLECTED FRACTIONS		
Biodegradable waste	20 02 01	**X**
Mixed municipal waste	20 03 01	**X**
Paper and cardboard	20 01 01	**X**
Discarded electrical and electronic equipment other than those mentioned in 20 01 21, 20 01 23 and 20 01 35	20 01 36	
Waste from sewage cleaning	20 03 06	

To estimate the production of waste, a work has been developed a spreadsheet (APENDIX I of the Quality Assessment Tool). Depending on the materials used in the infrastructures this tentative table has to be set.

In the Quality Assessment Tool, handling recommendations and a quality control system have been defined.

Stakeholder engagement and collaborative learning network

During the planning phase of demonstration actions of the project, an exhaustive analysis was carried out, focused on the CDW value chain in the city of Seville, trying to include groups and entities from each of the stages (production, management, etc.). The main stakeholders were: Lipasam, Emasesa, Aprocom, Idener, Corporación Tecnológica de Andalucia, Llopis, Martin Casillas, Aborgase, Universidad de Sevilla, Mercasevilla, Dpto. Parques y Jardines, Ayuntamiento de Sevilla, Junta de Andalucia, Joint Research Centre, Andalusian Industrial Research and Cooperation Association, Confederation of Commerce, Services and Autonomous of Seville, Factor Circular, and Consumers Union of Andalusia. These stakeholders represent the main actor of the value chain i.e., landfills, local construction companies, and depts. of the municipality, consumer associations, waste managers, etc.

Likewise, in the execution of the demonstration actions, the main stakeholders, whose have had a direct impact on the results of the project, have been the citizenship and the constructors. During all the project, CityLoops Seville cluster have tried to find out their concerns and motivations throughout the demonstration actions developed. A Collaborative Local Network has been created with local stakeholders and environmental and engineering departments of municipal companies. The Collaborative Local Network was established setting biannual meetings and the commitment to collaborate in the guideline's development. In the local meetings, project results, demonstration actions, and developed tools have been shown. Additionally, a communication campaign that were carried out through various channels and media (social networks, in-person meetings, and other places with a special influx of people) was carried out.

▪ 3.1.2 Procurement of demolition and construction works contractors.

Emasesa has a strong commitment to preserving, reusing, and recycling the materials generated during water and sanitation works, as a part of its program of good practices in environmental sustainability and corporate responsibility performance.

In 2009 Emasesa was approved as a very starting point related to a circular economy- a guide addressed to works managers wherein develops a strategy to reduce the environmental impact of its typical works, including some obligations related to waste generation. In this document, the company shows great concerns about recycling, re-using and re-manufacturing the largest possible percentage of materials. The guide is incorporated into the processes of the company, and becomes a duty for waterworks contractors, with clauses of this kind:

- Perform demolitions according to deconstruction criteria.
- Make the most of used materials.
- Reuse work cuts whenever possible.
- Recycling stone materials and reusing them as subbases in urbanization works, such as draining material, etc.

- Effective improvements in waste management require a need to define a hierarchy of priorities. In order of importance, these are:
  - Minimize the use of necessary subjects and resources. In other words, reducing the consumption of raw materials as well as the use of materials that may make it difficult or impossible to recyclability or subsequent reuse.
  - Reuse materials. Take advantage of the materials disassembled during the demolition tasks which can be used later.
  - Reuse ceramics, tiles, etc.
  - 3R strategy: reduce + reuse + recycle.

As a result, Emasesa demands to all its works contractors the implementation of a waste management plan, according to the requirements stablished in an environmental Annex I that is included in the tender documents.

The use of recycled aggregates in the base units and/or subbases of the projected pavements is rewarded with up to four points. The new units shall in no case entail a budgetary change to the work.

These recycled aggregates shall comply with the List of general technical specifications for road and bridge works- PG3.

Cityloops project has contributed to extend those practices to all pipe replacement and renovation works, so Emasesa is currently including this evaluation criterion in all the tender documents of this types of works.

Emasesa adapts its contracting requirements to the applicable regulations, as well as to the context of the market in which it operates. In this sense, it offers the possibility of using any recycled aggregate allowed by the applicable legislation and that complies with the requirements established by the PG3 standard, such as recycled aggregates from the steel and metal industry.

In this sense, most of the contractors offer the use of steelmaking aggregates, because of the availability and price.

Another contribution of Cityloops project is the Emasesa has started monitoring the number of tenders including this clause as well as how many bids in each contract include CDW.

Next Steps: Emasesa is currently considering new actions during the Cityloops project, such as defining, within the tender documents, the exact measures of recycled and reused work units, or the insertion of award criteria related to the implementation of circular economy plans suggested by tenderers, as well as reaching to agreements with waste plants to ensure the re-utilization of work materials.

In another way, further efforts have to be made, in order to improve public procurement related to a circular economy approach. Examples of those aspects are:

• Extend the use of good practices in public companies, in order to train the people of the organization to improve the management of waste generated in production systems, about circularity opportunities.

• Specify aspects related to the circular economy in bidding for infrastructure works projects, and also supply contracts.

Bidding for infrastructure works projects: Establish the obligation in the specifications to improve good circular practices, rewarding the technical criteria for the best memory and the greatest commitment to this separation and delivery to plants.

Reward during the tender, as an award criterion, the highest volume of material delivered to the CDW recycling plants. It would be possible to measure the volume of demolition waste delivered separately for future reuse.

▪ 3.1.3 Demolition and construction work for substitution of pipes.

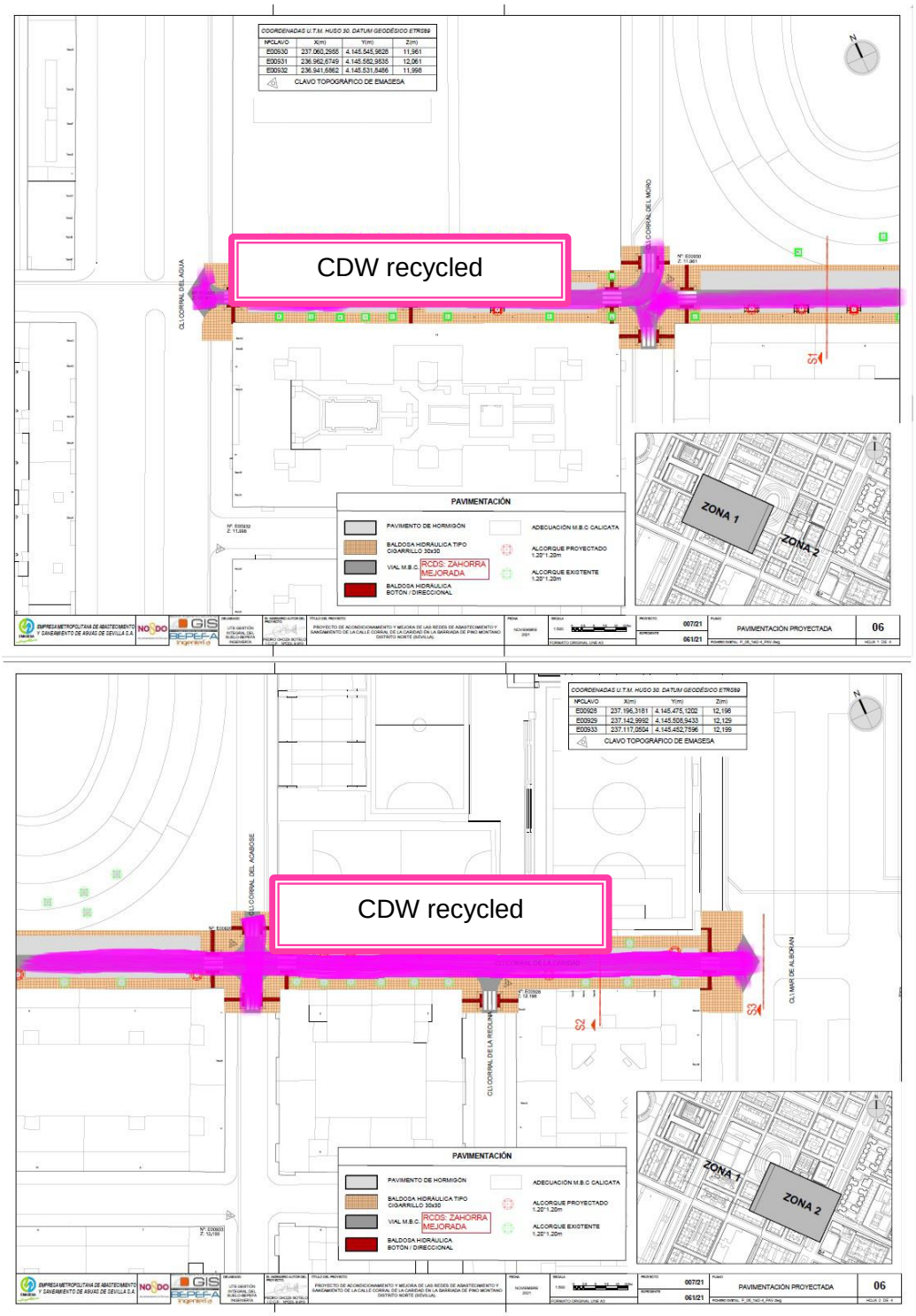
In accordance with the Emasesa pipeline renewal plan, a selection of demonstration areas has been carried out.

Each case is different as the size, a quality needed, and context of each construction site varies. So, Emasesa has chosen 2 works from all the total number of tenders carried out, in which the use of recycle aggregates has been offered.

Specific zones of the street (not the whole construction site area) will be piloted with CDW. Not the same to pilot CDW in a highly transited area that requires a high-quality compact base, rather Emasesa will assess the most appropriate sites and areas of the site to use CDW.

Demonstrative Place 1 (Proceeding Nº 061/21): Project for the conditioning and improvement of the supply and sanitation networks of Corral de la Caridad Street, in the Pino Montano neighbourhood. North District, Seville.

The location of the CDW, the improved aggregate used on site, as the base of the road, is represented in the project's paving plans.



Visits to works were made on November 3, 9 and 17 December 2022, and 20 and 25 January 2023 for the control of CDW employment of the improved aggregate based on road paving.

	
3/11/2022	

	
9/11/2022	

	
17/11/2022	2/12/2022

Prior to commissioning, quality certificates were requested for the CDW from Siderúrgica Sevillana, providing the construction company awarded the works with the following documentation:

- CE marking
- Statement of performance
- Technical sheet and tests.

This documentation was approved while the certificates were in force on the date of their reception on site. These documents are attached in Annex II of this report.

Following the quality control units provided for in the Reception Quality Control Program and in the Self-control Program of the construction company, material identification tests have been carried out, obtaining satisfactory results. An extract from the monthly comparative table of tests of the PCCR and PAC of the contractor is provided, and the minutes of the reception quality control tests are attached in Annex III of this report:

ARTIFICIAL BASE CDW 98% from Siderurgica Sevillana (440 m3)						
Material identification						
Test	PCCP			PCCR		
UNE 103501	1	1		1	1	
UNE-EN 933-1				1	1	
UNE 103103 & UNE 103104				1	1	
UNE-EN 933-8				1	1	
UNE-EN 933-3				1	1	
UNE-EN 1097-2				1	1	
Compaction (20 cm thick layers)						
Determination of density "in situ" including humidity by the method of radioactive isotopes, according to ASTM-D 3017 ASTM-D 2923	6	16		6	6	
The number of points to be tested is adjusted to the number of filling layers executed on site						

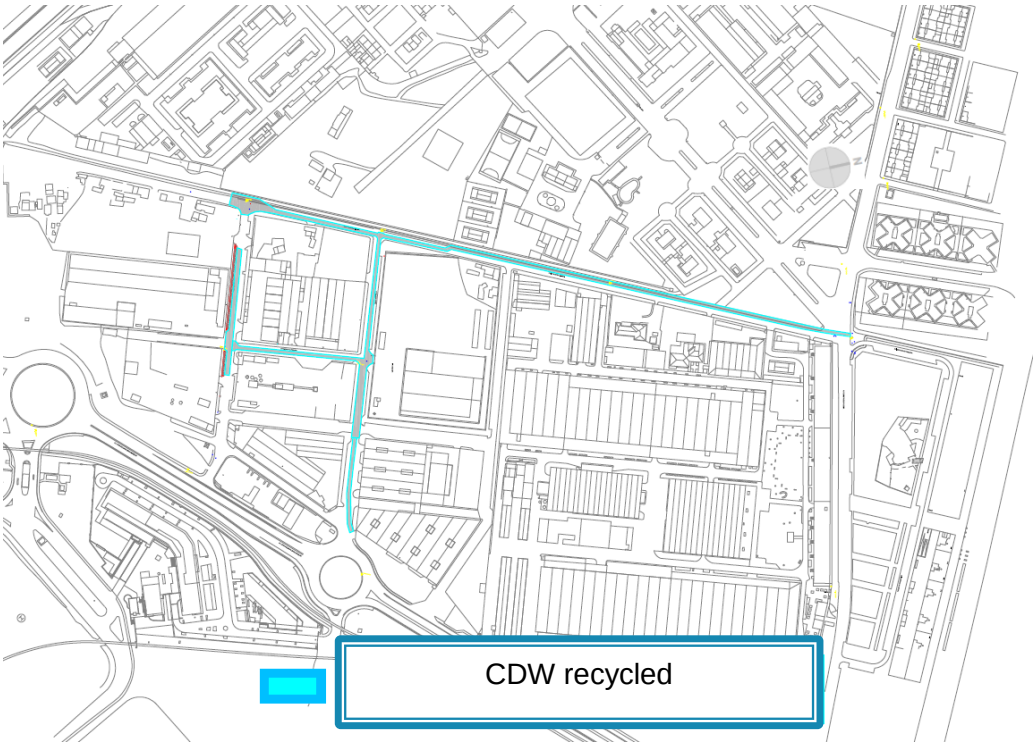
Following the quality control units provided for in the Reception Quality Control Program and in the Self-control Program of the construction company, the compaction tests of the road base have been carried out, obtaining satisfactory results (average value of 100% on Modified Proctor), fulfilling the project requirements. The compaction test report is provided in Annex IV of this report.

The economic valuation of the tests and quality controls carried out on the improved slag aggregate (Siderurgica Sevillana) used as RCDS material for the base of the road in the works of: "Project for the conditioning and improvement of the street supply and sanitation networks Corral de la Caridad Street, in the Neighbourhood Pino Montano. North District. Seville", amount to 293.55 euros (vat not included).

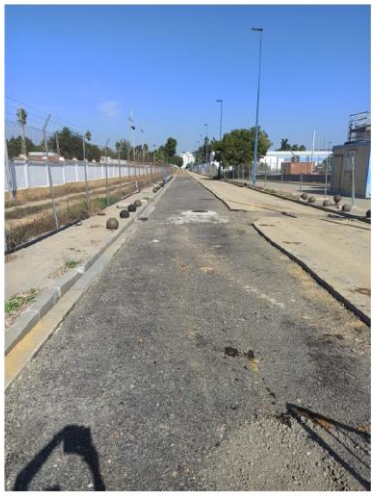
- Initially estimated steel CDW: 378,826 m^3
- Steel CDW provided according to quality report: 448 m^3
- Estimated excavation land: 4142.98 m^3
- Estimated Mixed CDW: 1349.38 m^3

Demonstrative Place 2 (Proceeding Nº 250/20): Project to improve sanitation networks in the Tablaba Industrial Sector. Los Remedios District, Seville.

The location of the CDW, the improved aggregate used on site, as the base of the road, is represented in the project's paving plans.



Visits to works were made on October 18, 2, 11 and 24 November 2022, and 7, 12 and 16 December 2022 for the control of CDW employment of the improved aggregate based on road paving.

	
18/10/2022	2/11/2022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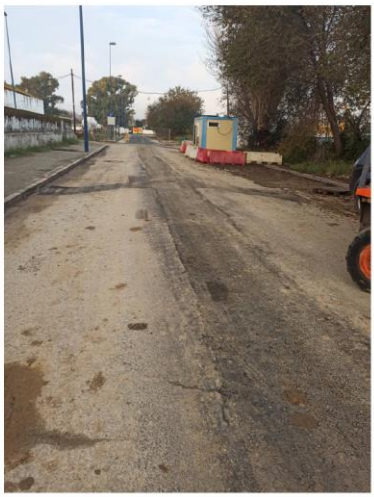
	
7/12/2022	16/12/2022

Prior to commissioning, quality certificates were requested for the CDW from Siderúrgica Sevillana, providing the construction company awarded the works with the following documentation:

- CE marking
- Statement of performance
- Technical sheet and tests.

This documentation was approved while the certificates were in force on the date of their reception on site. These documents are attached in Annex II of this report.

Following the quality control units provided for in the Reception Quality Control Program and in the Self-control Program of the construction company, material identification tests have been carried out, obtaining satisfactory results. An extract from the monthly comparative table of tests of the PCCR and PAC of the contractor is provided, and the minutes of the reception quality control tests are attached in Annex V of this report:

ARTIFICIAL BASE CDW 98% from Siderurgica Sevillana (440 m3)						
Material identification						
Test	PCCP			PCCR		
UNE 103501	1	1		1	1	
UNE-EN 933-1	1	1		1	1	
UNE 103103 & UNE 103104	1	1		1	1	
UNE-EN 933-8	1	1		1	1	
UNE-EN 933-3	1	1		1	1	
UNE-EN 1097-2	1	1		1	1	
Compaction (20 cm thick layers)						
Determination of density "in situ" including humidity by the method of radioactive isotopes, according to ASTM-D 3017 ASTM-D 2923	6	6		9	9	
The number of points to be tested is adjusted to the number of filling layers executed on site						

Following the quality control units provided for in the Reception Quality Control Program and in the Self-control Program of the construction company, the compaction tests of the road base have been carried out, obtaining satisfactory results (average value of 100% on Modified Proctor), fulfilling the project requirements. The compaction test report is provided in Annex VI of this report.

The economic valuation of the tests and quality controls carried out on the improved slag aggregate (Siderurgica Sevillana) used as CDW material for the base of the road in the works of: " Project to improve sanitation networks in the Tablada Industrial Sector. Los Remedios District, Seville", amount to 331.54 euros (vat not included).

- Initially estimated steel CDW: 1,105.24 m^3
- Steel CDW provided according to quality report: 1,229 m^3
- Estimated excavation land: 9,315.30 m^3
- Estimated Mixed CDW: 1,886.51 m^3

3.1.4 Transformation of materials

Emasesa includes in the environmental annexes of its tenders documents the obligation to separate all non-hazardous waste generated in the works regardless of the amount generated, prior to the publication of the guidelines of the new Law 7/2022, on waste and contaminated soils for a circular economy, of national rank.

The CDW generated is delivered by the contractor to authorized waste managers, for valorisation. The type of valorisation will depend on the quality of waste separation.

Emasesa is working on the establishment of agreements with waste managers to promote the circularity of CDW and to guarantee the traceability of the CDW depending on the final use.

That is the case of Fermovert, an authorized CDW manager that has the capacity and experience in classifying and transforming the material to turn it into recycled aggregates for other uses.

The material transformation is done in parallel to the construction works. All material that Fermovert receives is classified and those of enough quality are transformed into recycled aggregates to be reused in constructions works or other uses, such as soil remediation.

Emasesa in order to have a correct traceability of CDW treatment, is asking contractors that all certificates submitted for correct waste management also include the final treatment that will be given.

In collaboration with one of the main CDW managers Emasesa have reached an agreement so that all the issued certificates, documenting the correct management of CDW generated in works promoted by Emasesa, contain information about:

- CDW received (LER Code, quantity)
- CDW treatment
- Type of valorisation (% of recovery, quantity of recovery (m^3), and LER code).

Currently, CDW and other kinds of waste can be used in construction by contractors, up to their selection of appropriate materials. So, Seville has to monitor what proportion of each secondary material is used, to monitor the quality of each. Another material is Iron or steel aggregates - likely higher quality than the usual mixed CDW. The choice of which materials is up to the contractor, and the total percentage of CDW included is also up to them.

3.1.5 Analysis of the results on procurement approach and development of best practice guidance on CDW classification.

The next table shows the evolution of the tender processes that includes environmental clauses since the beginning of the project. The figures clearly demonstrate the effectiveness of the internal promotion actions taken in Emasesa. This table have been done considering the year of the tender documents elaboration (year of the file), because one or several years can pass from the time the specifications are drawn up until the tender is put out.

Tender process evolution with environmental clauses considering the year of file

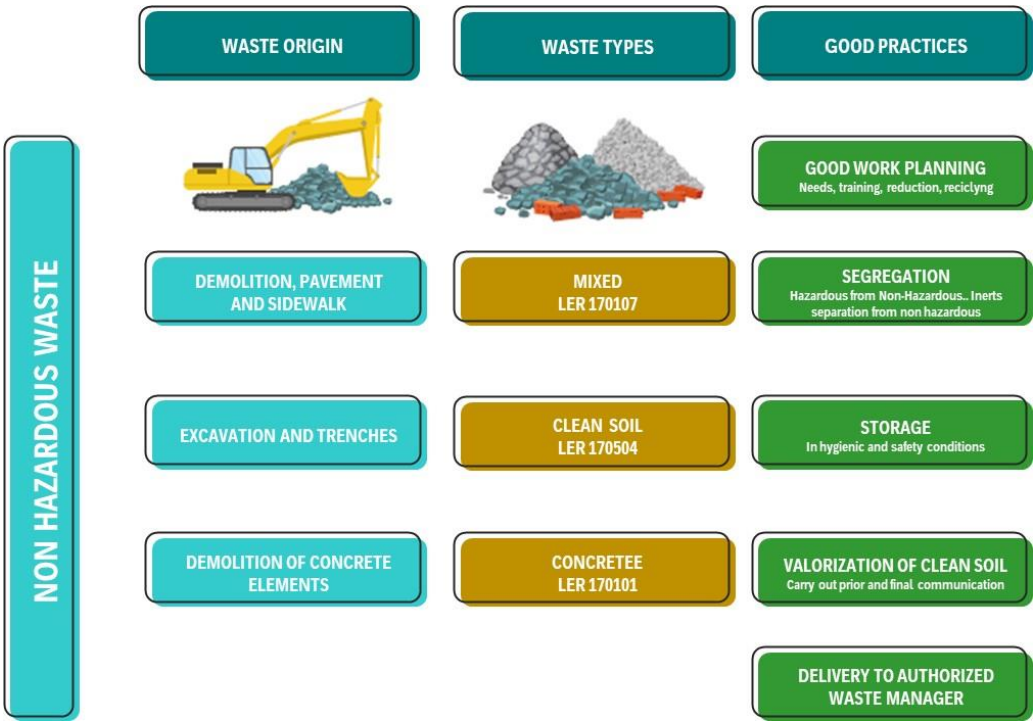
	2022	2021	2020	2019
Nº Included	2	6	11	4
Nº Not included	0	1	7	13
% included	**100%**	**85,71%**	**61%**	**23,53%**

The next table shows the evolution of the percentage of Offerer that offers the use of CDW, considering the date of publishing the tender process.

Offerers including the CDW use, considering the date of publishing the tender process				
	2023	**2022**	**2021**	**2020**
Nº Included	20	104	187	57
Nº Not included	20	104	183	56
% included	**100%**	**100%**	**97,86**	**98,25%**

The data don´t show significant differences in the evolution of bidders that offer the use of CDW. Emasesa has developed an Environmental Control Manual in Works. The main objective of this Manual is to publicize good practices and work habits, which once carried out, lead to an increase in environmental quality during the execution of work. In this way, it will be possible the environmental impacts, and reach an economic, social, and environmental balance. The scope of the Manual goes beyond the territorial scope since it intends to be a document of reference and application in the works of the hydraulic sector.

The Manual is structured in 6 blocks according to the main environmental aspects and includes a set of good practices for every environmental aspect.



GOOD ENVIRONMENTAL PRACTICE SHEET
GENERATION OF NON-HAZARDOUS WASTE

Planification	• Apply measures to minimize waste generation. • Promote training for the handling and maintenance of machinery transport of soil and debris. • Collect in the Waste Management Study the possibility of on-site recycling whenever the conditions allow it.
Clasiffication/segregation at work	• Separate the tipology of non-hazardous waste from 1 m3 in inert or stony, and the rest of non-hazardous waste. • When due to lack of physical space, in the work, it is not technically feasible to carry out such a separation operation, the waste owner may entrust the separation of waste to an authorized manager, in an external treatment to the work, obtaining the documentation that demonstrate this operation.
Clasiffication/segregation at work	• If segregation of waste is foreseen on site, these will be stored in suitable containers, duly protected and marked. • Verify that no other waste is dumped outside the work. • The rules established in the Municipal Regulations must be complied with. • The collection of residues on the root zone should be avoided. It causes compaction that decreases soil porosity, and therefore the access of roots to resources of water and nutrients, as well as a mechanical impediment to their growth. • The storage time will be less than 2 years when they are for valorization and 1 year when they are disposed of for disposal. • The collection of soil should be located in suitable areas where they do not represents a hazard to existing constructions, by direct pressure or by overload on the ground. It should be in regular form. • Don´t accumulate soil on the edge of trenches.
Cleaning	• Maintain order and cleanliness in the work both in the materials supplied as in the waste generated. • Avoid dragging of waste or materials into the excavation area or to the drainage works.
Reuse of materials on site	• The generation of waste will be minimized with the reuse of all that material from the work to which the same use may be made, for example, the paving stones of the pavement.
Recycling of materials on site	• On-site recycling of inert or stone materials by mobile machinery in the work itself. To be done through an Authorized Manager with a Plan.
Valorization soil from excavation	• Promote the valorization of clean excavation soil for their reuse in works as raw material.
CDW Transport	• Signpost access area and route within the work to avoid unnecessary travel. • The container should always be covered with a tarpaulin to avoid dust propagation. • Debris will not exceed the side closures of the container

QUALITY ASSESSMENT TOOL FOR THE USE OF CDW AS RECYCLED AGGREGATES IN WATER AND SEWAGE INFRASTRUCTURES.
The quality assessment is a standard classification that aims to set a guideline in order to increase the number of bids for public infrastructure projects that contemplate CDW valorisation. In spring 2021, using the tool developed, a pilot area will be selected to compare the performance of conventional raw material versus CDW, including the physical properties within different static and dynamic contexts. Through this feedback process, the Quality Assessment tool will be iteratively improved. The classification will be applied to demolition material from multiple pipe replacement sites. Based on the result, Fermovert, the waste treatment company, will treat the material accordingly so that it can be used as construction aggregates.
Lessons learned Emasesa the municipal company on water and wastewater management has gone from including the circular criterion in the 25% of the procurements (before CityLoops implementation) to 100% in the procurements currently (at the end of the implementation period). This positive evolution including circular criterion has been possible thanks to the interest shown by the local stakeholders in the engagement strategy carried out among workshops, and Collaborative Learning Networks meetings under the CityLoops project. This increasing interest could be checked by the percentage of the offers submitted in the tendering processes during CityLoops implementation which has gone from 98% to 100%. Although it may seem like an insignificant increase, it must be considered that it has gone from 25% of tenders that include the circular clause to 100% and that makes a significant increase. From project results, a standardisation of the methodology to circular CDW management has been identified as a requirement, so, Emasesa has developed a Best Practices Guidelines (Annex VII).
https://cityloops.eu/fileadmin/user_upload/Materials/Tools/Quality_Assesment_Tool_Seville.pdf

3.2 Implementation Activities Demo Action 2: Optimising clean points

Digital tools have been developed to optimise the use of Seville's five clean points for collection of CDW from citizens and small producers. Data will be shown through a web portal, with one interface for citizens to instruct them to the clean point best suited to receive their CDW, and one interface for city managers to understand the quantity of CDW at each clean point and plan for future scenarios of city growth to open new clean points. Data collected on the stocks and flows of CDW through the cities' clean points will be used to continuously optimise their management. The collected CDW will be treated by Fermovert if need be, to ensure its safety and quality for further future uses. Lipasam, the waste management company of Seville, plans to analyse the composition of the CDW collected in Clean Points, in order to evaluate the potential uses of the material recovered and be able to take decisions with the aim of

recuperating costs for the clean points management and CDW treatment. Finally, an awareness campaign will aim to introduce these tools to the public and encourage proper handling of CDW, in order to avoid the common practice of illegal dumping of CDW.

Technologies for development of the digital platform

Machine learning and Data-Driven Applications have been gaining popularity in recent years. However, the final deployment requires a combination of different mathematical, programming and web development skills (or creation of graphical applications using frameworks such as Qt5 or GTK+).

Django is a very popular framework for web development with a very smooth learning curve, allowing the full development of web applications from initial concepts to final user products very quickly taking into consideration the most important aspects of security. These advantages overcome some limitations of other frameworks such as verbosity and complexity or steeper learning curves. Besides those limitations related to the development of the software platform, the use of Django as a framework also helps to improve the performance of the applications developed with other popular web frameworks. Dynamic applications did not always perform well, and complex single-page applications may have a significant lag, making them inconvenient to use due to their size.

Even if Django is an easy-to-learn framework for web development, it has been used in developing professional sites and platforms such as Instagram, Spotify, YouTube, BitBucket, DropBox, The Washington Post, Mozilla, Pinterest and even the websites of NASA or National Geographic. Another additional advantage consists in using a single web framework and other Python modules without using communication protocols or separated containers with the back-end operations.

For the back-end part of the application, the data analysis and machine learning have also been powered by Python libraries. The communication between data sources has also been managed with Python when needed.

The initial developments have been provided to the managers for testing in containers or virtual machines to facilitate direct deployment in any computer. Virtual Machines allow preparing a complete operating system with the pre-installed CityLoops platform in a single file which can be directly executed by the user using Virtual Box, KVM, VMware or Hyper-V. Similarly, Docker containers allow running virtual servers to deploy web applications very quickly, even not booting an OS with the main advantage of allowing continuous integration.

A Gitlab repository has been created with a clean Django project to serve as a template to implement the initial features of the CityLoops platform. Once the main functionalities and widgets have been developed and tested, they have been all integrated into a single common application panel (e.g., like a dashboard), and interactions between them have been implemented and tested. This corresponds to Stage 1 of the development. Stage 2 has been the full development of one of the CityLoops platforms (i.e., CDW flow optimisation tool) without taking into consideration aesthetics or final product aspects, only a basic front-end and main functionality. Stage 3, has been reproducing this development in all the remaining applications,

obtaining as a result an initial version fully functional of all the CityLoops applications. Finally, Stage 4, will consist of adding the aesthetics and improving UX and GUI, together with the deployment of citizens' web pages for visualization and services.

Main goals and functionalities of each platform

Now that the technologies for development have been presented. Let us briefly discuss the main goals and functionalities of each platform.

The CityLoops platform for Seville's construction and demolition waste (CDW) will have two main goals: optimization of the fluxes of CDW from citizens and small businesses; and the selection of optimal locations of new "clean points", i.e., intermediate management facilities for construction or other specific waste. The software tool for managers will combine data regarding the economic and geographic growth of the city with data about waste generation and, more specifically, construction and demolition waste, CDW, to support managers on the decision of new locations for future clean points. In the case of the version for citizens, regarding CDW, provide the user with the location of the optimal clean point to fulfil the needs of the citizen to dump construction and demolition waste from their homes and small business.

The CWD flow optimisation tool is expected to contribute to the following outcomes:

- Advance in the fulfilment of the European, national, and regional objectives, in the selective collection, recycling and not disposal in a landfill, marked by Directive 851/2018 and 850/2018.

- Strengthen the education, awareness and knowledge of citizens and other socio-economic agents related to the bases of the circular economy about the improvement of CDW management.

- Reduced illegal dumping and abandonment of CDW and increased reused and recycled CDW due to the awareness campaign and improved management and clean points.

Idener has developed the IT software tool in collaboration with Seville´s cluster. Seville's cluster of partners for the CityLoops project includes the Municipality of Seville, Lipasam (Municipal Solid Waste Management Company), Emasesa (Municipal Wastewater Treatment Management company) and Idener (Private Research company). Together these partners are committed to the CityLoops' approach to close the loops of waste material in the city, promoting a circular economy approach to the city's development.

▪ 3.2.1 Development of digital tool: Optimisation of CDW flow.

The platform for each use case within Seville has two versions, one for managers and authorities and another for citizens. The platform version for citizens has only visualization capabilities and widgets using data provided by managers from Lipasam or results from the corresponding CityLoops platform for partners.

Therefore, the applications for managers consist, at least, of a data collection tool where managers will provide the data to power up the data-driven applications or the visualization

widgets in the platforms for citizens. Additionally, the platforms for managers may have additional capabilities for decision support. The applications for citizens show interactive visualizations of the data provided by managers and will use the available widgets to get information about specific questions regarding CDW.

Citizen platform

Visit the platform here (Optimisation of CDW flow)

When the user enters the CDW platform, they will encounter the form with the text inputs for the user's district, zip code and the date the user wants to go to the clean point. Below the form, the user will see the inputs to enter the amount of waste of each type they will be placed in the clean point. Additionally, there are checkboxes in case the user wants to dispose of a type of waste that is thrown away in an Ecopoint. Two buttons are found at the bottom of the form: one that submits the form (the one labelled "Search") and the other one to reset all the text boxes. Just before the buttons there is a reminder for the user to select the origin point on the map. At the right of the form, a map of Seville will be shown.

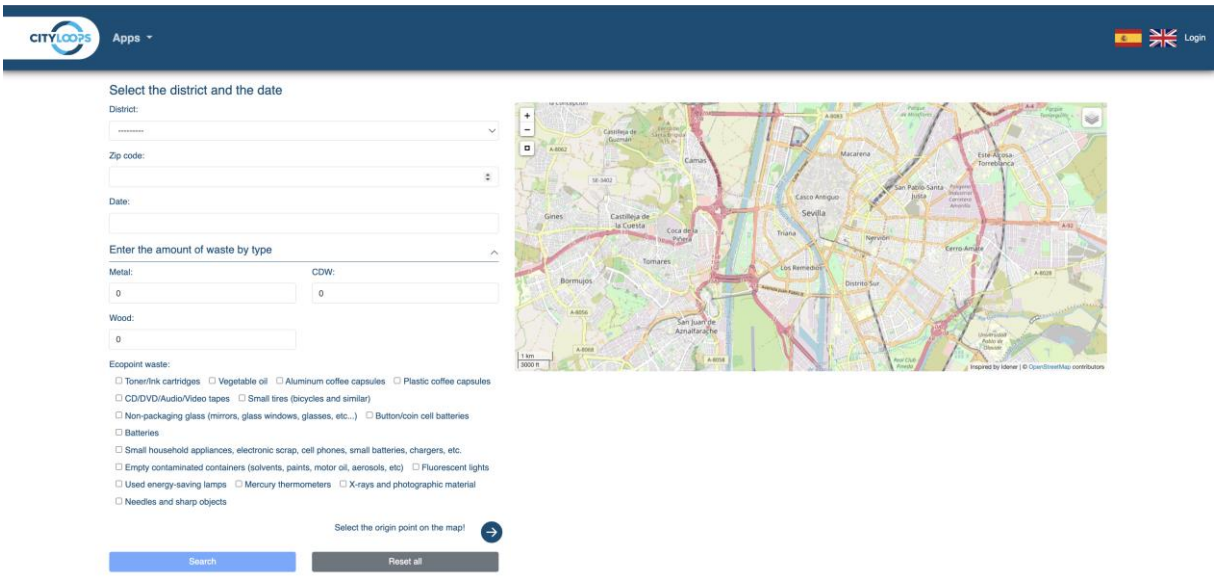


Figure 1. CDW platform main page.

Once the user fills in the form and hits the "Search" button, a column with the results will appear between the original form and the map. In this section, the user can expand each collapsible to show the information of each clean point, including the distance between the selected origin point and the clean point, an estimation of the container fill levels and the opening hours. The map will also show the distance between the origin point that the user selected and the best clean point for their needs. Finally, the user will see historical infographic on total CDW and metal collected at the bottom of the page.

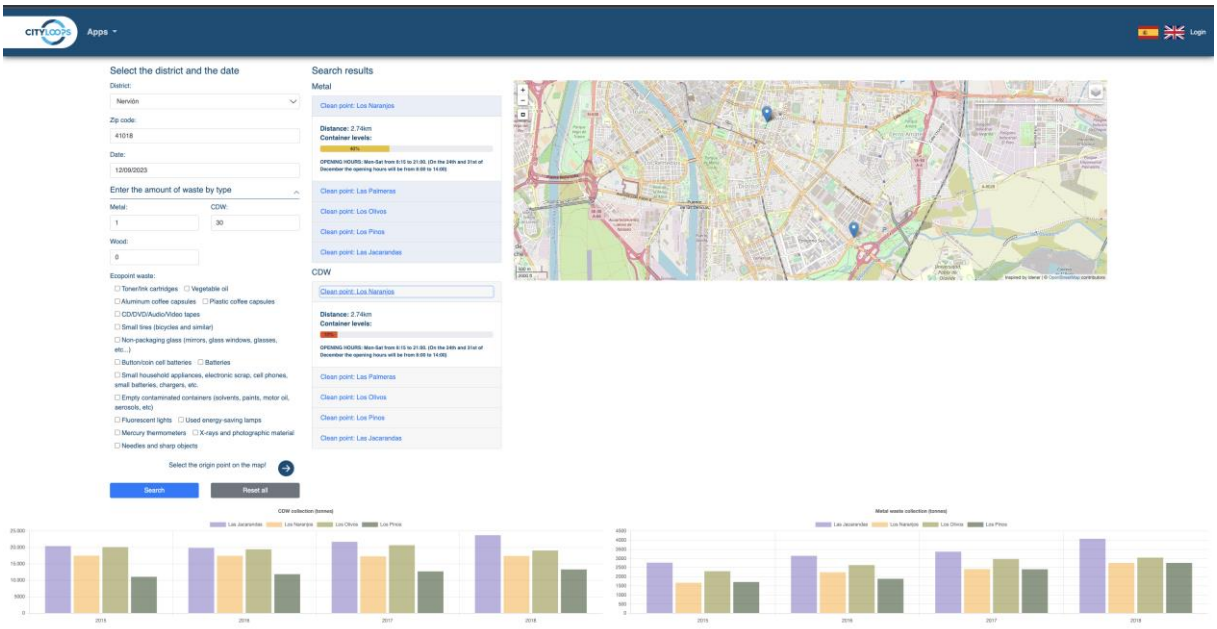


Figure 2. CDW platform main page showing results.

The user can only select any other waste types compatible with Ecopoints without entering any amount of wood, metal, or CDW (those last three ones are only collected in the clean points). In this case, the results page shows the clean points sorted by distance to the origin point and the list of Ecopoints sorted by distance to the origin point selected by the user. The user can decide to deliver the waste in both an Ecopoint or a Clean Point. Finally, the user will see historical information on the total other waste collected by graphics at the bottom of the results page.

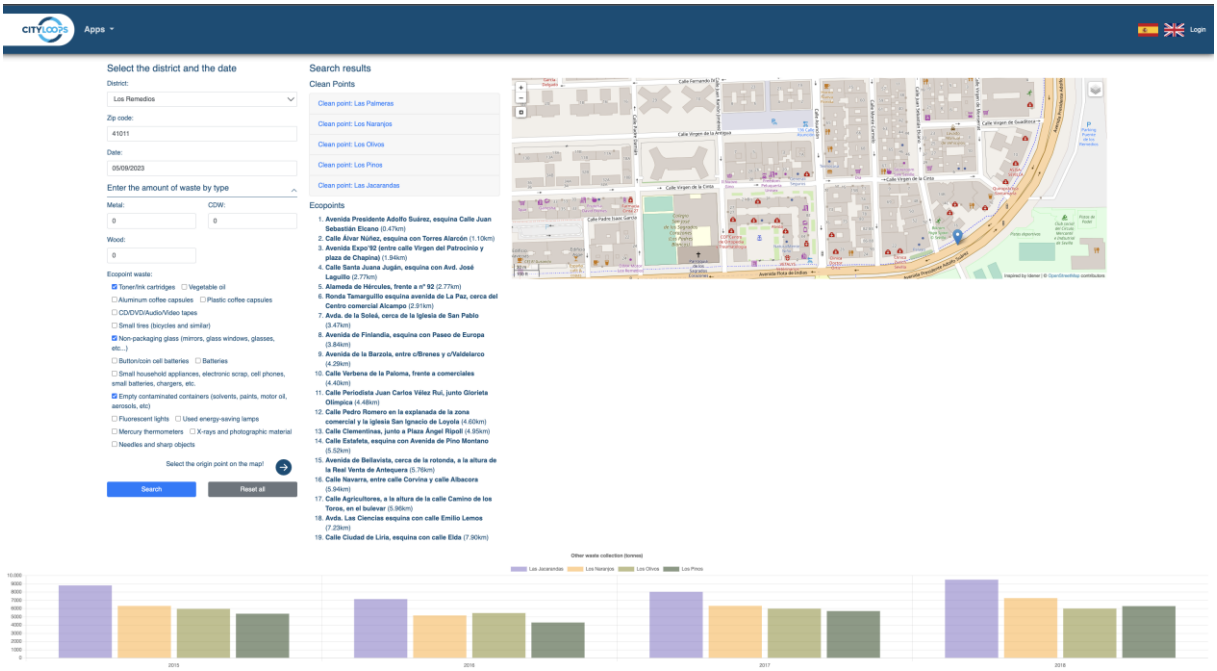


Figure 3. CDW platform main page showing results (Eco-points).

In a third case, the user can also select waste types compatible with Ecopoints at the same time along with CDW, metal, or wood (those last three ones are only collected in the clean points). The result page shows the clean points sorted by distance to the origin point selected by the user. In this case, only clean points are shown in order to deliver all types of waste at the same time. Finally, the user will see historical information on the total CDW, and other waste collected by graphics at the bottom of the results page.

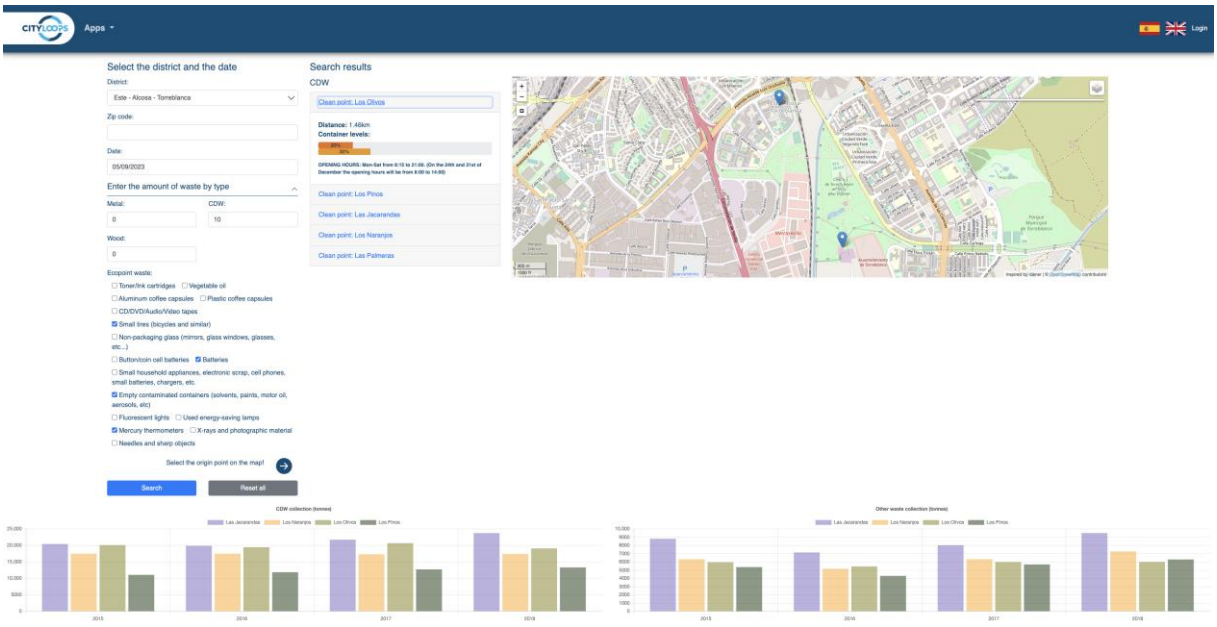


Figure 4. CDW platform main page showing results (Clean points with other waste).

Functionalities of CDW platform for citizens

- Forms for query: The citizen will provide data about its location and the type of waste placed in the “clean point”. Using this data and the status of the clean points, the CDW CityLoops platform for citizens will suggest the most suitable “clean point”.

- Map showing clean points and highlighting the most suitable one: A widget with a map (using OpenStreet Maps) will be presented to the citizens showing the current location of the “clean points” and after the results of the query, the most suitable one will be highlighted. At the same time, a route from the district origin to the proposed clean point will be suggested to the citizen based on OpenStreetMap.

- Dashboard showing the current status of the “clean points”: Clean points have different containers for different types of waste (e.g., bricks, wood, steel…). A dashboard will show the fill levels of the containers and the timestamp of the presented data.

- Control panel: A set of buttons will be included in the application to clean the forms, do the query, and export information. Logos of the involved partners (Emasesa, Lipasam, Municipality of Seville, Cityloops project) will be included providing additional information.

Manager platform

The manager platform has several pages to perform actions related to the management of the application and its resources.

To access the manager platform, the user must click the “Login” link at the top right corner of the page. This will lead them to the login page, in which they can enter their username and password to access the manager platform.

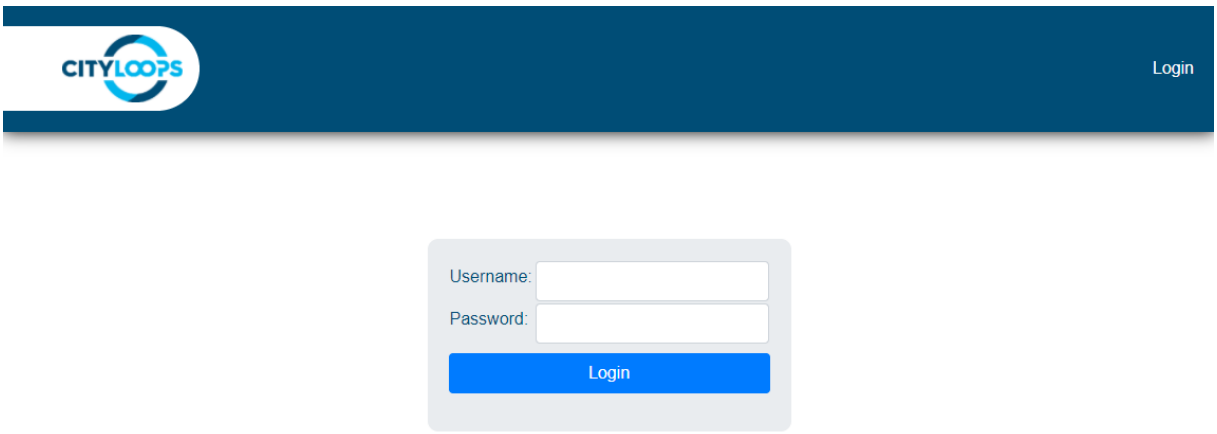


Figure 5. Login screen.

Once the user has logged in to the application, they will be able to access the pages to manage the entities of the application (containers, clean points, and districts). Each of the buttons located at the top bar of the page regarding these entities leads to the list of said entity. Through this list, the user can see the different attributes of each entity created. They can also create a new entity by clicking on the + sign located at the top right of the table, or edit any of the already created ones, by clicking the pencil icon at the end of each row.

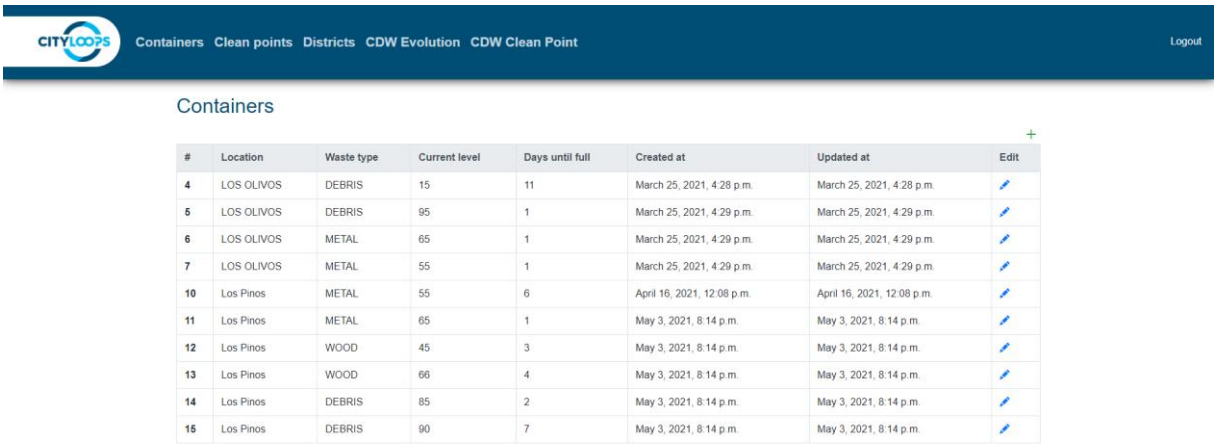


Figure 6. Container list page.

When entering the page to create a new entity, the user will be supplied with two ways to create a new entity: to create it manually, entering the data in several inputs or uploading a file that contains the pertaining data. Note that the file uploaded must be in the correct format and contain the needed data to create a new entity.

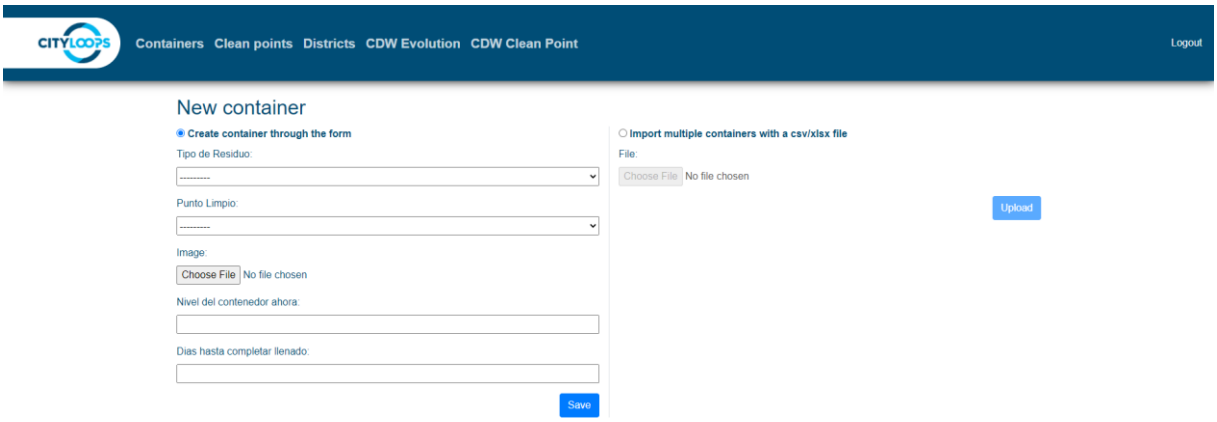


Figure 7. Container creation page. On the left, the form to create the container manually. On the right, the input to upload a file with the containers data to create.

One of the main functionalities for the manager is to evaluate the evolution of the production of CDW in the city. To do this, a dataset with demographic information by districts have been set with socio-economical information as well as building licences, new construction licences, maintenance licences and available area of construction. The manager can update or modify the dataset through the CDW datasets menu. In this menu, the manager can also update or modify the other dataset used to study the evolution of the waste collected by the Clean Point (the other main functionality of the tool for managers).

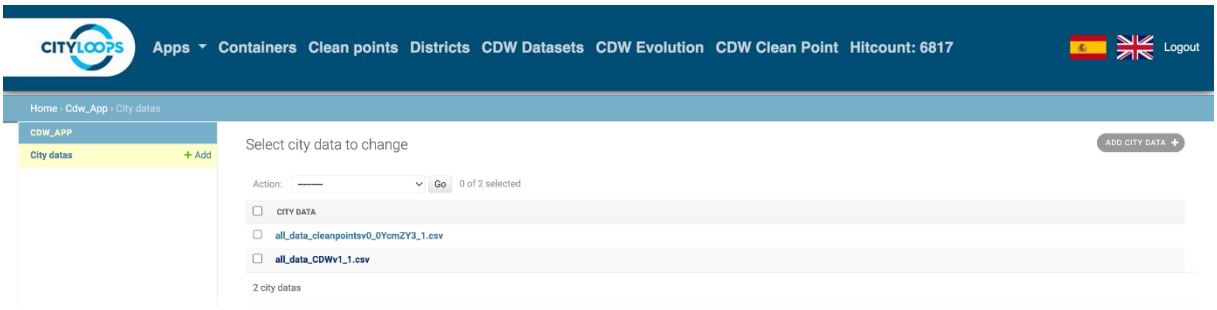


Figure 8. CDW Datasets page.

Once the manager checks the dataset, different estimations on the CDW production in the city can be done by the CDW evolution menu. Those simulations by ML contribute more information about the origin of the CDW in the city in order to make decisions in advance on the logistics, and infrastructures of the current Clean Points or the potential location of new ones if required. To get the estimations, the manager just selects the correct dataset and has to determine the year of study for the simulation.

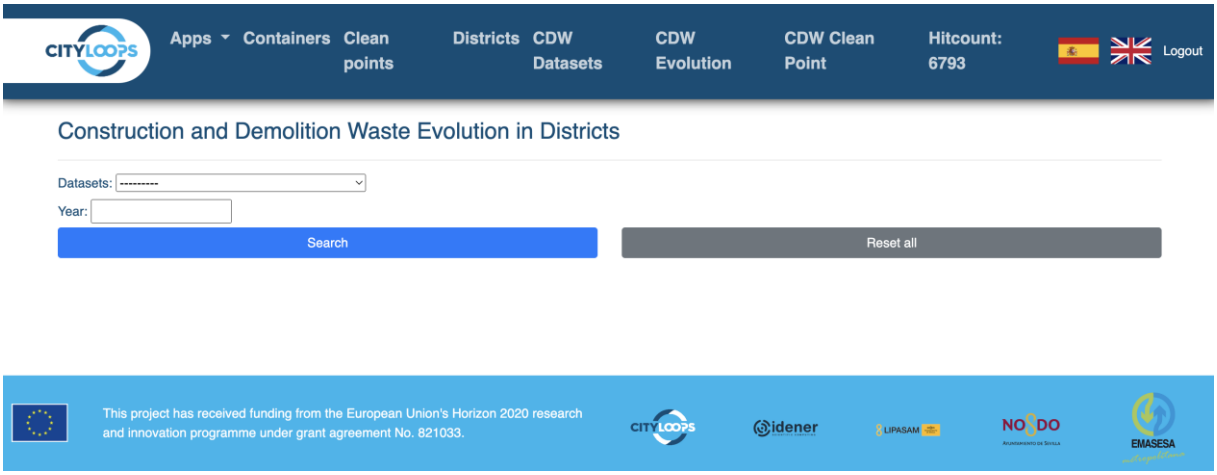


Figure 6. CDW evolution page.

Different simulations have been made by Lipasam's managers (some can be seen in Annex VIII) who keep increasing the dataset with internal data. Below an example is shown with a simulation of 2030. Results from this simulation showed similar CDW production amounts in most of the districts in the city with an exception. The centre of the city (Casco Antiguo) showed the most CDW production in comparison with the rest of the city. This result is due to the limited available construction area in the city as well as the economic framework in which new construction buildings are limited for several years. Therefore, the maintenance works in the centre of the city as well as reform works in old buildings show an upward trend with the related CDW production. Results will definitely help in the decision-making process to take the advance of this information and adapt the infrastructure as well as the CDW collection service in this potential scenario.

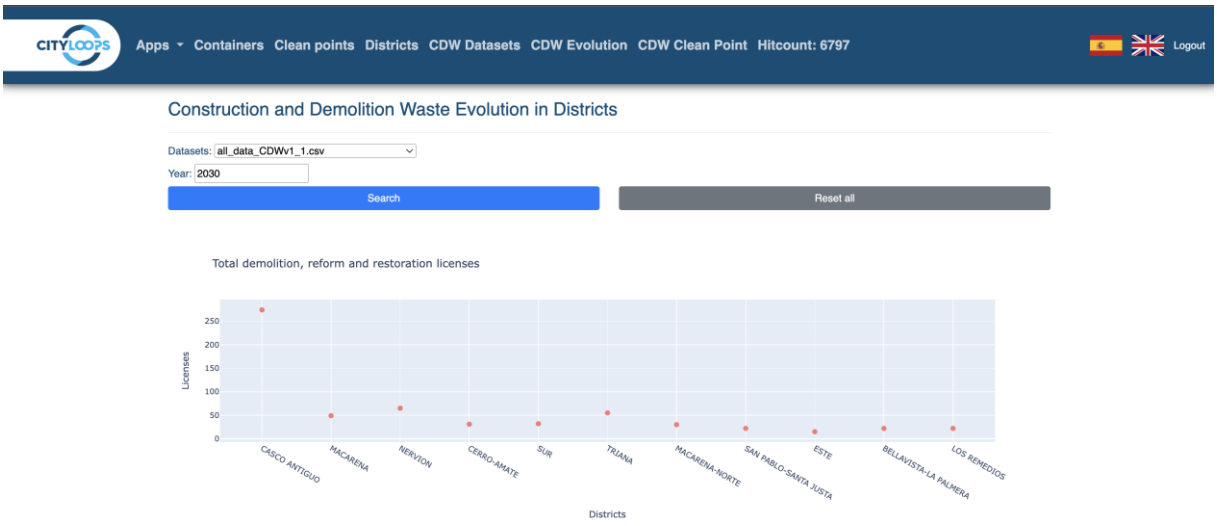


Figure 7. CDW evolution page (Results).

The other main functionality for the manager is to evaluate the evolution of the CDW collection in the different Clean Points in comparison with the other waste collected in such facilities. To do this, a dataset with demographic information by districts has been set with internal information from Lipasam. The manager can update or modify the dataset through the CDW datasets menu as shown previously. Once the manager checks the dataset, different estimations on the CDW collection can be done by the CDW Clean Point menu. Those simulations by ML contribute more information about the estimated CDW amount to collect in order to make decisions in advance on the logistics, and infrastructures of the current Clean Points. To get the estimations, the manager just selects the correct dataset and has to determine the year of study for the simulation.

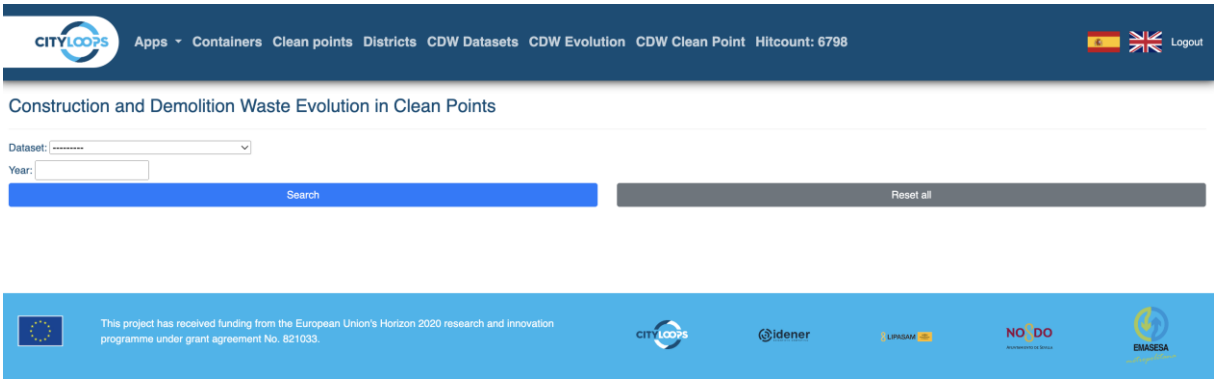


Figure 8. Clean Point evolution page.

Different simulations have been made by Lipasam's managers (some can be seen in Annex IX) who keep increasing the dataset with internal data. Below an example is shown with a simulation of 2030. Results from this simulation showed similar CDW collection amounts in most of the Clean Points with an exception. The Clean Point "Las Jacarandas" showed an

increase in CDW collection in comparison with the rest of the Clean Points. First, the short differences between the CDW collection amount in the Clean Points are explained because the construction activity in the city has been limited for several years because of the economic framework, so no significant changes are expected. Finally, the increase shown in "Las Jacarandas" results due to the proximity of the Clean Point to the several Industrial Estates which are more likely to the CDW production. Results will definitely help in the decision-making process to take the advance of this information and adapt the infrastructure as well as the CDW collection service in this potential scenario.

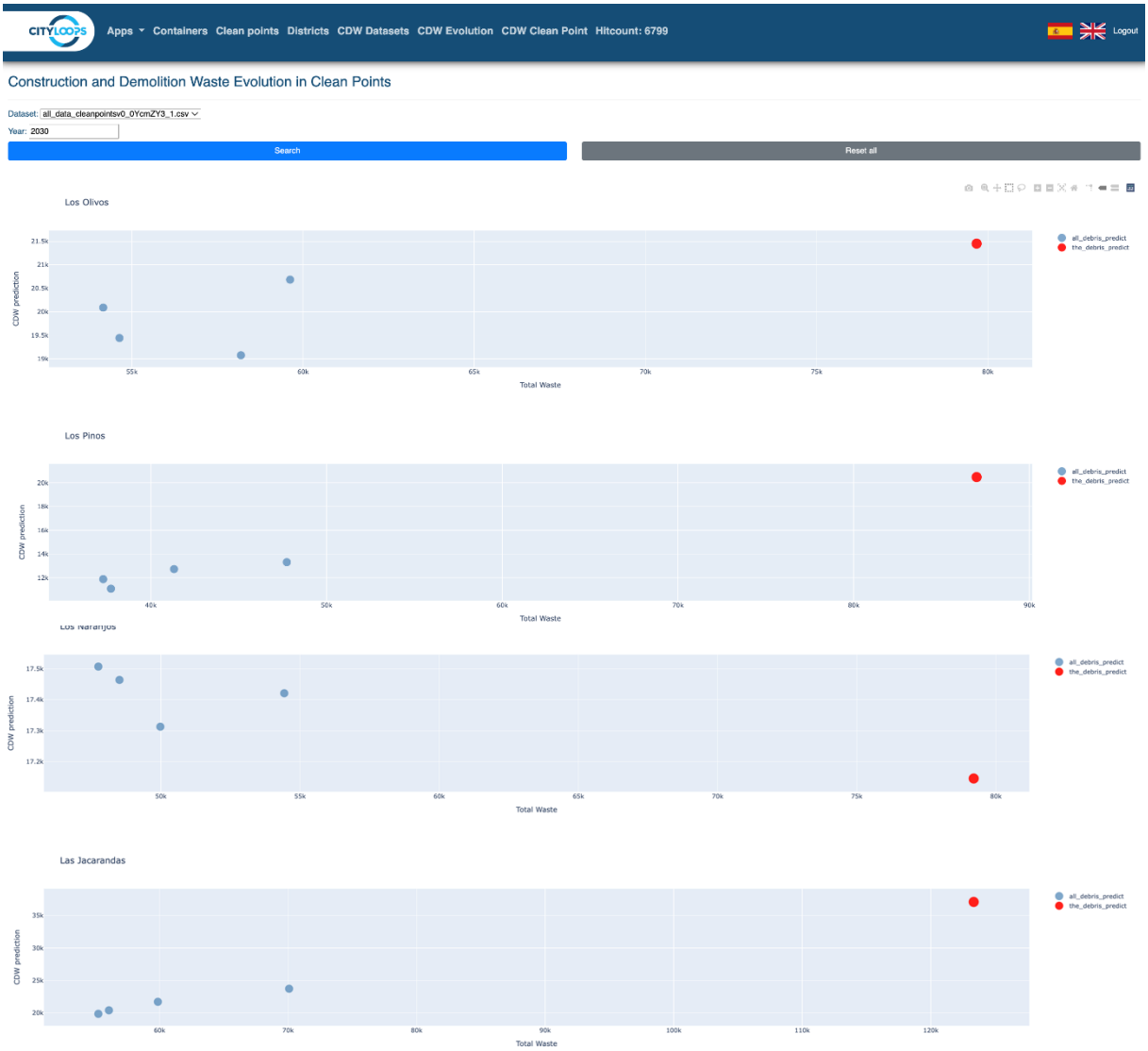


Figure 9. Clean Point evolution page (Results).

Functionalities of CDW platform for managers.

- District representation of Seville Data: The city of Seville will be divided into a discrete representation of districts and overlapped over a real map of the city.

- Data request of each district: Each district will be represented by different social and economic aspects, and the waste generation will be described. The remaining areas must be classified as “urban soil”, “urban land scheduled for development”, “rural areas” or “natural ecosystem”.

- Representation of the growth of the city: The growth of the city will be represented in a time-lapse showing in the last frame the projection of the next 3, 5, and 10 years according to the data provided by the manager through the platform.

- Location of potential future “clean points”: Using the data provided by the managers and machine learning techniques, the platform will present the areas where “clean points” could be placed in the next few years, according to the previously decided criteria.

Functional Requirements

This section lists specific functions and object-oriented designs linked to functionalities of the Cityloops platform.

- ORM/SQL database management (included already using Django)
- Machine Learning functionalities: regression, clustering.
- GIS / OpenStreetMap data management.
- Web Apps, Widgets and data visualization.
- Data collection and data analysis.
- PostgreSQL 12.6
- Django 3.2
- OSGeo4W
- Leaflet
- Gdal: (required modules installation: wheel; pip win; NumPy; pandas; shapely; gdal; fiona; pyproj; six; rtree; geopandas)

List of Components of WebApp for Construction and Demolition Waste (CDW)

CDW_APP001	**Web Form for Query and Data Collection**
Platform version	Basic User or Citizen
Description	This component of the Cityloops platform for CDW is a web form where the citizen or basic user will introduce the parameters of a query to find the closest “clean point” to dump construction waste (debris, metal, wood, or other). Some fields of these data include postal code, district, type of waste, estimated amount. Once all the fields of the form are completed and the button “Search” is pressed, the query is sent to the back-end function, which will provide as answer the “closest suitable clean point or clean points according to the location of the CDW and the type and amount of waste”.

Implementation	Django Form object has been implemented and formatted in the front-end of the web-app. A search and decision-making algorithm have been implemented to 1) select the suitable “clean points” according to the types of containers; 2) suggestion of the “clean point” to the user based on how full the existing containers and the distance from the district to the clean point are. The distance is calculated using the Haversine formula.
Input Data and Widgets	Text Edit (Postal Code), Spinbox (Amount of waste in kg), Comboboxes (District, Type of Waste), Date (expected date of disposal), Push Button (Search, create the query)
Output / Results	Once the button is clicked, the closest Clean Point will be highlighted in a map, and the information of the containers and a route will be suggested to the user (citizen) based on OpenStreetMap tools.

CDW_APP002	**OpenStreet Map showing districts highlighted and Clean Points location**
Platform version	Basic User or Citizen / Manager or Admin
Description	Widget imported from OpenStreetMaps showing a map of Seville City, including some additional layers, such as polygons representing the districts of Seville in terms of administrative divisions and waste generation. Locations of the current Sevilla districts and the current “clean points” will be marked in the initial map. Once the query is done and the result of checking the “optimal clean point for your needs” is obtained, this clean point will be highlighted in the map as well as the district of the origin of CDW, and, finally, a route by car will be suggested using OpenStreetMaps.
Implementation	The searching and decision-making function is implemented in Python in the back end, including the Haversine formula. The results of the most suitable clean point, the distance and the coordinates of district and clean point are passed to the frontend. There, a geodjango application using OpenStreetMaps, calculates and presents the suggested route to the clean point from the corresponding district.
Input Data and Widgets	Map imported from OpenStreetMap library. Additional layers added, including district representation and clean points position. The route is highlighted on the map.
Output / Results	Points, lines and polygons highlighted on the map.

CDW_APP003	**Visualisation of Containers Status in the Clean Points**

Platform version	Basic User or Citizen / Manager or Admin
Description	This part of the platform for CDW will present the status and the expected evolution (according to previous data) of the level in each of the containers for the different CDW materials that a citizen can dump in the clean point. Once the clean point is selected in the menu, the corresponding location will be highlighted in the map of CDW_APP002, and the status of each container will be presented in the panel of containers of the selected clean point.
Implementation	Javascript function combined with CSS to create a dashboard for each clean point. This dashboard will show the level of each container.
Input Data and Widgets	ComboBox containing the list of clean points to select. Panel with several plots showing the status of the containers and the projection based on past data.
Output / Results	Bar Plots with the evolution of the containers and line plots with the projected evolution.

CDW_APP004	**Updating data of the containers of the clean points**
Platform version	Manager or Admin
Description	The responsible for the management of this app will collect the information about the status of the containers in the clean point and will update the corresponding section in the CityLoops CDW webapp. This information will be used in the selection of the most suitable clean point. The information about the status of the containers in the “clean points” corresponding to the different types of construction and demolition waste (e.g., bricks, concrete, wood) will be part of the inputs for the decision-making process when recommending a “clean point” to the citizen.
Implementation	A Django model will be implemented, and a specific interface will be implemented in the front-end to update this information.
Input Data and Widgets	The input of this data may be using a table widget within the CDW platform.
Output / Results	Once the data is loaded (or updated) into the system, the visualisation panel CDW_APP3 of the containers will be refreshed, showing the updated data and a corrected projection for the next 2-3 days.

CDW_APP005	Loading data of clean points
Platform version	Manager or Admin
Description	The data of the CDW collected in the different clean points will be loaded to the system in order to predict which clean point will receive more CDW in the near future. The CDW, with an increasing trend of CDW reception, may need an extension or a near additional clean point in the future. Select the clean points of Seville receiving the highest amount of CDW.
Input Data and Widgets	Data will be loaded in one or several CSV files to the platform. Widget: Load File Dialog Window for each one of the input files
Implementation	A Django model will be created to store the name and the CSV file of the dataset. In the front-end part, the manager will select the available datasets (previously loaded by the administrator) and will use a form to provide the query as the input to the ML prediction model. Then, the model, implemented in the back end, will calculate the result (i.e., the prediction), and this information will be presented to the user, together with a visualization of the dataset. In this way, the manager will check if the prediction is consistent with the corresponding data and will increase the trust of the manager on the tool.
Output / Results	According to the results obtained by the back-end calculations, the clean points with the increasing demand of containers for CDW will be highlighted in the OpenStreet Map of the CDW_App002 Current and Expected tons of CDW will be presented on the map over the corresponding polygon of the district.

CDW_APP006	Loading data of CDW generation by district
Platform version	Manager or Admin
Description	CityLoops Platform for CDW will collect the data provided by managers or admins in CSV files. This data will include social, economic, geographic, and waste-related data of Sevilla districts. This data may include, construction related licenses, number of containers for residues, packages, glass and paper, and other data relevant for the characterisation of the Sevilla district.

Implementation	A Django model will be created to store the name and the CSV file of the dataset. In the front-end part, the manager will select the available datasets (previously loaded by the administrator) and will use a form to provide the query as the input to the ML prediction model. Then, the model, implemented in the back end, will calculate the result (i.e., the prediction), and this information will be presented to the user, together with a visualization of the dataset. In this way, the manager will check if the prediction is consistent with the corresponding data and will increase the trust of the manager in the tool. In this case, the prediction will be related to the potential generation of CDW based on the expected number of licenses for construction activities directly related to citizens and small enterprises (e.g., new buildings are mostly managed by big construction companies, and they will be not considered here).
Input Data and Widgets	Loading CSV or XLSX file or modifying the data directly in the CDW platform (this must be decided)
Output / Results	Updated data about CDW generated in each district of Seville city.

CDW FLOW OPTIMISATION TOOL

Digital tools have been developed to optimise the use of Seville's Clean Points for collection of CDW from citizens and small producers. Data will be shown through a web portal, with one interface for citizens to instruct them to the Clean Point best suited to receive their CDW, and one interface for city managers to understand the quantity of CDW at each Clean Point and plan for future scenarios of city growth to open new clean points. Data collected on the stocks and flows of CDW through the cities' Clean Points will be used to continuously optimise their management. The collected CDW will be treated by Fermovert if need be, to ensure its safety and quality for further future uses. Lipasam, the waste management company of Seville, plans to analyse the composition of the CDW collected in Clean Points, in order to evaluate the potential uses of the material recovered and be able to take decisions with the aim of recuperating costs for the Clean Points management and CDW treatment. Finally, an awareness campaign will aim to introduce these tools to the public and encourage proper handling of CDW, in order to avoid the common practice of illegal dumping of CDW.

Lessons learned

- Distributed presence of clean points around the city.
- Separate collection of as many fractions as possible and the possibility to drop off professional CDW, under the limits established.
- Training of the staff of clean points to maximize CDW recycling and appropriate management.
- Proximity of the sites to citizens (e.g., easily accessible with a car and nearby to residential areas).

- Long opening hours to enhance convenience for citizens. - Regular inspection of “frequent” areas where waste is abandoned. - Try to implicate the neighbourhood of the surrounding areas. - Inform recurrently about possible sanctions for CDW abandonment. - Maximise the divulgation of CDW collection service and facilitate users' actual information of the clean points (IT tool) - Optimise the infrastructure and facilities according to actual requirements (including machine learning methodology to analyse available data) - IT tools could increase the users' commitment, 6,824 visits to the tool in the last 12 months.
https://cdw-app.idener.es/

▪ 3.2.2 Launch and use of CDW optimization tool, by citizens and by city managers.

In September 2021, an internal team from Idener tested the CDW optimization tool in order to evaluate the robustness and user-friendly. Then, in November 2021, Lipasam started to test the CDW optimization tool. The tool was refined based on the feedback they provided regarding the functionalities are database updated. Additionally, Emasesa gave their feedback on the CDW optimization tool in December 2021. The main suggestions were focused on improving the user-friendly of the Managers’ functionalities.

Simultaneously, Lipasam carried out surveys (annex X) in the clean points (civic amenity sites), since 27th October 2021 in order to evaluate the evolution of the usage from citizens. In these surveys, which are voluntary, Lipasam asked about the origin of the waste (who produces it, professional or general citizen, how much and where, in which ZIP code of the city). Surveys stopped taking place in February 2022.

Also, Lipasam CDW characterizations from the waste collected in the clean points were carried out, with the idea of evaluating the applicability of these waste in construction works. The parameters expected to measure are:

3.2.- Identification of CDW flows **3.2.1.- Control of origin. CDW flows**		
RCD treatment plant verification		AOPJA (Agencia de Obra Pública de la Junta de Andalucía) Model
Compaction test. Normal proctor		UNE 103500
Compaction test. Modified Proctor	*	UNE 103501
Soil granulometric analysis		UNE 103101
Atterberg limits		UNE 103103 UNE 103104
Laboratory determination of the C.B.R. Index. of a floor		UNE 103502

Organic matter content in soils		UNE 103204
Content of soluble salts in soils		NLT-114
Gypsum content in soils		NLT-115
Free swell test in oedometer		UNE 103601
Soil collapse test	*	NLT-254
Relative density of soil particles		UNE 103302

Lipasam need to know if the main users leaving CDW at clean points are professionals or individuals, and survey to see where the waste is generated. It could be interesting to see kind of hotspots on a map with the sites of CDW generation and compare this information with the IT tool simulations.

One feature of the tool for managers is that they can simulate future CDW generation points so that appropriate areas are allocated for future clean points. For example, if one city district is found to be a large generation area of CDW, Lipasam could take advantage to plan another clean point near it. This kind of simulation is done and used by city managers.

So far, the data used is historical data from 2015, about maintenance work in buildings, construction permits, and economic data from the city - some machine learning methods to identify hotspots for CDW production. With the surveys, Lipasam pursues improving the dataset of the tool and increase the accuracy of the IT tool.

In the Spring of 2022, the CityLoops managers from Lipasam validated the IT tool and then, the CDW optimization tool was deployed (internally) for citizens. Then, in May 2022, the database was improved with more data from Lipasam. This way, in August 2022 the tool was launched.

▪ 3.2.3 Testing of the Optimisation of CDW flow.

The Optimisation CDW flow tool was lunched before summer 2022 after a preliminary testing period by the managers of Lipasam. Several modifications have been developed after the preliminary testing process taking into account the suggestions from the members of the local cluster in Seville. Those modifications have the main objective to increase the user friendliness of the tool for both manager and citizens.

The use from the citizens is focused on the selection of the closed clean point for CDW disposal according to their location. After a period of use, other local points i.e., Eco points, that manage other waste selectively throughout the city have been added to the tool in order to increase the use of the tool.

The use from the Lipasam managers is focused on the monitoring the accuracy of the tool identifying the city districts with more CDW production by the comparison of the surveys launched in the clean points to their users, increase the dataset of the tool and monitor the predictions of the estimated waste in the clean points in future scenarios. Good results were observed considering the short period of implementation and collected information. Good maintenance of the dataset and clean points' monitoring a sound evaluation of results could be shown beyond Project implementation.

During demonstration action 2, some modifications and new functionalities were implemented considering the suggestions from the local managers. These modifications and new functionalities are identified below:

- Internationalization: Using the built-in internationalization functionality in Django it was possible to translate the application from English to Spanish. This is done by adding a specific tag in Django's templates wherever a translatable text appears. Then, by using a Django command, the application generates a file for each language implemented with all the translatable text, where the translated text could be entered so the application can replace the original text whenever the app language is changed.

- Footer: A footer was added to the base HTML template to show the partners involved in the application and the H2020 funding statement.

- Hit count: A hit count was added to the application header that indicates the number of times any page of the application has been visited. To do this, the method that registers the visit was added as a "middleware". Middleware methods are executed for every request to the server, so it's totally independent of the page the user is accessing.

- Citizen form result visual improvements: The map districts overlays were hidden and can be shown again by clicking on the top-right corner of the map. The container level bars are coloured based on the current level of each container.

- Added calendar to citizen form date input: The date input in the citizen form now displays a calendar to select the date. This was implemented using the flatpickr library for Django, which displays date pickers in Django forms.

- Added graphs of clean point previous year data in citizen form results: After a correct form submission from the user in the citizen form, the page displays several graphs representing waste collection from previous years. This was implemented using the chart.js library. Chart.js is a JavaScript library used to represent graphs.

- Add citizen origin point in citizen form map: The user must select the origin point on the map to be able to submit the citizen form. To do this, a JavaScript event was added to the map where, on every click action, would set the selected point latitude and longitude to a pair of hidden HTML inputs.

- Improved ML form inputs: Unnecessary inputs were removed from the HTML templates of the ML forms.

- Added Ecopoints: A new model was added to the database to store Ecopoints. In addition, the citizen form was changed by removing the "Other" waste input and adding a checkbox for each waste type that Ecopoints allow. When not selecting wood, metal or CDW as the waste types in the citizen form, ecopoints would show in the result screen as well as the clean points. If any of the three waste types mentioned above were selected, only clean points would be shown in the result view.

3.2.4 Preparation and procurement of awareness campaign.

The abandonment of CDW in vacant lots and ditches, mainly in peripheral areas, is a problem from an environmental, landscape and cost point of view for its removal and cleaning for cities. In Seville, for this pilot action, 15 of the publicly owned plots that present a more serious situation of abandonment of CDW have been selected. The scope of the pilot is limited to publicly owned parcels due to the difficulty of contacting private owners.

In the design of the campaign, an attempt has been made to opt for a mixed model of physical and online actions, through billboards at points of abandonment, where the prohibition of this practice is emphasized, in addition to stressing that it is a crime that contravenes the ordinances premises and with an economic penalty. Likewise, it was considered appropriate to specify on said signage the possibility of using the Clean Points system managed by Lipasam, under the conditions established by the Local Waste Management Ordinance.

For the digital part, the making of a video was devised, accompanied by a segmented marketing action to the population near the plots where posters were going to be placed. The message to be conveyed in the video is the same as that of the billboards, in addition to reinforcing the support of Lipasam (the city's cleaning and waste management company) that it carries out in the area within its powers.

From a technical point of view, the recruitment required the campaign to comply with the following concepts:

• Complete creativity of the campaign.

• Design and production of 15 billboards with a support of total measurements of 500mm to the ground and 3000mm of free pole, of which 1500 wide x 1000 high will be used, leaving 2000mm free from the edge of the sign to the ground. Being composed of 2 tubes of 3500 40/40 x 1.5 mm galvanised, and 3 full-width reinforcement tubes of 30x20 mm galvanised, with assembly included in 15 locations. The material of the poster had to be dibon on the front, 1500 x 1000 mm in full colour, painted and laminated with turned ends and hidden screws, leaving the front smooth.

• Creation and dissemination of an online campaign in the areas of interest. In addition to informing about the prohibition to abandon CDW, the campaign would be used to inform about one of the tools to be developed in the CityLoops project, consisting of a web tool that will allow the citizen various functionalities, such as:

- Know what type of construction and demolition waste can be deposited in the Collection Points.
- Quantities admitted.
- Find out which Clean Point is the nearest, etc.

• Realisation of a Video-spot

▪ 3.2.5 Awareness campaign: 1) Prevention of illegal dumping 2) Correct segregation and management of CDW for large generators.

1) Prevention of illegal dumping

One communication campaign target citizens/SMEs - focused on prevention of illegal dumping. It will accompany the launch of the digital tools, so that users are aware and encouraged to use the tool to improve their experience using the clean points.

A preliminary CDW illegal drop-off point identification analysis was conducted in early 2021. 15 significantly hot spots were identified. Of these points, part of them are private plots. Internally, it was decided to act only in those of public ownership. These points and the nearby residential areas were the target for the implementation of the communication actions.

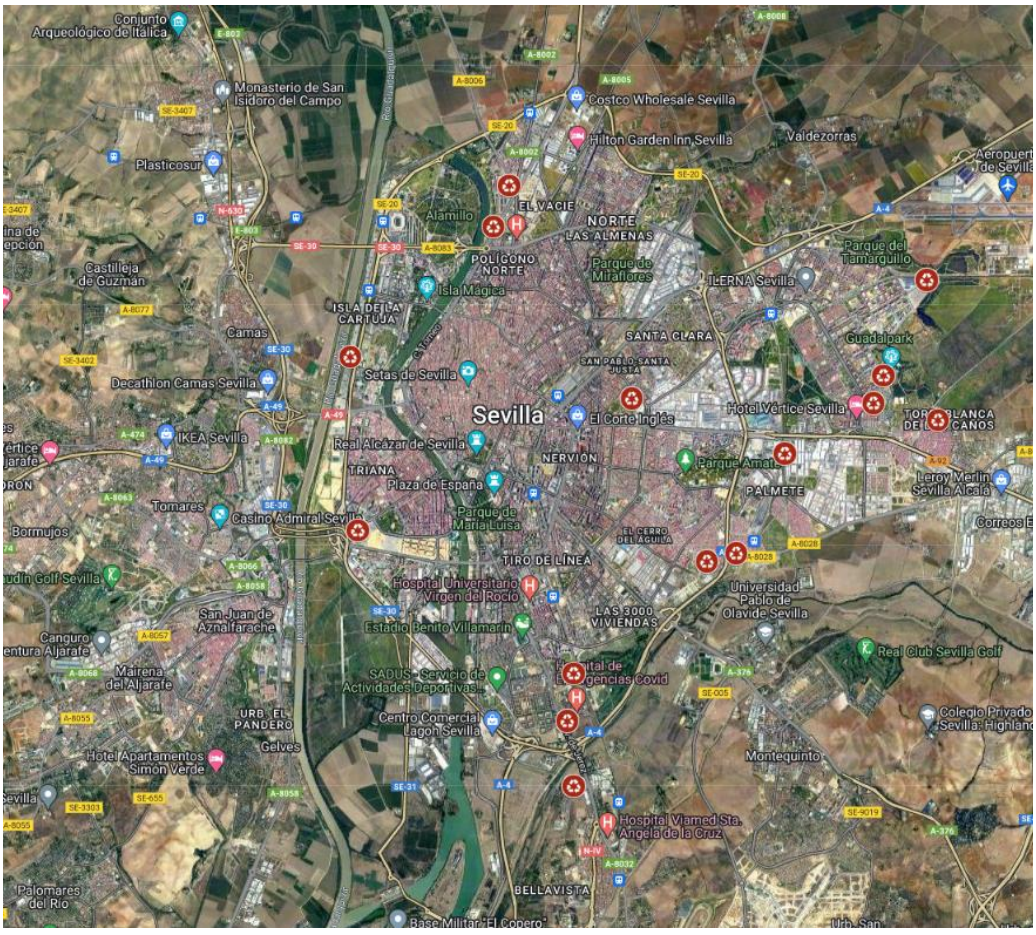


Illustration 1. Screenshot of illegal drop-off points selected for communication actions aimed to avoid illegal dumping.

In each selected point a billboard was installed. The aim of this was to warn of such non-compliance and to explain the alternatives to properly dispose of such waste. Complementing this action, a marketing campaign and social media is carried out.

The message of this campaign is clear: Avoid dumping mixed CDW in public area, and rather separately sort them and deliver to clean points for proper handling.

A promotional video is filmed and shared using social media where the Dept of Inspection in Lipasam one of their responsibilities is monitoring CDW abandonment, and act as the protagonists in the video. Residents of neighbourhoods next to the billboard sites are also invited to participate in the video.

The video is used as a resource for the marketing campaign and social media. Also, this action is used to promote the digital tools developed during the project, related to CDW management. Citizens currently know the location of clean points via Lipasam's website, but the added value of the digital tool is that it can calculate the closest clean point.

2) Correct segregation and management of CDW for large generators.

Activity is in the workshops with these companies (e.g., to show the QA tool of Emasesa), will also let them know about the correct separation and management of waste on sites. Not explicitly targeted in the communication campaign, though the message applies to anyone.

▪ 3.2.5 Analysis of the results of the demo-action Optimising clean points.

From the results of demonstration action 2 some conclusions have been highlighted:

- A good divulgation of the location of clean points around the city as well as Eco-points helps to increase the citizen's usage.

- Separate collection of as many fractions as possible and the possibility to drop off professional CDW, under the limits established increase the commitment on circular CDW and other waste management as well as reduce the illegal dumping.

- Training of the staff of clean points to maximize CDW recycling and appropriate management as well as collect information from users and origin of waste to improve datasets and ML analysis of the Tool will increase the IT tool accuracy and facilitate the decision-making process.

- Recurrent awareness campaigns could increase the awareness of citizens as well as implicate the neighbourhood of the surrounding areas.

- Optimise the infrastructure and facilities according to actual requirements (including machine learning methodology to analyse available data) is a critical way to maximise the circular CDW management in the city.

3.3 Implementation Activities Demo Action 3: Data driven decision making and Best Practice Guidelines for CDW Management in Sevilla

Django has been used for developing the platforms in Seville. See the description of Django in chapter 3.2.

The CityLoops platform for Seville´s wellbeing (WB) monitoring has two main goals: the determination of the current wellbeing both in the city and in the different districts; and the evaluation of the impact of the demonstration actions from CityLoops on the wellbeing. The software tool for managers will combine data regarding economic, social, demographic, environmental and waste with circular indicators. This way, the tool will determine a new composite indicator that determines the relationship between wellbeing and the demonstration actions, focused on circularity. Managers will have access to a simulation framework that quantifies the influences of such circular demonstration actions from CityLoops on well-being. The software tool for citizens will provide data about the new composite indicators (well-being-circularity), demonstration actions, and impact estimations on the city´s well-being.

The WB monitoring tool is expected to contribute to the following outcomes:

- Advance in the fulfilment of the European, national, and regional objectives, in selective collection, recycling and not disposal in a landfill, marked by Directive 851/2018 and 850/2018.
- Strengthen the education, awareness and knowledge of citizens and other socio-economic agents related to the bases of the circular economy concerning the improvement of biowaste management.
- Increase the amount of material that can be recovered/recycled / recovery, and therefore, reduce the amount of material that is deposited in landfills.

Idener has developed the IT software tool in collaboration with Seville´s cluster. Seville's cluster of partners for the CityLoops project includes the Municipality of Seville, Lipasam (Municipal Solid Waste Management company), Emasesa (Municipal Wastewater Treatment Management company) and Idener (Private Research company). Together these partners are

committed to the CityLoops' approach to close the loops of waste material in the city, promoting a circular economy approach to the city's development.

3.3.1 Development of wellbeing monitoring tool.

WELLBEING MONITORING TOOL
IDENER has developed digital tools to integrate available data on environmental, economic and social development in Seville municipality in order to facilitate data-driven decision-making and better understanding of the impacts of policies and initiatives on citizen wellbeing, and to ensure the city is on the right track towards the sustainable development goals. Citizens will also be able to access information about their waste generation, and how city initiatives are impacting a series of sustainability and wellbeing indicators.
Lessons learned There are a lot of socio-economic and environmental indicators related with the wellbeing in a city. A good understanding about the impact of those indicators in the wellbeing can facilitate the transition to a circular economy. Further analysis and a frequent update of the dataset as well as the selected indicators is required in order to help in the decision-making process on circular economy and required mechanisms. In the implementation phase of the demonstration actions, Emasesa and Lipasam set a target in their Strategy to enable the transition to a circular economy focused on the circular management of CDW as well as to minimise the illegal dumping of CDW. Good monitoring of the implementation actions made during CityLoops implementation as well as keeping fluent communication with the other municipal companies of the municipality as well as private stakeholders will allow to scale up the circular economy approach in the city. From results, it has been highlighted that the municipal waste management as well as the house renting pressure in the city have critical impact in the wellbeing of citizens. For this reason, in September of 2023 Lipasam will stablish specific meetings with different associations a municipal stakeholder in order to adapt the municipal waste collection service in those districts with higher house rent pressure. Finally, CityLoops results contribute to the development of the Local waste prevention and management Plan of Seville (currently in draft status).
https://wb-app.idener.es/

The platform for each use case within Seville will have two versions, one for managers and authorities and another for citizens.

The idea is that the platform version for citizens has only visualization capabilities and widgets using data provided by managers or results from the corresponding CityLoops platform for partners.

Therefore, the applications for managers will consist, at least, in a data collection tool where managers will provide the data to power up the data-driven applications or the visualization widgets in the platforms for citizens. Additionally, the platforms for managers may have

additional capabilities for decision support. The applications for citizens show interactive visualizations of the data provided by managers and will use the available widgets to get information about specific questions regarding WB.

Wellbeing Module development

This Section details all the necessary data transformations that have been carried out for the calculation of wellbeing. Additionally, a module has been prepared where different Machine Learning-based models have been trained to predict wellbeing. For this purpose, data from the different districts of the city of Seville from 2015 to 2018 was used. This data is composed of different columns, and these columns can belong to three groups:

- Social columns: The columns grouped under this category represent a factor related to the sociological situation of the inhabitants residing in each district. Some columns can affect positively (e.g., neighbourhood associations) or negatively (e.g., number of detainees) to the Wellbeing calculation.

- Environmental columns: These columns represent different environment-related variables in the district. As in the previous case, some columns will increase the value of wellbeing, and others will decrease it.

- Economic columns: Columns related to the economy in a specific sector or district within the city. Following the same methodology as the previous ones, some economic columns can positively (e.g., activity percentage) or negatively (e.g., increase in unemployment compared to previous years) affect the Wellbeing calculation.

The rest of this section is organised as follows: (1) details the steps that comprise the data; (2) presents the calculation of wellbeing value; (3) proposes a Machine-Learning method to predict the wellbeing; and (4) concludes this research work with future research directions.

Citizen platform

On the WB main page, the user will see a form including a list of the city districts and a text box where they will introduce their zip code. Two buttons are located below the form: the left one submits the form (“Get Well-Being indicators”), and the right one resets all the form fields (Figure 18). At the right of the form, a map of Seville will be shown.

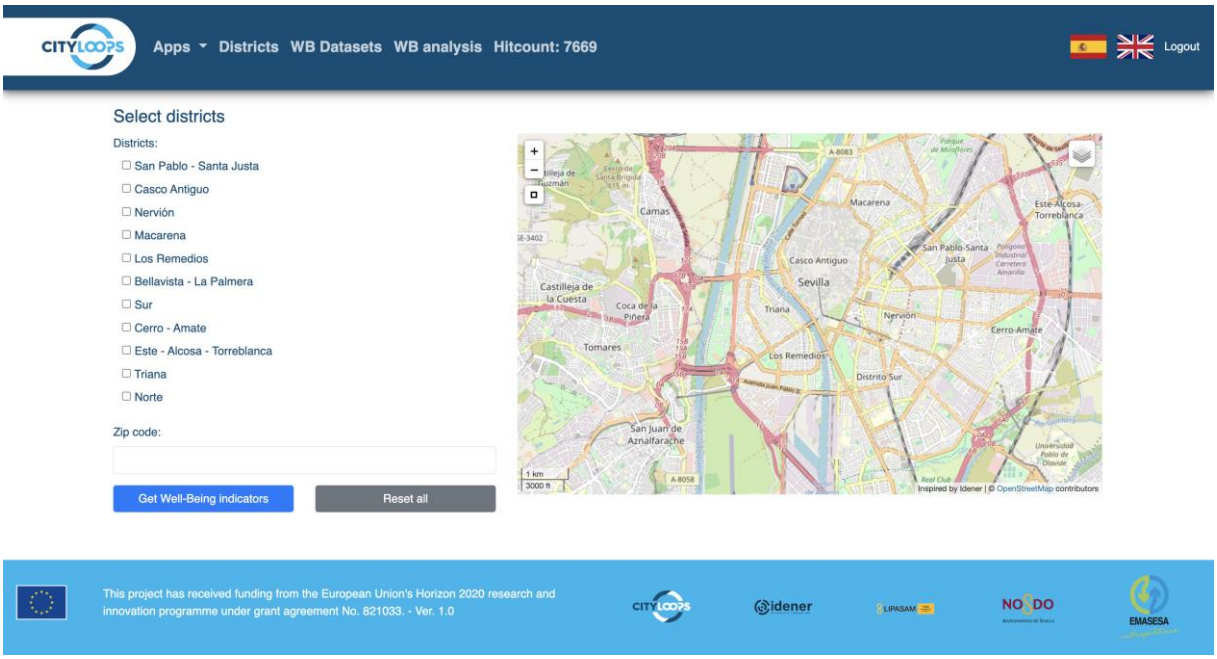
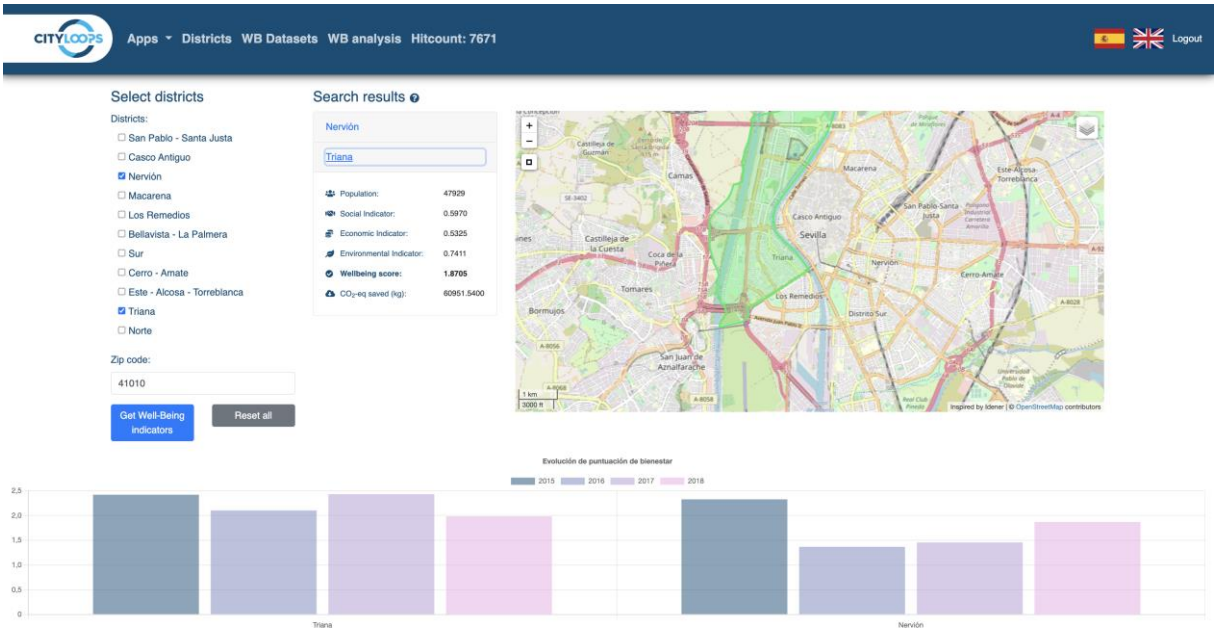


Figure 1. WB platform main page.

When the user clicks on the submit button, the application will show the results in a column that will appear between the original form and the map (Figure 19). The column will contain a collapsible with each district that the user selected in the form. Inside each section, the user can see the Wellbeing score for that district and its social, economic, and environmental indicators as well as the CO_2 equivalent saved by the separate organic waste collection and valorised through Anaerobic Digestion process. Finally, the user will see historical information on wellbeing score of the selected districts by graphics at the bottom of the results page.



Functionalities of WB platform for citizens

- Forms for query: The citizen will provide data about its location. The WB CityLoops platform for citizens will show the wellbeing indicators, circular indicators and composite indicators per district and city.
- Dropdown list: The citizen could select a district. The WB CityLoops platform for citizens will show the demonstration actions deployed and the estimated impact on the indicators.
- Map showing: A widget with a map (using OpenStreet Maps) will be presented to the citizens showing the city's current status regarding the indicators.
- Dashboard showing the current data on indicators: The dashboard will show the data on each indicator measurement.
- Control panel: A set of buttons will be included in the application to clean the forms, do the query, and export information. Logos of the involved partners (Emasesa, Lipasam, Municipality of Sevilla, CityLoops project) will be included providing additional information.

Manager platform

The manager platform has several pages to perform actions related to the management of the application and its resources.

To access the manager platform, the user must click the “Login” link at the top right corner of the page. This will lead them to the login page, in which they can enter their username and password to access the manager platform (Figure 20).

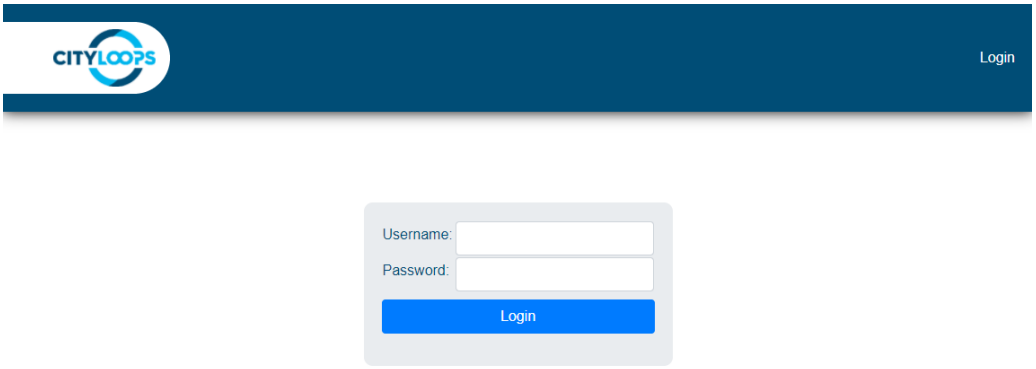
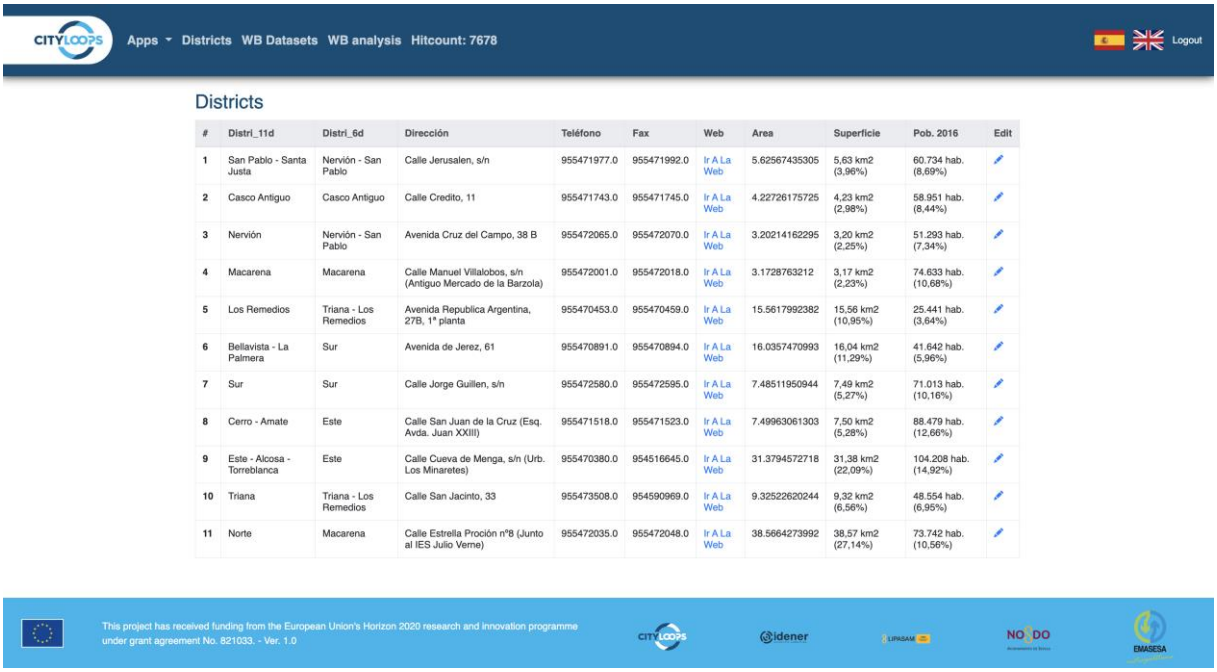


Figure 2. Login screen.

Once the user has logged in to the application, users will be able to access the pages to manage the entities of the application i.e., districts, dataset, and Well-Being analysis (Figure 21). Each of the buttons located at the top bar of the page regarding these entities leads to the

list of said entities. Through this list, the user can see the different attributes of each entity created.



#	Distri_11d	Distri_6d	Dirección	Teléfono	Fax	Web	Area	Superficie	Pob. 2016	Edit
1	San Pablo - Santa Justa	Nervión - San Pablo	Calle Jerusalen, s/n	955471977.0	955471992.0	Ir A La Web	5.62567435305	5,63 km2 (3,96%)	60.734 hab. (8,69%)	
2	Casco Antiguo	Casco Antiguo	Calle Credito, 11	955471743.0	955471745.0	Ir A La Web	4.22726175725	4,23 km2 (2,98%)	58.951 hab. (8,44%)	
3	Nervión	Nervión - San Pablo	Avenida Cruz del Campo, 38 B	955472065.0	955472070.0	Ir A La Web	3.20214162295	3,20 km2 (2,25%)	51.293 hab. (7,34%)	
4	Macarena	Macarena	Calle Manuel Villalobos, s/n (Antiguo Mercado de la Barzola)	955472001.0	955472018.0	Ir A La Web	3.1728763212	3,17 km2 (2,23%)	74.633 hab. (10,68%)	
5	Los Remedios	Triana - Los Remedios	Avenida Republica Argentina, 27B, 1ª planta	955470453.0	955470459.0	Ir A La Web	15.5617992382	15,56 km2 (10,95%)	25.441 hab. (3,64%)	
6	Bellavista - La Palmera	Sur	Avenida de Jerez, 61	955470891.0	955470894.0	Ir A La Web	16.0357470993	16,04 km2 (11,29%)	41.642 hab. (5,96%)	
7	Sur	Sur	Calle Jorge Guillen, s/n	955472580.0	955472595.0	Ir A La Web	7.48511950944	7,49 km2 (5,27%)	71.013 hab. (10,16%)	
8	Cerro - Amate	Este	Calle San Juan de la Cruz (Esq. Avda. Juan XXIII)	955471518.0	955471523.0	Ir A La Web	7.49963061303	7,50 km2 (5,28%)	88.479 hab. (12,66%)	
9	Este - Alcosa - Torreblanca	Este	Calle Cueva de Menga, s/n (Urb. Los Minaretes)	955470380.0	954516645.0	Ir A La Web	31.3794572718	31,38 km2 (22,09%)	104.208 hab. (14,92%)	
10	Triana	Triana - Los Remedios	Calle San Jacinto, 33	955473508.0	954590969.0	Ir A La Web	9.32522620244	9,32 km2 (6,56%)	48.554 hab. (6,95%)	
11	Norte	Macarena	Calle Estrella Proción nº8 (Junto al IES Julio Verne)	955472035.0	955472048.0	Ir A La Web	38.5664273992	38,57 km2 (27,14%)	73.742 hab. (10,56%)	

One of the main functionalities of the manager is to analyse the Well-Being of the districts in the city. To do this, a dataset with demographic information by districts has been set with socio-economical information and environmental data. The manager can update or modify the dataset through the WB dataset menu.

Once the manager checks the dataset, different analyses on the Well-Being in the city can be done by the WB analysis menu. Those simulations by ML contribute more information about the impact of different indicators considered in the dataset and can help in the decision-making process to prioritize the actions to be done in each district or identify the required actions or areas in which different actions are needed. To get the Well-Being indicators, the manager just selects the dataset, and the weights of the data areas in the dataset i.e., social, economic, and environmental areas, and has to determine the year of study for the simulation.

Figure 3. WB analysis.

Additionally, you can make quick simulations introducing new data not considered into the dataset in order to see the impact in comparison with the analysis without considering them. To do this, the manager selects the box "Include custom fields" and then, fills the text boxes with the required information per district including the area (social, economic, or environmental), year of data, and weight.

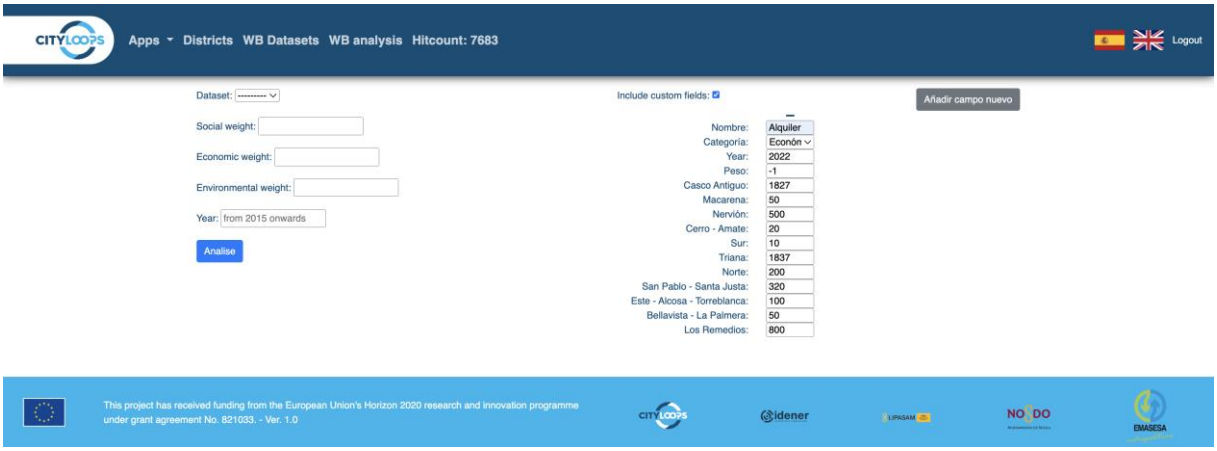
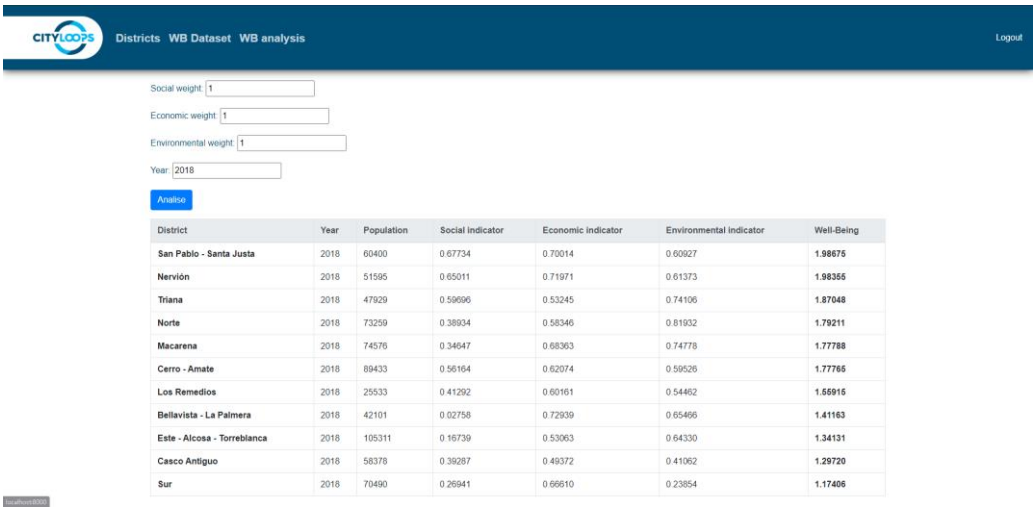


Figure 4. WB analysis including new data

Managers can simulate different scenarios determining different weights in each area of the dataset (social, economic, and environmental). So, the Well-Being analysis is very resilient to different political frameworks or political will due to the weight of the areas being totally defined by managers. To get the estimations, the manager just selects the correct dataset, and weights of areas and has to determine the year of study for the simulation. When the user presses “Analyse”, the app shows the results (Figure 22). Results show the year of estimation, the population of each district, Social indicator, Economic indicator, Environmental indicator, and finally, Well-Being indicators.

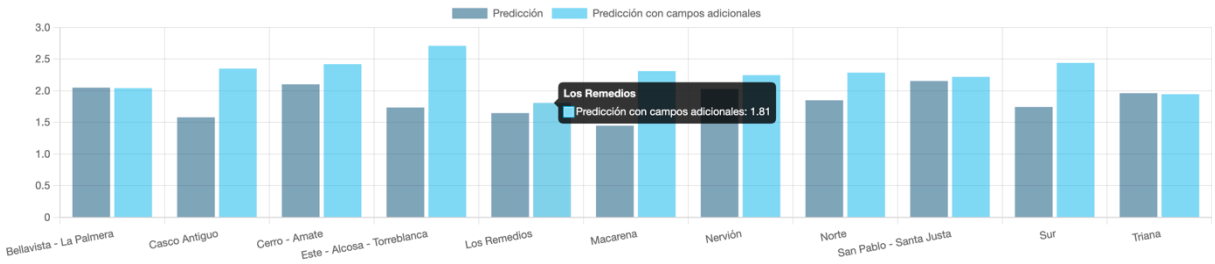


District	Year	Population	Social indicator	Economic indicator	Environmental indicator	Well-Being
San Pablo - Santa Justa	2018	60400	0.67734	0.70014	0.60927	1.98675
Nervión	2018	51595	0.65011	0.71971	0.61373	1.98355
Triana	2018	47929	0.59696	0.53245	0.74106	1.87048
Norte	2018	73259	0.38934	0.58346	0.81932	1.79211
Macarena	2018	74576	0.34647	0.68363	0.74778	1.77788
Cerro - Amate	2018	89433	0.56164	0.62074	0.59526	1.77765
Los Remedios	2018	25533	0.41292	0.60161	0.54462	1.55915
Bellavista - La Palmera	2018	42101	0.02758	0.72939	0.65466	1.41163
Este - Alcosa - Torreblanca	2018	105311	0.16739	0.53063	0.64330	1.34131
Casco Antiguo	2018	58378	0.39287	0.49372	0.41062	1.29720
Sur	2018	70490	0.26941	0.66610	0.23854	1.17406

Figure 5. WB analysis result.

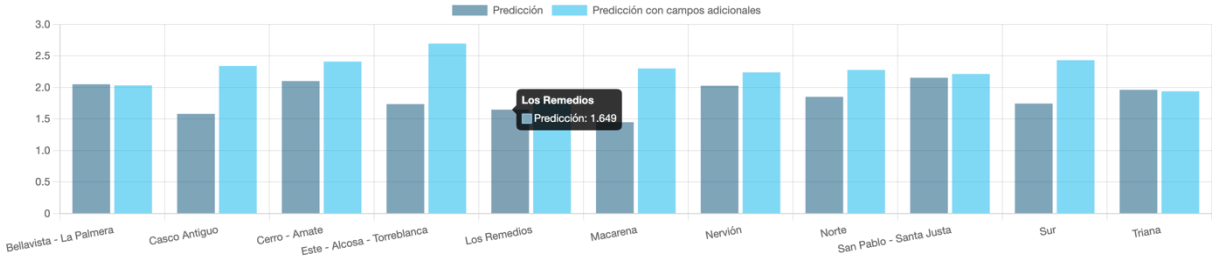
Different simulations have been made by the managers of the Municipality of Seville in collaboration with Lipasam and Emasesa (some can be seen in Annex XI) who also keep increasing the dataset with internal data. Below an example is shown with two simulations: one introducing the house rent pressure in the districts of Seville and the other one including the separate organic waste collection, both for 2030. The analysis of obtained indicators showed that both new sets of data have an impact on the Well-Being of the different districts.

This result is due to, on the one hand, the house rent pressure in the districts is a recent issue aggravated by the limited offer of the house to rent and the competition with the tourist ones. This situation is producing a increasing unrest which that harms the wellbeing of citizens. The main reasons of this unrest are the increase of the house rent prices and the waste production associated with this kind of tourism. On the other hand, the implementation of the separate organic waste collection results in a increase of the wellbeing, in general, mostly due to the increase of the number of bins and seggregation of the municipal waste that cause an improvement on the disposed waste on the streets. Results will definitely help in the decision-making process to take the advance of this information and adapt the municipal waste services collection in the present scenario and short future one. In fact, recently, Lipasam has arrange specific meeting with local associtation on house rents and local stakeholders to face the waste collection in those districts with more house rent pressure. Those meeting will be carried out during the end of 2023.



Resultados de la Regresión Lineal Multivariante

Distrito	Predicción de Puntuación de Bienestar	Predicción de Puntuación de Bienestar con campos adicionales
Bellavista - La Palmera	2,0506	2,0426
Casco Antiguo	1,5815	2,3514
Cerro - Amate	2,1031	2,4218
Este - Alcosa - Torreblanca	1,7366	2,7113
Los Remedios	1,6484	1,8096
Macarena	1,4491	2,3119
Nervión	2,0279	2,2477
Norte	1,8508	2,2875
San Pablo - Santa Justa	2,1556	2,2202
Sur	1,7450	2,4415
Triana	1,9627	1,9466



Resultados de la Regresión Lineal Multivariante

Distrito	Predicción de Puntuación de Bienestar	Predicción de Puntuación de Bienestar con campos adicionales
Bellavista - La Palmera	2,0508	2,0339
Casco Antiguo	1,5815	2,3415
Cerro - Amate	2,1024	2,4111
Este - Alcosa - Torreblanca	1,7363	2,6962
Los Remedios	1,6487	1,8072
Macarena	1,4496	2,3016
Nervión	2,0279	2,2395
Norte	1,8519	2,2781
San Pablo - Santa Justa	2,1548	2,2141
Sur	1,7450	2,4328
Triana	1,9635	1,9391

Functionalities of WB platform for managers.

- District representation of Seville Data: The city of Seville will be divided into a discrete representation of districts and overlapped over a real map of the city, including public infrastructures related to wellbeing.
- Data request of each district: Each district will be represented by different social and economic aspects, public infrastructure, and the potential demonstration actions from the CityLoops project.

- Evolution of the well-being indicators: Data about the evolution of the well-being indicators will be represented in a time-lapse, showing in the last frame the estimation in the next years according to the data provided by the manager through the platform.
- Evolution of the circular indicators: Data about the evolution of the circular indicators will be represented in a time-lapse showing in the last frame the estimation in the next years according to the data provided by the manager through the platform.
- Estimation of the well-being CityLoops indicators: Using the data provided by the managers, and the results from the analysis through the ML methods, the platform will present the indicators' values.

Functional Requirements.

This section lists specific functions and object-oriented designs linked to functionalities of the CityLoops platform.

- ORM/SQL database management (included already using Django)
- Machine Learning functionalities: regression, clustering.
- GIS / OpenStreetMap data management.
- Web Apps, Widgets and data visualization.
- Data collection and data analysis.
- PostgreSQL 12.6
- Django 3.2
- OSGeo4W
- Leaflet
- Gdal: (required modules installation: wheel; pipwin; numpy; pandas; shapely; gdal; fiona; pyproj; six; rtree; geopandas)

List of Components of WebApp for Well-being tool (WB)

WB_APP001	**Web Form for Query and Data Collection**
Platform version	Basic User or Citizen
Description	This component of the Cityloops platform for WB is a web form where the citizen or basic user will introduce the parameters of a query to consult wellbeing indicators, circular indicators and composite indicators per district and city. Some fields of these data include postal code, district, street name, etc. Once all the fields of the form are completed, and the button “Show” is pressed, two actions occur. Database of WB generation by districts is updated, and the query is sent to the back-end function, which will provide as answer the wellbeing indicators, circular indicators and composite indicators according to the location of the user”

Input Data and Widgets	Text Edit (Postal Code), Comboboxes (District), Push Button (Search, create the query)
Output / Results	The database of WB by the district will be updated (all the queries will be incorporated in a dedicated database). Once the button is clicked, the wellbeing indicators, circular indicators and composite indicators will be highlighted on a map.

WB_APP002	**Web Form for Query**
Platform version	Basic User or Citizen
Description	This component of the CityLoops platform for WB is a web form where the citizen or basic user will introduce the parameters of a query to see the CityLoops´ demonstration actions deployed and the estimated impact on the indicators. The user will select a district among those in which CityLoops´ demonstration actions are implemented. Once the district is selected, and the button “Show” is pressed, two actions occur. Database of WB generation is updated, and the query is sent to the back-end function, which will provide as answer the location, status, and description of “CityLoops´ demonstration actions”
Input Data and Widgets	Comboboxes (District), Push Button (Show, create the query)
Output / Results	The database of WB by the district will be updated (all the queries will be incorporated in a dedicated database). Once the button is clicked, the “CityLoops´ demonstration actions” will be highlighted on a map and the information on status and impact on indicators

WB _APP003	**OpenStreet Map showing districts highlighted and CityLoops´ demonstration actions**
Platform version	Basic User or Citizen / Manager or Admin
Description	Widget imported from OpenStreetMaps showing a map of Seville City, including some additional layers, such as polygons representing the districts of Seville in terms of administrative divisions and waste generation. Locations of CityLoops´ demonstration actions will be marked in the initial map. Once the query is done and the result of checking the demonstration action is obtained, the related information will be highlighted in the map as well as the district.
Input Data and Widgets	Map imported from OpenStreetMap library. Additional layers added, including district representation, indicators, and demonstration actions

Output / Results	Points and polygons highlighted on the map.

WB_APP004	**OpenStreet Map showing districts highlighted and & indicators**
Platform version	Basic User or Citizen / Manager or Admin
Description	Widget imported from OpenStreetMaps showing a map of Seville City, including some additional layers, such as polygons representing the districts of Seville in terms of administrative divisions and waste generation. Indicators will be marked in the initial map. Once the query is done and the result of checking the selected district is obtained, the indicators will be highlighted in the map as well as the district.
Input Data and Widgets	Map imported from OpenStreetMap library. Additional layers added, including district representation, indicators and demonstration actions
Output / Results	Points and polygons highlighted on the map.

WB_APP005	**Visualisation of demonstration actions Status**
Platform version	Basic User or Citizen / Manager or Admin
Description	This part of the platform for WB will present the status and the expected evolution of the demonstration action and indicators. Once the district is selected in the menu, the corresponding demonstration action will be highlighted in the map of WB_APP002 / WB_APP003 and the status of the action and the related indicators will be presented in the panel
Input Data and Widgets	ComboBox containing the list of actions and indicators to select. Panel with several plots showing the status of the actions and the projection based on past data
Output / Results	Bar Plots with the evolution of the actions and line plots with the projected evolution.

WB_APP006	**Updating data of the demonstration actions and indicators**
Platform version	Manager or Admin

Description	The responsible for the management of this app will collect the information about the status of the indicators measures and will update the corresponding XLSX or CSV file, which will be loaded into the platform. The information about the status of the demonstration actions will be part of the inputs for the decision-making process when recommending a new action to be deployed.
Input Data and Widgets	The input of this data may be done in two possible ways: 1) a table widget within the WB platform or by an external CSV file which will be loaded into the WB platform.
Output / Results	Once the data is loaded (or updated) into the system, the visualisation panel WB_APP5 of the demonstration actions will be refreshed, showing the updated data and a corrected projection.

WB_APP007	**Manually loading data of WB generation by district**
Platform version	Manager or Admin
Description	CityLoops Platform for WB will collect the data (stored in Municipality of Sevilla or Lipasam servers) from the users. This data will include the district name, indicators measure of WB and circularity. However, it may be necessary to complete this data with additional data introduced manually (or corrected).
Input Data and Widgets	Loading CSV or XLSX file or modifying the data directly in the WB platform (this must be decided)
Output / Results	Updated data about WB generated in each district of Seville city.

▪ 3.3.2 Development of city simulation platform, including integration of Seville's other digital tools.

The city simulation platform has been developed by creating an HTML template in which all the interface elements have been included, including header, links to each of the applications and the logos of the companies involved in the development of the application.

In addition, a CSS file has been created to style the elements of the HTML template.

When the user enters the platform, they will see two sections below the page header. The first section presents three buttons (Figure 23). Each button takes the user to one of the application platforms (Construction and Demolition Waste, Organic Waste and Wellbeing).

Below the first section, there is another with the logos of the organisations involved in the application development. When the user clicks each logo, it will take them to the organisation web page.

Figure 6 City Simulation Platform

CITY SIMULATION PLATFORM

A “city simulation” has been performed to estimate the impact of specific actions and policies on specified indicators including an analysis of the current population satisfaction. The digital tools are not only focusing on CDW, but analysis carried out during the inception phase by the City Council of Seville, Emasesa and Lipasam are covering other areas concerning wellbeing and population satisfaction, such as sustainable public transport, management of urban trees, the wastewater management in the urban environment, and the collection of others waste fractions keys to improve the circular economy. These initiatives will be measured and monitored using the digital tools mentioned in order to understand how they impact in the wellbeing of the city and citizens. Based on that, the tools will fuel data driven decision making, where the city can determine and prioritize potential actions to improve wellbeing and population satisfaction as well as the Sustainability Goals. A report will explain how the wellbeing is calculated and how the data can be used for decision making process.

Lessons learned In a society in which inexhaustible amount of information is within reach of a click on your mobile phone, there is a growing need to use different means of dissemination to reach the widest range of people with information that helps make the transition to a circular economy as successful as possible. as realistic as possible. Therefore, the development of IT tools that help municipal managers make decisions is of great help, since they analyse a large amount of data and can advance data analysis and different future scenarios, thanks to the methodologies of Machine Learning. However, deploying these tools with public information for citizens and users of public services not only helps maximize the dissemination of the actions carried out by the municipality in the circular economy, but also contributes to increasing social commitment. of citizens and the increase in the use of services at their disposal. Results showed this increase in the number of visits to the City Simulation platform (more than 60,000 visits) in the last year of the project implementation.
https://wb-app.idener.es/landing

▪ 3.3.3 Report explaining how wellbeing is calculated and how the data can be used for decision making processes.

Wellbeing calculation

This section presents how the well-being value is calculated based on coefficients. This will be done in four steps:

- The first step consists of giving a coefficient to each column category (social, environmental, economic). The sum of this weight should be 1; therefore, a higher weight will represent that wellbeing is favoured by that group of columns. For example, a coefficient of 0.5 for social, 0.2 for environmental, and 0.3 for economic means that the columns within the social category have a greater impact than the economic and environmental categories. The following formula will give the weight of each column.

$$coeff_{social} + coeff_{\text{environmental}} + coeff_{economics} = 1 \qquad (2)$$

- Once this value has been defined, the next step is to give a weight to each column within the category. This weight will be given in a range from 0 to 10, whereby 0 means that it contributes nothing to wellbeing and 10 means that it contributes as much as possible to wellbeing within the weight of this category.

$$\sum_{i=1}^{Nº\ of\ columns} coeff_{col_i} = 1 \qquad (3)$$

$$coeff_{soc\_col_i} = \frac{weight_{col_{social_i}}}{(Nº\ of\ social\ cols)} * coeff_{social} \quad (4)$$

$$coeff_{env\_col_i} = \frac{weight_{col_{env_i}}}{(Nº\ of\ \text{environmental}\ cols)} * coeff_{\text{environmental}} \quad (5)$$

$$coeff_{ecs\_col_i} = \frac{weight_{col_{economics_i}}}{(Nº\ of\ economics\ cols)} * coeff_{economics} \quad (6)$$

Where, $coeff_{soc\_col_i}$, $coeff_{env\_col_i}$, $coeff_{ecs\_col_i}$ are the coefficients that represent the importance of each column in well-being. $weight_{col_{social_i}}$, $weight_{col_{env_i}}$, $weight_{col_{economics_i}}$ are the weights defined by a user/researcher set to each column, ranging from 0 to 10, given the importance of each column based on scientific knowledge. $coeff_{social}$, $coeff_{\text{environmental}}$, $coeff_{economics}$ are another coefficient previously set by the user/researcher that represents the importance that each category affect to wellbeing. In case it is desired that all three categories affect the same, it is only necessary to enter the same value in all three categories.

- Once the coefficients representing the weight of each wellbeing column are obtained, the next step consists of multiplying this coefficient by the corresponding column. The value of this column has been previously normalised between 0 and 1 for columns that have a positive effect and between 0 and -1 for columns that have a negative impact. The following images show the dataset before/after this stage.

poblacion_ini	densidad_ini	poblacion_fin	densidad_fin	Hombres 0-4	Hombres 5-9	Hombres 10-14	Hombres 15-19	Hombres 20-24	Hombres 25-29	...	Mujeres TOTAL	Nucleo familiar con 0 Hijos	Nucleo familiar con 1 Hijos
0.004436	0.001115	0.004505	0.001145	0.010282	0.004779	0.034291	0.010094	0.010021	0.003361	...	0.003502	0.002271	0.000158
0.292211	0.155234	0.283969	0.153669	0.101475	0.134926	0.156627	0.153696	0.162422	0.235714	...	0.314498	0.499148	0.215064
0.421042	0.551409	0.414355	0.551440	0.232007	0.233824	0.221810	0.183002	0.218789	0.337815	...	0.430835	0.810733	0.264803
0.330280	0.650262	0.329715	0.656430	0.244524	0.208456	0.223973	0.210029	0.245929	0.263445	...	0.353773	0.483135	0.217117
0.796346	0.465435	0.801869	0.473183	0.653107	0.646324	0.645042	0.493650	0.722756	0.960924	...	0.810984	1.000000	0.712301

poblacion_ini	densidad_ini	poblacion_fin	densidad_fin	Hombres 0-4	Hombres 5-9	Hombres 10-14	Hombres 15-19	Hombres 20-24	Hombres 25-29	...	Mujeres TOTAL	Nucleo familiar con 0 Hijos	Nucleo familiar con 1 Hijos
0.000028	0.000035	0.000170	0.000072	0.000194	0.000030	0.000216	0.000063	0.000252	0.000021	...	0.000044	0.000043	0.000002
0.001838	0.004882	0.010716	0.009665	0.001915	0.000849	0.000985	0.000967	0.004086	0.001482	...	0.003956	0.009418	0.002705
0.002648	0.017340	0.015636	0.034682	0.004377	0.001471	0.001395	0.001151	0.005504	0.002125	...	0.005419	0.015297	0.003331
0.002077	0.020449	0.012442	0.041285	0.004614	0.001311	0.001409	0.001321	0.006187	0.001657	...	0.004450	0.009116	0.002731
0.005008	0.014636	0.030259	0.029760	0.012323	0.004065	0.004057	0.003105	0.018183	0.006044	...	0.010201	0.018868	0.008960

Figure 7. Dataset before/after of coefficient stage.

- Therefore, the wellbeing will be calculated as the sum of all columns that have been previously multiplied by the coefficient. An example of wellbeing with a random coefficient from 2015 to 2018 is presented in Figure 15.

	distritos	YEAR	Wellbeing
9	BELLAVISTA-LA PALMERA	2015	3.247853
5	TRIANA	2015	2.421800
4	SUR	2015	2.374561
3	CERRO-AMATE	2015	2.345181
7	SAN PABLO-SANTA JUSTA	2015	2.331161
2	NERVION	2015	2.327797
6	MACARENA-NORTE	2015	2.143142
8	ESTE	2015	1.947953
10	LOS REMEDIOS	2015	1.884126
1	MACARENA	2015	1.566865
0	CASCO ANTIGUO	2015	1.211274

distritos	YEAR	Wellbeing
CERRO-AMATE	2016	2.418423
SAN PABLO-SANTA JUSTA	2016	2.258636
TRIANA	2016	2.103519
ESTE	2016	1.971437
LOS REMEDIOS	2016	1.953766
CASCO ANTIGUO	2016	1.844854
SUR	2016	1.652235
BELLAVISTA-LA PALMERA	2016	1.635680
NERVION	2016	1.367414
MACARENA-NORTE	2016	1.358915
MACARENA	2016	0.961728

distritos	YEAR	Wellbeing
NERVION	2017	2.432851
MACARENA-NORTE	2017	2.108742
SAN PABLO-SANTA JUSTA	2017	2.047648
CASCO ANTIGUO	2017	1.972651
BELLAVISTA-LA PALMERA	2017	1.907864
CERRO-AMATE	2017	1.868422
SUR	2017	1.779018
ESTE	2017	1.685382
MACARENA	2017	1.491164
TRIANA	2017	1.456162
LOS REMEDIOS	2017	1.196412

distritos	YEAR	Wellbeing
SAN PABLO-SANTA JUSTA	2018	1.986750
NERVION	2018	1.983555
TRIANA	2018	1.870476
MACARENA-NORTE	2018	1.792111
MACARENA	2018	1.777882
CERRO-AMATE	2018	1.777646
LOS REMEDIOS	2018	1.559152
BELLAVISTA-LA PALMERA	2018	1.411626
ESTE	2018	1.341311
CASCO ANTIGUO	2018	1.297203
SUR	2018	1.174056

2. Figure 8. Well-being examples from 2015 to 2018.

▪ 3.3.4 Testing of the Well-being monitoring tool.

The Well-being monitoring tool was launched before the summer of 2022 after a preliminary testing period by the managers of the Seville cluster. Several modifications have been developed after the preliminary testing process considering the suggestions from the members of the local cluster in Seville. Those modifications have the main objective to increase the user-friendliness of the tool for both managers and citizens.

The use from the citizens is focused on the visualization of the estimated indicators on the economy, social and environmental areas as well as the well-being indicator now. The use of managers is focused on monitoring the evolution of the indicators, increasing the dataset of the tool, and monitoring the predictions of the estimated indicators in future scenarios.

During demonstration action 3, we are implementing different modifications and new functionalities considering the suggestions from the local managers. These modifications and new functionalities are identified below:

- Internationalization: Using the built-in internationalization functionality in Django it was possible to translate the application from English to Spanish. This is done by adding a specific tag in Django's templates wherever a translatable text appears. Then, by using a Django command, the application generates a file for each language implemented with all the translatable text, where the translated text could be entered so the application can replace the original text whenever the app language is changed.

- Footer: A footer was added to the base HTML template to show the partners involved in the application and the H2020 funding statement.

- Hit count: A hit count was added to the application header that indicates the number of times any page of the application has been visited. To do this, the method that registers the visit was added as a "middleware". Middleware methods are executed for every request to the server, so it's totally independent of the page the user is accessing.

- "How we do it" modal in citizen form results: In the results view, an enclosed question mark icon has been added to the end of the "Search results" title. When clicking said icon, a modal appears with an explanation of the methodology used to get the results. The modal is shown using the Bootstrap library.

- Added graphs with Wellbeing scores from previous years in citizen form: After a correct form submission from the user in the citizen form, the page displays several graphs representing waste collection from previous years. This was implemented using the chart.js library. Chart.js is a JavaScript library used to represent graphs.

- Highlighting selected districts in citizen form results: Whenever the user shows the information of a district in the results view, the district is highlighted in the map. This has been done using the “show.bs.collapse” JavaScript event provided by the Bootstrap library.

- Improved ML output (tables, graphs, WB score by district): A new table has been added to the ML result view, where WB scores are displayed next to its corresponding district.

- Added custom fields to ML form: The user can now add custom fields to the ML operation. This has been done using JavaScript to add/remove the inputs for each custom field and retrieving the fields in the backend from the POST request directly.

▪ 3.3.5 Development of best practice guidelines for waste management based on the experience of CityLoops demonstrations and analysed data.

According to the results analysis of the demonstration actions in CityLoops project, Emasesa in collaboration with Lipasam and the municipality have developed a best practice guideline. The main aim of this guidelines is to standardise the CDW management in the maintenance work of the pipelines’ infrastructure. The gained knowledge and lessons learned suggested that a new business model on CDW management could be built in the midterm, so CityLoops local consortium considered set standard steps in order to facilitate the new business model through the privet sector. You can consult the guideline in Annex VII.

▪ 3.3.6 Analysis of incorporation of learnings into new Waste Management Plan for the municipality

CityLoops project is helping Seville to progress towards becoming a more circular city, in line with the declaration that the city itself led in 2017, together with more than 200 municipalities in Spain, which underlines the importance of Local Governments to be committed, as well as their need to implement the Circular Economy. Gained experiences, results and demonstration actions contribute to the development of the Local waste prevention and management Plan of Seville (currently in draft status).

4. Results

4.1 Summary

The results from the demonstration actions in Seville under the CityLoops project implementation have a small area of influence derived directly from the demonstration actions. This is due to relatively few changes that could be achieved in the decision-making practices in a municipality like Seville municipality with around 700,000 inhabitants. However, the demonstration actions served as a critical platform for demonstrating that collaboration between different municipal companies i.e., Emasesa and Lipasam with private companies like Idener as well as with the municipality has resulted in research actions, developing circular instruments and tools which increased the circularity in the CDW management in both significant areas for the city water infrastructure maintenance and municipal waste management. A main result of the demonstration actions was the clarification of some changes needed to move from a linear to a circular approach for municipal areas.

The circular CDW management has been identified as a critical management area in the city of Seville and CityLoops was recognised as a significant contribution to the analysis and design of the roadmap for implementing the circular economy approach in the CDW as well as other municipal waste management in the municipal companies.

The city of Seville signed the European Circular Cities Declaration proposed by ICLEI in October 2020. The Declaration was launched at the 9th European Conference on Sustainable Cities & Towns – Mannheim2020, at the policy panel Circular Economy in Cities. The city of Seville committed to identifying circular targets, implementing a circular economy approach into decision-making, promoting the circular economy in procurement, and reporting on progress to the ICLEI (Network of Local Governments for Sustainability).

The demonstration actions in Seville under the CityLoops project implementation have contributed environmental and procurement programs of the municipal companies providing comments and suggestions to the Environmental and procurement departments.

The CityLoops project implementation has strengthened the know-how in circular waste management issues within municipal companies. The results and suggestions from the Seville team have served as a catalyst to generalise the inclusion of circular clauses in the procurement of Emasesa and to reduce the illegal CDW dumping increasing the awareness commitment of Lipasam increasing the visualisation and information of the Clean points.

The experience from demonstration actions in Seville has shown that there is a need for development in Seville's tendering practices so that procurement can promote a circular economy approach. Currently, the benchmark for tendering is a balanced price/quality. Legislation approved by the public authorities enhances in the first place the minimization and reuse of CDW, in the second place the production of recycled aggregates through the use of authorized treatment plants, and in the third place the valorisation of those wastes that are not suitable for recycling, it must be always considered as a last option its elimination in an authorized landfill. However, in Spain, CDWs are being treated inappropriately. Project designers and construction managers do not consider in most cases the recycled aggregates of CDW as valid materials for new constructions, the main reason for this besides the lack of

legal regulations, is the scarce knowledge of recycled aggregates and their use as granular layers in pavements and as recycled sand in pipelines.

CityLoops demonstration actions in Seville have promoted the generalized inclusion of the circular clause for the circular CDW management in the procurement of Emasesa maintenance works and in the development of a quality assessment tool for the use of CDW as recycled aggregates in water and sewage infrastructures.

As a main output of the CityLoops project, new best practices guidelines have been drawn up to promote the circular economy in CDW management. The best practices propose new qualitative requirements, standards and incentives to promote a circular economy approach.

Overall, nine workshops and seminars/webinars have been organized by the CityLoops Seville Team for the decision-makers, procurement personnel, and other stakeholders of the construction- and demolition sector in Seville. In those workshops, the participants developed ideas and solutions for better upcycling of circular CDW management.

4.2 Impacts

The impacts of the demonstration actions have been evaluated considering the selected indicators in the Evaluation Plan. The demonstration action 1 has enabled the CDW circular management in the maintenance work in Emasesa as well as increase the monitoring of the use CDW as recycled aggregates in the sub-base of their construction works. The quality and standards requirements like were analysed according to the Instrument made by Emasesa. Based on lessons learned from the demonstration actions, a fruitful discussion has been made, which resulted in the development of a best practices guidelines.

New IT tools have been developed to promote the circular economy in the decision-making process in the municipal companies and to increase the visibility of the circular actions as well as awareness on citizens. An IT tool on the optimisation of CDW flow has been developed and lunched to increase the visibility and use of the Clean points by citizens as well as support the awareness campaign to reducing the illegal CDW dumping. Additionally, this IT tool has been tested by Lipasam as Waste managers in order to enable the decision-making process on future scenarios in the Clean points requirements. Another IT tool has been also developed under the demonstration actions, a wellbeing monitoring tool has been lunched to increase the dissemination of the different indicators of wellbeing (social, economic and environmental indicators) show the city according to the dataset provided by the municipality of Seville and their public companies. Additionally, this IT tool has been tested by Lipasam, Emasesa and the municipality of Seville as municipal managers in order to enable the decision-making process on future scenarios to increase the circularity of the city and the set of indicators to consider measuring the wellbeing of the citizens.

The selected indicators are presented in the next tables. The planned outcomes and their interim review are summarized in the following tables.

Table 1. Impacts of demonstration action 1

Planned Outcome 1: Strengthened awareness and knowledge of the improvement of CDW management among the main stakeholders and other socio-economic agents related to the bases of the circular economy.		
Indicator	**Baseline result**	**Final result**
CE-related knowledge building campaigns: Qualitative description.	0	4
CE-related knowledge building campaigns: Impact	0	4
Circularity-related stakeholder activities	- Personalized emailing explaining project and purpose of the workshop. No. of people reached: 11. - Individual phone calls and snowball sampling: No. of people reached: 11. - First round of preparation meeting for workshops: No. of people reached: 11. - Workshop: No. of people reached: 14.	4
Communication measures on circular transformations and waste prevention	0	4
Outcome review *Assessment results including reasons for not reaching or exceeding planned outcome* Outcome achieved. A broad range of stakeholder outreach activities has been carried out in accordance with the plan.		

Planned Outcome 2: Increased share of “circular” indicators and specifications in tender documents and contracts.		
Indicator	**Baseline result**	**Final result**
CityLoops indicators used in procurement tenders and contracts	0	1

Outcome review

Assessment results including reasons for not reaching or exceeding planned outcome

Outcome reached. Previously tenders in Emasesa were mostly awarded based on the optimal balance price/quality. In the demonstration action, circularity criteria were included in all tenders.

Planned Outcome 3: Increased use of recycled CDW by construction companies in the City.

Indicator	Baseline result	Final result
Number of tenders submitted by companies offering the use of recycled CDW	12	368

Outcome review

Assessment results including reasons for not reaching or exceeding planned outcome

Outcome reached. Previously tenders in Emasesa were mostly awarded based on the optimal balance price/quality. In the demonstration action, circularity criteria were included in all tenders.

Planned Outcome 4: Increased amount of CDW that is prepared for recovery/recycling, and therefore reduced amount of material that is deposited in landfills, in accordance with Directive 851/2018 and 850/2018.

Indicator	Baseline result	Final result
Quantity of material subjected to recycling	20 Tn/year	21 Tn/year
Landfilling rate	68%	65%

Outcome review

Assessment results including reasons for not reaching or exceeding planned outcome

Outcome reached. In the demonstration action, circularity criteria were included in all tenders. Additionally, the contracted company should show at the end of the demolition and construction work an environmental report which is contemplated to specify the waste management done.

Planned Outcome 5: Increased amount of recycled materials used in the construction projects, compared to similar construction projects.

Indicator	Baseline result	Final result
Number of projects that implement CDW valorisation	0	2
Outcome review *Assessment results including reasons for not reaching or exceeding planned outcome* Outcome reached. In the demonstration action, circularity criteria were included in all tenders. Results show an increase in the companies that offer the valorisation and use of CDW in their demolition and construction works.		

Planned Outcome 6: Increased amount of soil reuse.		
Indicator	**Baseline result**	**Final result**
Number of projects that implement reused soil	0	2
Outcome review *Assessment results including reasons for not reaching or exceeding planned outcome* Outcome reached. In the demonstration action, circularity criteria were included in all tenders. Results show soil produced during the demolitions phase and it was re-used in the construction phase.		

Planned Outcome 7: Reduced use of virgin materials.		
Indicator	**Baseline result**	**Final result**
Share of local secondary materials in domestic material consumption	0	3,235 Tn
Outcome review *Assessment results including reasons for not reaching or exceeding planned outcome* Outcome reached. In the demonstration action, circularity criteria were included in all tenders. Results show an increase in the companies that offer the valorisation and use of CDW in their demolition and construction works. This way the use was reduced in the demonstration actions.		

Table 2. Impacts of demonstration action 2

Planned Outcome 1: Increased knowledge of CDW management among citizens and small producers.

Indicator	Baseline result	Final result
Communication measures on circular transformations and waste prevention	0	1 Action: Installation of 15 billboards in areas where they are repeatedly abandoned CDW.
Outcome review *Assessment results including reasons for not reaching or exceeding planned outcome* Outcome achieved. A broad range of stakeholder outreach activities has been carried out in accordance with the plan. Additionally, an awareness campaign and the CDW flow optimization tool were launched.		

Planned Outcome 2: Increased use of clean points for CDW management by citizens and small producers.		
Indicator	**Baseline result**	**Final result**
Number of visits to the clean points	254,544 users	268,504 users
Outcome review *Assessment results including reasons for not reaching or exceeding planned outcome* Outcome reached. Results show an increase in the number of users in the Clean points. From 254,544 users in 2019 to 268,504 users in 2021. +5.5%.		

Planned Outcome 3: Increased amount of CDW managed through the clean points by citizens and small producers.		
Indicator	**Baseline result**	**Final result**
Amount of CDW collected at the clean points	25,774 tons	27,914.52 tons
Outcome review *Assessment results including reasons for not reaching or exceeding planned outcome* Outcome reached. Results show an increase in the number of users in the Clean points as well as the amount of CDW. From 25,774 tons in 2019 to 27,914.52 tons in 2021. +8.3%.		

Planned Outcome 4: Reduced illegal dumping and landfilling of CDW in the city.		
Indicator	**Baseline result**	**Final result**

Assessment of illegal dumping sites	0 (visual estimation by technicians)	Results show a slight reduction in the illegal CDW managed in the parcel selected in the project (visual estimation by technicians)
Outcome review *Assessment results including reasons for not reaching or exceeding planned outcome* Outcome reached. Results show a reduction in the illegal CDW managed in the identified places in which the awareness campaign has been installed.		

Table 3. Impacts of demonstration action 3

Planned Outcome 1: Increased interest in the guidelines and tools among public companies and other stakeholders.		
Indicator	**Baseline result**	**Final result**
Circularity-related stakeholder activities	0	4
Outcome review *Assessment results including reasons for not reaching or exceeding planned outcome* Outcome achieved. A broad range of stakeholder outreach activities has been carried out in accordance with the plan.		

Planned Outcome 2: Increased participation of stakeholders in the assessment of the guidelines.		
Indicator	**Baseline result**	**Final result**
Number of external agents who express interest in guideline assessment	0	3
Outcome review *Assessment results including reasons for not reaching or exceeding planned outcome* Outcome achieved. A broad range of stakeholder outreach activities has been carried out in accordance with the plan.		

Planned Outcome 3: Increased commitment of citizens to circularity.

Indicator	Baseline result	Final result
Number of visits to the applications	0	13390 visits
Outcome review *Assessment results including reasons for not reaching or exceeding planned outcome* Outcome reached. Results show an increased interest and commitment according to the number of visits to the IT tools.		

Planned Outcome 4: Increased amount of recycled CDW.		
Indicator	**Baseline result**	**Final result**
Amount of recycled CDW from large producers	0	4,912,000 kg
Outcome review *Assessment results including reasons for not reaching or exceeding planned outcome* Outcome reached. In the demonstration action, circularity criteria were included in all tenders. Results show an increase in the companies that offer the valorisation and use of CDW in their demolition and construction works.		

Planned Outcome 5: Increase in initiatives on circular CDW management.		
Indicator	**Baseline result**	**Final result**
Number of companies implementing CDW valorisation measures	0	3
Outcome review *Assessment results including reasons for not reaching or exceeding planned outcome* Outcome reached. In the demonstration action, circularity criteria were included in all tenders. Results show an increase in the companies that offer the valorisation and use of CDW in their demolition and construction works.		

4.3 Economic Analysis

4.3.1 Economic assessment of demonstration

Demo action 1: Renovation of water pipelines with circular material management

Demonstrative Place 1 (Proceeding Nº 061/21): Project for the conditioning and improvement of the supply and sanitation networks of Corral de la Caridad Street, in the Pino Montano neighbourhood. North District, Seville.

The total budget for this work was € 665,950.62, in the paving stage, the budget was € 202,059.48. The waste management accounted for a total of € 24,124.34, including the CDW valorisation commitment. The waste management costs accounted for about 3.62 % of the contract amount. The unit price for the natural material used in the sub-base in the paving stage is € 5.50 while the unitary price for the artificial aggregates (valorised CDW) is € 13.62. In this work, a total amount of 991.95 m^3 of natural material was used while 378.83 m^3 of artificial aggregates. Thus, € 12,568.01 and € 11,558.10 were spent using natural material and valorised CDW as sub-base in the paving stage, respectively.

Demonstrative Place 2 (Proceeding Nº 250/20): Project to improve sanitation networks in the Tablaba Industrial Sector. Los Remedios District, Seville.

The total budget for this work was € 1,098,737.33, in the paving stage, the budget was € 171,632.27. The waste management accounted for a total of € 37,910.42, including the CDW valorisation commitment. The waste management costs accounted for about 3.45 % of the contract amount. The unit price for the natural material used in the sub-base in the paving stage is € 5.50 while the unitary price for the artificial aggregates (valorised CDW) is € 13.62. In this work, a total amount of 1,663.00 m^3 of natural material was used while 1,105.00 m^3 of artificial aggregates. Thus, € 12,294.77 and € 18,667.50 were spent using natural material and valorised CDW as sub-base in the paving stage, respectively.

Demo action 2: Optimising clean points

The CWD flow optimization tool: The total budget to develop the IT tool was € 30,000.00, this amount was split into the following areas of development i.e., design and plan of the required functionalities and interface; description of the technical specifications; functionalities development; required data identification, collection, and dataset development; and the interface development. The following table summarises the cost for each area of development.

Area of development	Cost (€)
Design and plan of the required functionalities and interface	5,000.00
Description of the technical specifications	4,000.00
Functionalities development	8,000.00
Required data identification, collection, and dataset development	3,000.00
Interface development	10,000.00
Total Cost of IT tool development	30,000.00

Communication campaign for the prevention of illegal dumping: The communication and information action in areas where CDW is dumped illegally has been subcontracted. The aim of this action is about warning of such non-compliance and explain the alternatives to properly manage this type of waste. In the action were contemplated the following concepts:

- Creativity for the campaign “Illegal dumping areas”.
- Design and production of 15 posters
- Creation and dissemination of online campaign in the areas of interest for 1 year (with three waves of 1 month each)
- 2-minute video report.

The external cost of this action was around € 9,000.

Demo action 3: Data driven decision making and Best Practice Guidelines for CDW Management in Seville

The Well-being monitoring tool & City platform: The total budget to develop the IT tool was € 36,000.00, this amount was split into the following areas of development i.e., design and plan of the required functionalities and interface; description of the technical specifications; functionalities development; required data identification, collection, and dataset development; and the interface development. The following table summarises the cost for each area of development.

Area of development	Cost (€)
Design and plan of the required functionalities and interface	6,000.00
Description of the technical specifications	4,000.00
Functionalities development	8,000.00
Required data identification, collection, and dataset development	3,000.00
Interface development	15,000.00
Total Cost of IT tool development	36,000.00

4.3.2 Business case

Recycling of CDW to artificial aggregate production

The current situation of the business case in Seville is defined by a short value chain structure with a few agents focused on CDW valorisation. No more than 2-3 agents centralize most of the CDW valorisation flows. Additionally, the prices of the natural aggregates are less than half in comparison with the artificial aggregates (vaporized CDW) i.e., 5.50 €/m^3 and 13.62 €/m^3, respectively. Thus, there is limited interest in the use of artificial aggregates (valorised CDW) by the most of constructors. However, circular initiatives like procurement in Emasesa in their maintenance water pipeline work or the circular CDW management by Lipasam could help and increase the private interest in the main actors of the value chain. In fact, the stakeholder engagement strategy made during CityLoops implementation showed interest in some of the main constructors to adapt their work including CDW valorisation.

However, the economic feasibility is not even considered attractive or acceptable unless the CDW valorisation gives them the contract as in the procurement made by Emasesa. But in those cases, the quantity of artificial aggregates is balanced in order to contain the excess cost. So, adopting circular criteria in tendering demolition projects not only in Emasesa but also in other municipal companies and upscaling all demolition works planned in Seville could increase the collection of CDW for recycling, the focused agents on CDW valorisation as well as competence and thus could be the key to changing the balance in favour of recycled aggregates. Also, a gate fee for the collection of the CDW could stimulate the recycling business concept.

Optimising clean points

The improvement in CDW management, in addition to providing new market opportunities, brings with it environmental, social and economic benefits that affect the interests of society as a whole, as is the case of minimizing abandoned CDW in urban areas and promoting and optimize the management of this waste through clean points. In Seville there are still areas where waste is abandoned, being construction and demolition waste (CDW) from minor construction works at households frequent in these areas.

Among the environmental and social impacts that this causes, it is worth highlighting the contamination of soils and aquifers in areas of uncontrolled dumping, landscape deterioration, degradation of the urban areas, citizen unrest and the elimination of this waste without taking advantage of its valuable resources. In accordance with Spanish legislation (Law 7/2022, of April 8, on waste and contaminated soil for a circular economy), construction and demolition waste is not considered municipal waste, so in theory, it would not what to be managed through this flow, although it allows municipalities to decide, if the amounts can be assimilated to domestic waste, to be able to manage them through municipal resources, as is the case of the network of Clean Points (civic amenity sites of each city), being the case of Seville.

Moreover, whether CDW is abandoned in public areas, its removal must be carried out by the Municipality, being the case of Seville, LIPASAM, the municipal waste management company that belong to the city council of Seville. This fact supposes an important economic effort, added to the previous impacts.

The network of Clean Points of Seville (civic amenity sites) is created and promoted as a measure to optimize the collection and management of this kind of waste, thus avoiding its abandonment, minimizing the environmental, social, and economic impacts that this causes, passing from a dispersed collection, to a centralized and ordered one. Currently, the use of Clean Points is free for users, establishing a limit on the amount of waste to be deposited per user, clean point, and day (15 bags).

One of the ways to optimize the CDW collection from minor construction works is through in the Clean Points, also trying to maximize the performance of these facilities. In practice, this means that efforts must be made to drive and pull the management of this kind of waste through these facilities, in a centralized manner, and to minimize scattered collection in uncontrolled areas. Centralized collection through clean points means saves in terms of resources (personal and economic). Instead of having several teams of people assigned to collect CDW abandoned, scattered throughout the city, which is quite expensive, in this case we have a facility where the users themselves transport their CDW there, which means less logistics for waste collection services, less emissions, etc. In addition, from a point of view of waste valorization, through the clean point, an adequate segregation of the same is ensured, which is destined for recycling and/or use as filling in degraded soils, instead of its disposal in a landfill.

Through the promotion of the use of clean points, in addition to these benefits, it means that the flows of this waste do not end up on public areas, which means an improvement of the urban areas at an environmental and social level.

The promotion of the use of clean points for the deposit of CDW results in an improvement in the optimization of resources for the local management of this waste. Through the actions to try to minimize the abandonment of waste (based on communication, inspection, etc.), in parallel, the use of clean is promoted, where a deposit and adequate management of the CDW is ensured.

The abandonment of CDW supposes the collection from scattered points of the city, which supposes a greater consume of resources (personnel and machinery) compared to the management through clean points. It is estimated that in economic terms, the collection of abandoned CDW is **3.7 times** more expensive, per ton of CDW, than its equivalent in clean points. This means that there is a wide margin of improvement for cost optimization.

In terms of CO_2 emissions in logistics (movement of machinery for cleaning uncontrolled dumps, and transport to the treatment plant), the collection of abandoned CDW represents **62% more** CO_2 emissions per ton of CDW (For this estimation, emissions from the waste treatment are not considered, because of both collection options are managed in the same manner, through recycling and use to fill degraded land.

Likewise, other actions, analysis and decision making can result in the improvement in the use of resources for the management of this waste through clean points, either by organizational changes, search for new treatment points closer to the origin and/or the expansion of the network of clean points in the city, to provide greater coverage.

The effort to drive the flow of CDW waste that is abandoned, instead of being deposited in clean points, brings with it other benefits such as an improvement of urban areas in social, landscape and environmental hygiene terms and lower energy consumption in logistics (transport and other waste management operations). Finally, greater control in the segregation and deposit of CDW can help to study new applications of this waste after its treatment, due to a higher quality and purity of each of the fractions that are contained in the CDW.

FERMOVERT oversees the transformation and selling of CDW in Seville. Potential valorisation options to reduce the landfilling of CDW will be evaluated, considering the placement of treatment plants. This will also define the characteristics that such CDW must fulfil to be used in construction works. A business case will be prepared according to the template prepared in CityLoops, e.g., assessing the possibility of reusing CDW as filling elements in EMASESA's construction works.

5. Conclusions

○ 5.1 Lessons learned

The main challenge in municipal procurement in Seville is to change the current practice in which the price is the main tendering criterion to add a circular criterion valorising the produced CDW. Emasesa the municipal company on water and wastewater management has gone from including the circular criterion in the 23.53% of the procurements (before CityLoops implementation) to 100% in the procurements currently (at the end of the implementation period). This positive evolution including circular criterion has been possible thanks to the interest shown by the local stakeholders in the engagement strategy carried out among workshops, and Collaborative Learning Networks meetings under the CityLoops project. This increasing interest could be checked by the percentage of the offers submitted in the tendering processes during CityLoops implementation which has gone from 98% to 100%. Although it may seem like an insignificant increase, it must be considered that it has gone from 25% of tenders that include the circular clause to 100% and that makes a significant increase.

The rising awareness of the circular economy concept is a major driving force for establishing and operating clean points. This awareness is driven by the limited availability of landfills and the legal ban on landfilling less than 10% of waste collected by 2030.

Actions to reduce uncontrolled CDW abandonment (communication and inspection mainly) and the concept of the clean point are applicable to all municipalities, cities, or countries. The implementation of clean points in cities can be limited due to space constraints. Recyclability also depends on available markets for the ulterior use of the product obtained under this process. In addition, the implementation of this tool could be strongly supported by other instruments such as the pay-as-you-throw system or incentives for a "strong" environmental awareness due to the use of segregation mechanisms (such as clean points) instead of mixed waste disposal.

Some lessons learned about the experience of managing clean points and implementing actions against CDW abandonment are:

- Distributed presence of clean points around the city.
- Separate collection of as many fractions as possible and the possibility to drop off professional CDW, under the limits established.
- Training of the staff of clean points to maximize CDW recycling and appropriate management.
- Proximity of the sites to citizens (e.g., easily accessible with a car and nearby to residential areas).
- Long opening hours to enhance convenience for citizens.
- Regular inspection of “frequent” areas where waste is abandoned.
- Try to implicate the neighbourhood of the surrounding areas.
- Inform recurrently about possible sanctions for CDW abandonment.
- Maximise the divulgation of CDW collection service and facilitate users' actual information of the clean points (IT tool).
- Optimise the infrastructure and facilities according to actual requirements (including machine learning methodology to analyse available data).
- IT tools could increase the users' commitment, 6,824 visits to the tool in the last 12 months.

There are a lot of socio-economic and environmental indicators related with the wellbeing in a city. A good understanding about the impact of those indicators in the wellbeing can facilitate the transition to a circular economy. Further analysis and a frequent update of the dataset as well as the selected indicators is required in order to help in the decision-making process on circular economy and required mechanisms. In the implementation phase of the demonstration actions, Emasesa and Lipasam set a target in their Strategy to enable the transition to a circular economy focused on the circular management of CDW as well as to minimise the illegal dumping of CDW. Good monitoring of the implementation actions made during CityLoops implementation as well as keeping fluent communication with the other municipal companies of the municipality as well as private stakeholders will allow to scale up the circular economy approach in the city. From results, it has been highlighted that the municipal waste management as well as the house renting pressure in the city have critical impact in the wellbeing of citizens. For this reason, in September of 2023 Lipasam will stablish specific meetings with different associations a municipal stakeholder in order to adapt the municipal waste collection service in those districts with higher house rent pressure. Finally, CityLoops results contribute to the development of the Local waste prevention and management Plan of Seville (currently in draft status).

In a society in which inexhaustible amount of information is within reach of a click on your mobile phone, there is a growing need to use different means of dissemination to reach the widest range of people with information that helps make the transition to a circular economy as successful as possible. Therefore, the development of IT tools that help municipal managers makes decisions is of great help since they analyse a large amount of data and can advance data analysis and different future scenarios, thanks to the methodologies of Machine Learning. However, deploying these tools with public information for citizens and users of public services not only helps maximize the dissemination of the actions carried out by the municipality in the circular economy but also contributes to increasing the social commitment of citizens and the increase in the use of services at their disposal. Results showed this increase in the number of visits to the IT tools i.e., 6,877 visits (CDW optimisation tool) and 7,824 visits (WB tool) in the last year of the project implementation.

5.1.1 Stakeholder engagement

The main lesson learned from stakeholder engagement has been that a significant change in a city like Seville i.e., a municipality that manages around 700,000 inhabitants takes a long time, needs the

commitment of all the municipal companies as well as has to be backed up by political leaders and leading civil servants. The local Seville cluster prepared the CityLoops involvement with the participation of two municipal companies i.e., Lipasam and Emasesa with the coordination of the municipality and the collaboration of a private company. This means that the demonstration actions planned for the CityLoops implementation were focused on the development area of these two municipal companies and so, a more general ambition was lacking. CityLoops project has allowed the development of several demonstration actions on circular economy in parallel, additionally, it is known that other municipal companies have been involved in other approaches testing and demonstrating the circular economy approach. However, a common strategy is needed in order to optimize the local resources which could increase and strengthen the private engagement in a holistic approach emphasizing the critical role that the private sector held in the circular CDW management. The interest observed in the engagement activities done in CityLoops as well as the business promotion that Seville shows has attracted enough companies from the private sector that makes it desirable to scale up these practices in other municipal areas.

5.1.2 Procurement

The main challenge on procurement was that the CityLoops managers from Lipasam and Emasesa are not decision-makers in the Seville municipality nor other municipal companies' procurement processes. Those managers have collaborated with their internal procurement departments and have provided advice to the procurement units of the municipality, but final decisions are out of their scope. The planned actions for the CityLoops project were focused on these two municipal companies in order to scale up the circular criterion on Emasesa's tendering and reduce the illegal CDW dumping managed by Lipasam. The discussion on the technical changes in the procurement practices with the other municipal companies and stakeholders was just started with CityLoops project implementation, so the implementation into their procurement process, even after receiving good feedback, is up to their own. The main lesson learned has been that an organizational change has to be designed at the strategic level. Policy decision-makers have the position to set clearly defined circularity criteria and monitor their implementation. The work started with CityLoops will contribute to enhancing collaborative connexions and support circular approach in all the municipal companies.

The CityLoops team from Seville suggests several practice changes:

- Plannification: Apply measures to minimize waste generation; promote training for the handling and maintenance of machinery transport of soil and debris; and collect in the Waste Management Study the possibility of on-site recycling whenever the conditions allow it.
- Classification/segregation at work: Separate the typology of non-hazardous waste from 1m3 in inert or stony, and the rest of non-hazardous waste; when this is not possible due to limited space, such a separation has to be made by an authorized manager which delivers the documentation that demonstrates the separation; If the separation is made on site, these will be stored in suitable containers, duly protected marked; verify that no other waste is dumpy outside the work; comply municipal regulations; the collection of waste from the root zone should be avoided; the storage time should be less than 2 years; the storage and collection of soil should be located in suitable areas avoiding risks like direct pressure or overload; and don't accumulate soil in the edge of trenches.
- Cleaning: Maintain order and cleanliness in the work for both supplied material and waste and avoid dragging waste or materials into the excavation area or to the drained works.
- Reuse of materials on site: try to reuse all possible materials e.g., paving stones the pavements.
- Recycling of materials on site: Recycle inert or stone material by mobile machinery by Authorized Manager.
- Valorisation of soil from excavation: Promote the valorisation of clean excavation soil for reuse in works as raw material.

- CDW transport: Signpost access area and route within the work to avoid unnecessary travels; that container should always be covered with a tarpaulin to avoid dust propagation; and debris will not exceed the side closures of the containers.

5.1.3 Organisational changes

Policy decisions are needed to uniform procurement strategies and CDW circular management. In this way, the municipality and all municipal companies could implement common goals on circular economy that maximise the impact of circular procurement as well as CDW circular management and strengthen the CDW recycling business concept.

Fluent communication and coordination are required between the municipal companies and the municipality. Standardisation of the minimum requirements in procurement with an evaluation team that studies in-deep case by case could enhance a sound replication and/or scale-up of the demonstration actions carried out during the CityLoops project implementation.

5.1.4 Data collection and monitoring

Demonstration actions under the Emasesa water pipelines maintenance and renovation works pointed out the development requirements in the data management of construction and demolition materials and procurement monitoring. CDW estimation are collected in all works both in the work implementation memory and waste management plan. However, these data are rarely used in the decision-making process. Additionally, the amount of produced CDW is collected but transporting and final manage of CDW is currently no specify. The demonstration actions under CityLoops observed that produced CDW was manage by the authorized managers with the CDW valorisation as main commitment. Therefore, data management still needs to be developed in order to maximise their use and impact in the circularity evaluation implementing this analysis in the decision-making process.

Demonstration actions related to the IT tools development needed deep searching work on data collection. Data collected was mainly found in the municipal annual memories as well as waste data were collected from Lipasam. Datasets have been developed with collected data in order to develop the different functionalities of the IT tools. During the implementation phase, local managers tested new data in these datasets, and it is expected that local managers increase the amount of data in datasets in order to increase the accuracy of the IT tools and gain more functionalities.

Regarding the demonstration action focused on the clean points, one of the challenges related to data collection has been the carrying out surveys to find out the origin of the CDW, if the user was a professional/citizen, etc.

To facilitate and encourage the carrying out of surveys, they were carried out by hand, which has entailed significant subsequent work to digitize the results. Likewise, during the conduct of the survey itself, some users were suspicious of the reason for the said survey. In order to resolve this, the reasons were explicitly stated in the own sheet.

The civic amenity site operator recorded the responses to each of the surveys. It would be interesting to include this type of question in the daily operations of the civic amenity sites, and for these to be recorded directly by the operator using digital resources, such as tablets, in order to facilitate the subsequent data processing.

5.2 Future perspectives

The gained knowledge throughout demonstration actions made under the CityLoops implementation period has produced the development of best practices guidelines which will be implemented into the internal practices both in Emasesa and Lipasam. The assessment of the potential changes from a linear economy to a circular economy approach is under discussion in the municipality. So, the best practices guidelines, as well as the gained knowledge thanks to the demonstration actions made under the CityLoops project implementation, should help to identify the potential improvement of the CDW valorisation as a common goal for all the municipal companies which additionally could act as the catalysts for the development of the CDW valorisation business model promoting the use of recycled aggregates to replace natural aggregates. Finally, a focus meeting has been arranged with the regional government due to the interest generated by the demonstration actions carried out in the implementation period in order to discuss and search for potential replications at the regional scale, this meeting was held in the municipality facilities in May 2023.

5.3 Assessment of replicability/recommendations

The transition to a circular economy approach in a city takes a long time, needs the commitment of all the municipal companies as well as has to be backed up by the political leaders and leading civil servants. A common strategy is needed to strengthen the collaboration public-private engagement in a circular economy approach emphasizing circular CDW management. Policy decision-makers have the position to set clearly defined circularity criteria and monitor their implementation. Policy decisions are needed to uniform procurement strategies and CDW circular management. In this way, the municipality and all municipal companies could implement common goals on circular economy that maximise the impact of circular procurement as well as CDW circular management and strengthen the CDW recycling business concept. Standardisation of the minimum requirements in procurement with an evaluation team that studies in-deep case by case could enhance a sound replication of the demonstration actions carried out under the CityLoops project implementation.

Instrument and IT tools developed and tested under the CityLoops project in Seville can be replicated in other cities. The Quality Assessment Tool is a useful instrument to check the potential use of the CDW as artificial aggregates in the sub-base of roads and pavements whatever the origin of the CDW. So, Seville CityLoops team highly recommends considering the instrument and guidelines for monitoring and managing not only the use of artificial aggregates on the pavement work of water pipelines substitution but also in any kind of work that need pavement.

CDW flow optimisation tool and well-being tool are useful tools for replication, although good practices are live documents that continuously growing with the gained experience and knowledge. The CDW flow optimisation tool is a good support in the management of the clean points considering their simulation into the decision-making process and a good way to maximise their use by citizens and small CDW producers. The tool was already replicated to manage and increase the use of eco-points disseminate by all the city to manage other kind of waste out of the usual municipal waste. Finally, the well-being monitoring tool is a good support to consider their simulations into the decision-making process implementing circular economy activities in the city (in the planning stage) and a good way to maximise the citizens' knowledge and commitment on circularity and other kind of sustainable activities planned along the city.

6. Annexes

ANNEX I. ENVIRONMENTAL CRITERIA IN THE TENDERING PROCEDURE (EMASESA).

PLIEGO DE CLÁUSULAS ADMINISTRATIVAS PARTICULARES PARA EL PROYECTO DE SUSTITUCIÓN DE LAS REDES DE ABASTECIMIENTO Y SANEAMIENTO DE LA CALLE MARÍA AUXILIADORA, POR CONSERVACIÓN, ACTUACIÓN LR-02, 1ª FASE, DEL PLAN DIRECTOR DE LA RINCONADA (SEVILLA).
Nº EXPTE. 071/21

En caso de ofertar este criterio, los licitadores deberán indicar en su oferta (conforme al modelo del anexo 3 del PCAP) que se comprometen a su contratación en caso de resultar adjudicatarios, aportando copia del certificado de demandante de empleo donde se acredite que se encuentra en dicha circunstancia por el periodo indicado en el párrafo anterior, sin perjuicio de que además deberán incluir a esta persona en la Tabla 1 del Anexo 1 del PPTP cuando ésta les sea solicitada, todo ello conforme se explica en los apartados 25.1.11 y 26.6.4 siguientes. La efectiva contratación de esta persona se deberá realizar en caso de resultar adjudicatario, por lo que tras la correspondiente notificación de la adjudicación deberá acreditarse su alta en la Seguridad Social y en todo caso antes de la formalización del acta de replanteo.

2. CRITERIO MEDIOAMBIENTAL

2.1 Empleo de Áridos reciclados: 4 puntos

Se valorará con cuatro (4) puntos el empleo de áridos reciclados en las unidades de bases y/o subbases de los pavimentos proyectados. Las nuevas unidades no supondrán, en ningún caso, una modificación presupuestaria a la obra.

Dichos áridos cumplirá lo exigido en PG3 en su artículo 510. Según el artículo 510.2.2.1 del PG3, se admite el empleo de "materiales granulares reciclados, áridos reciclados de residuos de construcción y demolición, áridos siderúrgicos, subproductos y productos inertes de desecho, en cumplimiento del Acuerdo de Consejo de Ministros de 26 de diciembre de 2008 por el que se aprueba el Plan Nacional Integrado de Residuos 2008-2015, siempre que cumplan las prescripciones técnicas exigidas en este artículo y se declare el origen de los materiales".

Para la acreditación de su empleo y la valoración de este apartado deberá presentarse la documentación que se indica en el apartado 25.1.12 de este anexo.

3. PLAZO DE EJECUCIÓN

Se valorará la reducción en el plazo de ejecución de la obra ofertado respecto al previsto en el proyecto. El plazo de obra ofertado deberá expresarse en semanas completas, conforme al modelo que figura en el anexo 3 del Pliego de Cláusulas Administrativas Particulares.

La Valoración en la Reducción de Plazo vendrá determinada por las siguientes fórmulas:

- Para aquellas Ofertas cuya Reducción de Plazo (RP_i) sea menor o igual a la Reducción de Plazo Medio de las ofertas admitidas (RP_{med}), la fórmula de valoración es la siguiente:

$$V_i = \frac{6 \cdot RP_i}{RP_{med}}$$

ANNEX II. DOCUMENTATION PRIOR TO SUPPLY: QUALITY CERTIFICATES CDW (SIDERURGICA SEVILLANA).

ÁRIDOS SIDERÚRGICOS ANDALUCES S.L.U
Glorieta Fernando Quiñones s/n
Edificio Centris. Planta 4 Módulo 14
41940 Tomares (Sevilla)
www.asidan.es

DOCUMENTACIÓN DE CALIDAD

Marcado CE
Declaración de Prestaciones
Ficha Técnica

GLORIETA FERNANDO QUIÑONES S/N. EDIFICIO CENTRIS. PLANTA 4ª MÓDULO 14. 41940 TOMARES (SEVILLA)
TLFN: 687 777 191. e-mail: info@asidan.es

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CERTIFICADO DE CONFORMIDAD CE DE CONTROL DE PRODUCCIÓN EN FÁBRICA

1377/CPR/AR-0125

En cumplimiento con el Reglamento (UE) nº 305/2011 del Parlamento Europeo y del Consejo, de 9 de marzo de 2011 (Reglamento de productos de construcción o CPR), este certificado se aplica al producto de construcción:

Producto:	**ÁRIDOS**
Descripción:	**Ver Anexo**
Norma:	**Ver Anexo**

Puesto en el mercado bajo el nombre o la marca comercial de:

Siderúrgica Sevillana, S.A.

Autovía Sevilla – Málaga, km. 6
41500 Alcalá de Guadaira (Sevilla)

Y producido en la planta de fabricación:

Autovía Sevilla – Málaga, km. 6
41500 Alcalá de Guadaira (Sevilla)

Este certificado indica que todas las disposiciones relativas a la evaluación y verificación de la constancia de las prestaciones descritas en el Anexo ZA de la norma arriba mencionada bajo el sistema 2+, se aplican y que el control de producción en fábrica se evalúa para estar en conformidad con los requisitos.

Este certificado fue emitido por primera vez el 22 de Noviembre de 2012 y seguirá siendo válido hasta el 22 de Diciembre de 2022 siempre y cuando ni la norma armonizada, el producto de construcción, los métodos EVCP ni las condiciones de producción en la planta se modifiquen de manera significativa, a no ser que sea suspendido o retirado por el organismo de certificación de producto notificado CEMOSA (nº 1377).

Este certificado anula y sustituye al de fecha de emisión: 22 de Diciembre de 2020.

Fecha de última emisión: 22 de Diciembre de 2021.

Por CEMOSA:

Centro de Estudios de Materiales y Control de Obra, S.A. (CEMOSA)
C/ Benaque 9
29004 - Málaga

Tel. 952 23 08 42
www.cemosa.es

ENAC
CERTIFICACIÓN
Nº 156/C-PR357

Alicia Pacheco Gómez
Directora de Certificación

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Ingeniería y Control

CERTIFICADO DE CONFORMIDAD CE DE CONTROL DE PRODUCCIÓN EN FÁBRICA

1377/CPR/AR-0125

ANEXO

Identificación del producto	Uso previsto	Norma
0/22.4	--	Áridos para mezclas bituminosas y tratamientos superficiales de carreteras, aeropuertos y otras zonas pavimentadas. EN 13043:2002 y EN 13043:2002/AC:2004
0/22.4	--	Áridos para capas granulares y capas tratadas con conglomerados hidráulicos para uso en capas estructurales de firmes. EN 13242:2002+A1:2007
0/20 (mejorada)	--	Áridos para capas granulares y capas tratadas con conglomerados hidráulicos para uso en capas estructurales de firmes. EN 13242:2002+A1:2007
16/32	--	Áridos para capas granulares y capas tratadas con conglomerados hidráulicos para uso en capas estructurales de firmes. EN 13242:2002+A1:2007

Fecha de última emisión: 22 de Diciembre de 2021.

Fecha de expiración: 22 de Diciembre de 2022.

Por CEMOSA:

Centro de Estudios de Materiales y Control de Obra, S.A. (CEMOSA)
C/ Benaque 9
29004 - Málaga

Tel. 952 23 08 42
www.cemosa.es

Alicia Pacheco Gómez
Directora de Certificación

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DECLARACIÓN DE PRESTACIONES
Nº SISE04CE

1. Nombre y código de Identificación
   Zahorra mejorada 0 – 20

2. Uso previsto
   Áridos para capas granulares y capas tratadas con conglomerados hidráulicos para uso en capas estructurales de firmes.

3. Nombre y dirección del fabricante
   Siderúrgica Sevillana, S.A., Autovía Sevilla-Málaga, km. - 41500 Alcalá de Guadaira (Sevilla)

4. Sistema de evaluación y verificación de la constancia de las prestaciones: **Sistema 2+**

5. Norma armonizada: **EN – 13242: 2002 + A1 : 2007**

6. Organismo notificado **Centro de Estudios de Materiales y Control de Obra S.A. (CEMOSA), nº 1377,**

   Prestaciones declaradas:

Características esenciales	Prestaciones Zahorra mejorada 0-20
Forma, tamaño y densidad de partículas	
• Tamaño de áridos	0 – 20 mm
• Granulometría	GA80 GTA25
• Forma de las Partículas	FI_{20}
• Densidad de partículas	NPD
Limpieza	
Contenido en finos	f_7
Calidad de los finos	EA ≥55
Porcentaje de partículas trituradas	$C_{90/3}$
Resistencia a la fragmentación/machaqueo	LA_{25}
Estabilidad en volumen	V_5
Absorción/succión de agua	NPD
Composición/ contenido	
Clasificación de los áridos gruesos reciclados.	NPD
• Sulfatos solubles en agua de áridos reciclados	NPD
• Sulfatos solubles en ácido	$AS_{0,8}$
• Azufre total	S_1
• Componentes que modifican la velocidad de fraguado y endurecimiento de las mezclas ligadas hidráulicamente	Mas claro que patrón
Resistencia al desgaste	NPD
Sustancias peligrosas:	NPD
• Liberación de metales pesados por lixiviación.	NPD
• Liberación de otras sustancias peligrosas.	NPD
Durabilidad frente a la meterorización	NPD
Durabilidad frente al hielo y deshielo	NPD

Las prestaciones de los productos identificados anteriormente son conformes con el conjunto de prestaciones declaradas..

La presente declaración de prestaciones se emite, de conformidad con el Reglamento (UE) nº 305/2011 bajo la sola responsabilidad del fabricante arriba identificado

Firmado por y en nombre del fabricante por:

Carlos Sánchez Fransesch
Responsable de Calidad, Medio Ambiente y Energía

Alcalá de Guadaíra, 2 de Diciembre de 2021

RESIDAN

Asidán
ÁRIDOS SIDERÚRGICOS ANDALUCES

SIDERÚRGICA SEVILLANA
ALCALÁ DE GUADAIRA

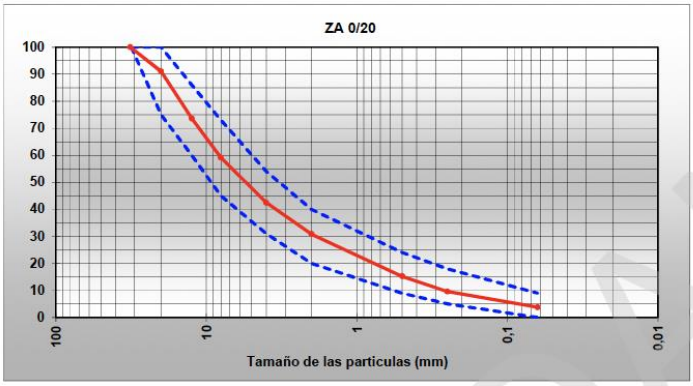
REGISTRO SISE GRU-321

Sostenibilidad Siderúrgica
Gestión RSE
SGSS – 002/2010

CE
Organismo notificado nº 1377
1377/CPR/AR-0125

FICHA TÉCNICA DEL PRODUCTO - ZAHORRA ARTIFICIAL MEJORADA ZA 0-20

Tipo de ensayo	Normativa	Resultado
Análisis granulométrico de zahorra	UNE-EN 933-1:1998/A1:2006	



Tamiz	% Pasa
32	100,0
20	91,1
12,5	73,6
8	59,1
4	42,5
2	30,8
0,50	15,2
0,25	9,6
0,063	3,8

Tipo de ensayo	Normativa	Resultado
Determinación del contenido de finos	UNE-EN 933-1:1998/A1:2006	f7
Indice de lajas	UNE-EN 933-3:1997	FI20 (Vmedio 4,0)
Porcentaje de caras de fractura	UNE-EN 933-5:1999	Porcentaje partículas trituradas (Cc).....100% Porcentaje partículas totalmente trituradas (Ctc).....100% Porcentaje partículas redondeadas (Cr).....0% Porcentaje partículas totalmente redondeadas(Ctr).....0%
Equivalente de arena de un suelo	UNE-EN 933-8:2000	72
Contenido de arcillas en fracc. Finas	UNE-EN 933-9:1999	Nc
Azul de metileno-árido para hormigones	UNE-EN 933-9:2010	1,9 g/kg
Determinación de los límites de Atterberg	UNE 103103:1994 UNE 103104:1993	Índice de plasticidad .....NO PLASTICO
Proctor modificado	UNE 103501:1994	Densidad máxima..... 2,51 g/cm3 Humedad óptima.....6,14 %
Determinación del índice CBR	UNE 103502:1995	Densidad máxima PROCTOR 2,51 g/cm3 Humedad óptima 6,14 % Indice CBR (Compactación 100 %) 110,30 Indice CBR (Compactación 95 %) 95,53 Hinchamiento medio 0%
Coeficiente de los Angeles (Zahorra)	UNE-EN 1097-2:1999	Fracción granulometrica utilizada: Entre tamices 10 y 14 mm.....LA 25
Contenido total de Azufre (Zahorra)	UNE-EN 1774-1:1999 Capítulo 11	Compuestos totales de azufre (S) .....0,10 % Sulfatos solubles al acido(SO3) .....0,04 %
Expansión en volumen (%)	UNE-EN 1774-1:1998 Apat 19.3	V5 (Vmedio ensayos 2021 = 0,1 %)
Contenido en Cal libre CaO (%)	UNE-EN 1774-1:2010+A1:2013	0,27%
Índice IGE	NLT-361/91	0,26

ASIDAN

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E-MAIL: malaga@cemosa.es

LABORATORIO DE ENSAYOS PARA EL CONTROL DE CALIDAD DE LA EDIFICACIÓN SEGÚN RD 410/2010

ACTA

Expediente:	**O/2105982/1/01**
Nº acta:	001-21/023344/1 Anula a:
Obra:	CONTROL ARIDOS ASIDAN 2021
Cliente:	ARIDOS SIDERURGICOS ANDALUCES SL
Dirección:	GTA.FERNANDO QUIÑONES S/N EDF.CENTRIS PLT.4 MOD 14 41940 TOMARES
Contratista:	
Dirección técnica:	
Modalidad de Control:	

ENSAYOS DE ZAHORRA ARTIFICIAL NEGRA

ALBARÁN: **1512724-1C1** COD. MUESTRA: **0201/001/2021/013911** FECHA DE TOMA: **25/05/2021 10:00**

MATERIAL

TIPO MATERIAL:	**Zahorra artificial negra**	MODALIDAD DE MUESTREO	**ML - Muestreo por laboratorio**
NORMA MUESTREO:		FECHA DE REGISTRO:	**22/07/2021**
LUGAR DE TOMA:	**ACOPIO CANTERA**	OPERADOR QUE REALIZA LA TOMA:	**RICARDO GARCIA REIS**
PROCEDENCIA:	**PLANTA SIDERURGICA SEVILLANA**	PROCEDIMIENTO MUESTREO:	
LOTE LABORATORIO:		CANTIDAD DE MUESTRA:	**KG**
OBSERVACIONES:		UBICACIÓN:	**PLANTA ALCALA DE GUADAIRA**
LOTE CLIENTE:			

ASIDAN

1. TRABAJO REALIZADO

De acuerdo con el programa de control establecido, se han realizado los siguientes ensayos:

- Índice Granulométrico de envejecimiento (NLT-361)
- Contenido en cal libre (UNE EN 1744-1:2010+A1:2013)

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Proyecto Nº: 095137

Fecha Recepción Laboratorio: 17/06/2021
Fecha Inicio de Ensayos: 05/07/2021
Fecha Final de Ensayos: 06/07/2021

Muestra/s: ZAHORRA

Destinatario:

CEMOSA INGENIERÍA Y CONTROL, S.A.
C/ Benaque 9
29004 MALAGA (MÁLAGA)
ATT. Dña. YOLANDA GARRIDO CAMACHO

Tipo de muestra (#): ZAHORRA NEGRA Id. 1068295
Obra (#): CONTROL ÁRIDOS ASIDAN 2020
Expediente (#): O/2002066/1/01
Nº de albarán (#): 1512724C1

Recogida por: Entregada por el cliente en TECNALIA
Fecha de recogida: 25/05/2021
Nº Muestras: 1

CONTENIDO EN CAL LIBRE, UNE-EN 1744-1:2010+A1:2013

MUESTRA	%CaO libre
ZAHORRA NEGRA Id. 1068295	0,27

ÍNDICE IGE, NLT-361/91

MUESTRA	I.G.E.
ZAHORRA NEGRA Id. 1068295	0,26

ASIDAN

Derio, 9 de julio de 2021

JOSÉ ANTONIO DEL CAZ
Responsable Laboratorio de Materiales

tecnalia Inspiring Business
Fundación TECNALIA Research & Innovation

FÉLIX RODRÍGUEZ
Responsable Técnico Ensayo

Laboratorio inscrito en Julio de 2010 en el Registro General del CTE, sección 5-1: PVS-L-013 en las áreas EHA B+C(1,2,3,4,5,6,7); GTL B; VSG B; C(9,10,11,12); EAP B; EAS B.

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E-MAIL: malaga@cemosa.es

ACTA

LABORATORIO DE ENSAYOS PARA EL CONTROL DE CALIDAD DE LA EDIFICACIÓN SEGÚN RD 410/2010

Expediente: **O/2007263/1/01**
Nº acta: 01-21/014242/1 Anula a:

tecnalia Inspiring Business

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Fdo. ELENA FRADE VIANO
Director Técnico de Laboratorio
Licenciado en Ciencias Químicas

Málaga a 10/05/2021

Fdo. YOLANDA GARRIDO CAMACHO
Responsable de Ensayos Físicos
Ldo. en Ciencias Ambientales

FRADE VIANO ELENA - 33399417J

Digitally signed by FRADE VIANO ELENA - 33399417J
DN: cn=FRADE VIANO ELENA - 33399417J, sn=FRADE VIANO, givenName=ELENA, c=ES, serialNumber=IDCES-33399417J
Reason: I attest to the accuracy and integrity of this document
Date: 2021.05.10 12:38:32 +02'00'

GARRIDO CAMACHO YOLANDA - 74861128S

Hoja nº: 1 de 1

Digitally signed by GARRIDO CAMACHO YOLANDA - 74861128S
DN: cn=GARRIDO CAMACHO YOLANDA - 74861128S, sn=GARRIDO CAMACHO, givenName=YOLANDA, c=ES, serialNumber=IDCES-74861128S
Reason: I attest to the accuracy and integrity of this document
Date: 2021.05.10 12:38:27 +02'00'

Fecha Recepción Laboratorio: 14/04/2021
Fecha Inicio de Ensayos: 30/04/2021
Fecha Final de Ensayos: 07/05/2021

Muestra/s: ESCORIAS

Destinatario:

CEMOSA INGENIERÍA Y CONTROL, S.A.
C/ Benaque 9
29004 MALAGA (MÁLAGA)
ATT. D. MIGUEL ANGEL GARZÓN MORENO

Tipo de muestra: ZAHORRA ARTIFICIAL
Ref. de la muestra (#): Albarán 1438977C1
Procedencia: Alcalá de Guadaira (Sevilla)

Recogida por: Entregada por el cliente en TECNALIA
Fecha de recogida: 05/03/2021
Nº Muestras: 1

EXPANSIÓN DE LA ESCORIA, UNE-EN 1744-1:2010+A1:2013

PROBETA Nº	EXPANSIÓN (en volumen, %)
1	0,1
2	0,0
Media	0,1

ASIDAN

Derio, 07 de mayo de 2021

JOSE ANTONIO DEL CAZ
Responsable Laboratorio de Materiales

tecnalia Inspiring Business
Fundación TECNALIA Research & Innovation

FÉLIX RODRÍGUEZ
Responsable Técnico de Ensayo

Laboratorio inscrito en Julio de 2010 en el Registro General del CTE, sección 8-1: PVS-L-013 en las áreas EHA B+C(1,2,3,4,5,6,7); GTL B; VSG B; C(9,10,11,12); EAP B; EAG B

Notas:
- La incertidumbre asociada a las determinaciones está a disposición del cliente en nuestros laboratorios.
- Este informe no podrá ser reproducido sin la autorización expresa de FUNDACIÓN TECNALIA R&I, excepto cuando lo sea de forma íntegra.
- Los resultados del presente informe conciernen, única y exclusivamente al material ensayado.

(#) Información aportada por el cliente. FUNDACIÓN TECNALIA R&I no se hace responsable de la información aportada por el cliente.

ANNEX III. RECEPTION CONTROL: TESTS IDENTIFICATION OF THE MATERIAL

ACTA DE RESULTADOS DE ENSAYOS DE ZAHORRA

Registro de Laboratorios de Ensayos. Junta de Andalucia. Nº de inscripción AND-L-155

elabora

Consulte sus actas en www.elabora.es

Cliente: EMASESA

Muestra: 5669
Albarán: 05351
Fecha de toma: 07/11/2022
Número Acta: 21580
Código: 23884

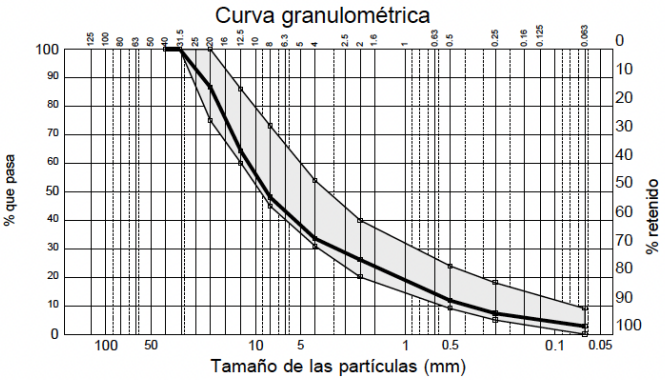
EMASESA
C/ Escuelas Pías nº 1
41003-Sevilla

Obra: OT 096 EXPTE 061/21 ACOND Y MEJORA REDES ABTO Y SNTO C/ CORRAL DE LA CARIDAD BDA PINO MONTANO, DISTRITO NORTE
Localidad: SEVILLA
Procedencia: ACOPIO EN OBRA
Descripción: ZAHORRA MEJORADA (ESCORIA), DE SIDERÚRGICA SEVILLANA

ELABORA AGENCIA PARA LA CALIDAD EN LA CONSTRUCCION, S.L. C.I.F. B-91433888 Registro Mercantil de Sevilla · Folio 121 · Tomo 4.105 · Hoja SE 61.121 · Inscripción 1ª

ANÁLISIS GRANULOMÉTRICO (UNE-EN 933-1:2012)

Tamiz (mm)	Pasa (%)	Huso ZA(0/20)
40	100	100 - 100
32	100	100 - 100
20	87	75 - 100
12,5	64	60 - 86
8	48	45 - 73
4	34	31 - 54
2	26	20 - 40
0,5	12	9 - 24
0,25	7	5 - 18
0,063	2,8	0 - 9



LIMITES DE ATTERBERG (UNE 103103:1994 y UNE 103104:1993)

Límite líquido	No obtenible
Límite plástico	No plástico
Índice de plasticidad	No plástico

EQUIVALENTE DE ARENA (UNE EN 933-8:2012)		
SE(4)	%	61
SE-	%	--

COEFICIENTE DE LOS ANGELES (UNE-EN 1097-2:2010)		
DLA	%	20

ACTA DE RESULTADOS DE ENSAYOS DE SUELO

Registro de Laboratorios de Ensayos. Junta de Andalucia. Nº de inscripción AND-L-155

elabora

Consulte sus actas en www.elabora.es

Cliente: EMASESA

Muestra: 5669
Albarán: 05351
Fecha de toma: 07/11/2022
Número Acta: 21580
Código: 23884

EMASESA
C/ Escuelas Pías nº 1
41003-Sevilla

Obra: OT 096 EXPTE 061/21 ACOND Y MEJORA REDES ABTO Y SNTO C/ CORRAL DE LA CARIDAD BDA PINO MONTANO, DISTRITO NORTE
Localidad: SEVILLA
Procedencia: ACOPIO EN OBRA
Descripción: ZAHORRA MEJORADA (ESCORIA), DE SIDERÚRGICA SEVILLANA

INDICE DE LAJAS GLOBAL (UNE EN 933-3:2012)		
IL	%	8

Sevilla 16 de diciembre de 2022

DIRECTOR DEL LABORATORIO
Fernando Fernández Díaz
Químico

ELABORA AGENCIA PARA LA CALIDAD EN LA CONSTRUCCIÓN, S.L. C.I.F. B-91433888 Registro Mercantil de Sevilla · Folio 121 · Tomo 4.105 · Hoja SE 61.121 · Inscripción 1ª

ACTA DE RESULTADOS DE ENSAYOS DE SUELO

Registro de Laboratorios de Ensayos. Junta de Andalucia. Nº de inscripción AND-L-155

elabora

Consulte sus actas en www.elabora.es

Cliente: EMASESA

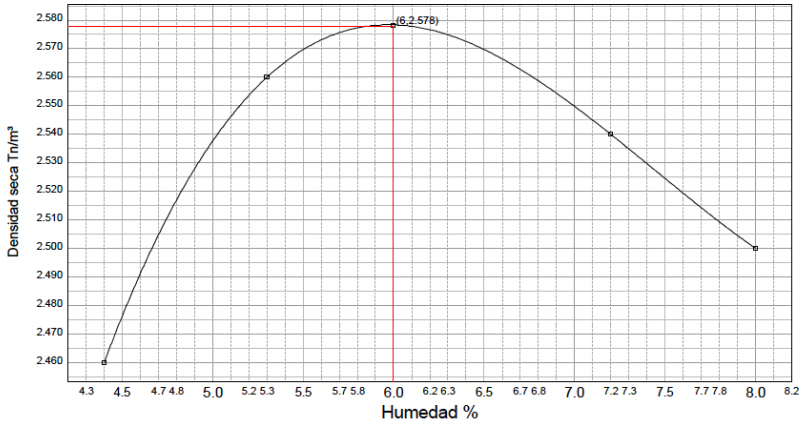
Muestra: 5669
Albarán: 05351
Fecha de toma: 07/11/2022
Número Acta: 21577
Código: 23884

EMASESA
C/ Escuelas Pías nº 1
41003-Sevilla

Obra: OT 096 EXPTE 061/21 ACOND Y MEJORA REDES ABTO Y SNTO C/ CORRAL DE LA CARIDAD BDA PINO MONTANO, DISTRITO NORTE
Localidad: SEVILLA
Procedencia: ACOPIO EN OBRA
Descripción: ZAHORRA MEJORADA (ESCORIA), DE SIDERÚRGICA SEVILLANA

ENSAYO PROCTOR MODIFICADO (UNE 103501:1994)

Densidad máxima 2,58 Tn/m³ Humedad óptima 6,0 %



Sevilla 16 de diciembre de 2022

DIRECTOR DEL LABORATORIO
Fernando Fernández Díaz
Químico

ELABORA AGENCIA PARA LA CALIDAD EN LA CONSTRUCCION, S.L. C.I.F. B-91433888 Registro Mercantil de Sevilla - Folio 121 - Tomo 4.105 - Hoja SE 61.121 - Inscripción 1ª

ANNEX IV. EXECUTION CONTROL: COMPACTION TESTS

ACTA DE RESULTADOS DE ENSAYOS DE SUELO

Registro de Laboratorios de Ensayos. Junta de Andalucia. Nº de inscripción AND-L-155

elabora

Consulte sus actas en www.elabora.es

Cliente: EMASESA

Muestra: 396
Albarán: 04015
Fecha de toma: 25/01/2023
Número Acta: 1518
Código: 23884

EMASESA
C/ Escuelas Pías nº 1
41003-Sevilla

Obra: OT 096 EXPTE 061/21 ACOND Y MEJORA REDES ABTO Y SNTO C/ CORRAL DE LA CARIDAD BDA PINO MONTANO, DISTRITO NORTE
Localidad: SEVILLA
Procedencia: PAVIMENTACIÓN, TONG. DE CORONACIÓN
Descripción: ZAHORRA MEJORADA (ESCORIA), DE SIDERÚRGICA SEVILLANA

Determinación "in situ" de la densidad y de la humedad de suelos y materiales granulares por métodos nucleares ASTM D-6938-17a / UNE 103900:2013

Nº	LOCALIZACIÓN		DATOS DE CAMPO			
		Tongada Capa	Profundidad cm.	Humedad %	Densidad t/m³	Compactación %
1	PUNTO 1	CORONAC.	15	2,5	2,56	99
2	PUNTO 2	CORONAC.	15	3,1	2,55	99
3	PUNTO 3	CORONAC.	15	2,5	2,63	102
4	PUNTO 4	CORONAC.	15	2,7	2,58	100
5	PUNTO 5	CORONAC.	15	2,6	2,58	100
6	PUNTO 6	CORONAC.	15	2,3	2,57	100
	Valores medios (6 puntos)			2,6	2,58	100

PROCTOR MODIFICADO DE REF. 5669	
Densidad máxima	2,58 t/m³
Humedad óptima	6,0 %

OBSERVACIONES:
Los resultados cumplen las especificaciones técnicas.

Operador: Antonio Jesús Castro Pinto

Sevilla 27 de enero de 2023

DIRECTOR DEL LABORATORIO
Fernando Fernández Díaz
Químico

ELABORA AGENCIA PARA LA CALIDAD EN LA CONSTRUCCIÓN, S.L. C.I.F. B-91433888 Registro Mercantil de Sevilla - Folio 121 - Tomo 4.105 - Hoja SE 61.121 - Inscripción 1ª

ACTA DE RESULTADOS DE ENSAYOS DE SUELO

Registro de Laboratorios de Ensayos. Junta de Andalucia. Nº de inscripción AND-L-155

elabora

Consulte sus actas en www.elabora.es

ELABORA AGENCIA PARA LA CALIDAD EN LA CONSTRUCCION, S.L. C.I.F. B-91433888 Registro Mercantil de Sevilla · Folio 121 · Tomo 4.105 · Hoja SE 61.121 · Inscripción nº

Cliente: EMASESA

Muestra: 396
Albarán: 04015
Fecha de toma: 25/01/2023
Número Acta: 1518
Código: 23884

EMASESA
C/ Escuelas Pías nº 1
41003-Sevilla

Obra: OT 096 EXPTE 061/21 ACOND Y MEJORA REDES ABTO Y SNTO C/ CORRAL DE LA CARIDAD BDA PINO MONTANO, DISTRITO NORTE

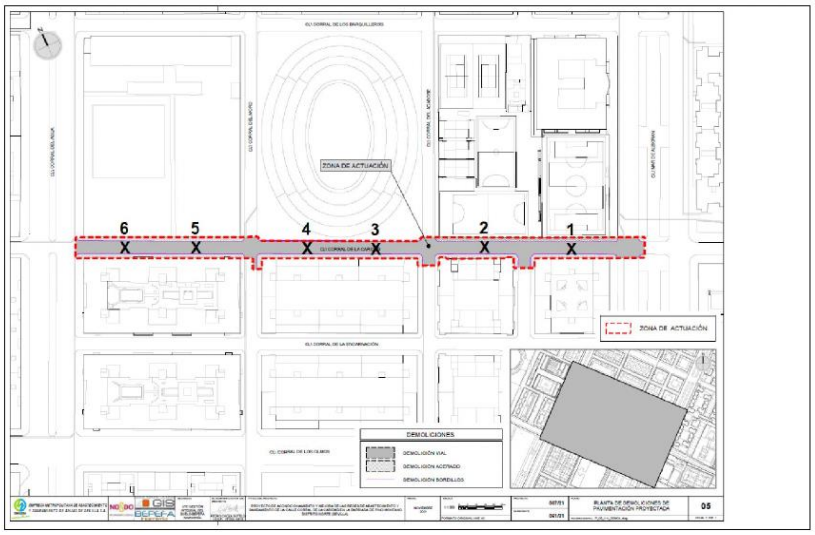
Localidad: SEVILLA

Procedencia: PAVIMENTACIÓN, TONG. DE CORONACIÓN

Descripción: ZAHORRA MEJORADA (ESCORIA), DE SIDERÚRGICA SEVILLANA

Determinación "in situ" de la densidad y de la humedad de suelos y materiales granulares por métodos nucleares ASTM D-6938-17a / UNE 103900:2013

PLANO DE SITUACIÓN



Operador: Antonio Jesús Castro Pinto

Sevilla 27 de enero de 2023

DIRECTOR DEL LABORATORIO
Fernando Fernández Díaz
Químico

ANNEX V. RECEPTION CONTROL: TESTS IDENTIFICATION OF THE MATERIAL

elabora

Consulte sus actas en www.elabora.es

ACTA DE RESULTADOS DE ENSAYOS DE ZAHORRA

Registro de Laboratorios de Ensayos. Junta de Andalucia. Nº de inscripción AND-L-155

Cliente: EMASESA

Muestra: 4833
Albarán: 01759
Fecha de toma: 18/10/2022
Número Acta: 18060
Código: 23101

EMASESA
C/ Escuelas Pías nº 1
41003-Sevilla

Obra: OT 054 EXPTE 250/20 MEJORA REDES DE SANEAMIENTO EN EL P.I. TABLADA DISTRITO LOS REMEDIOS
Localidad: SEVILLA
Procedencia: ACOPIO EN OBRA
Descripción: ZAHORRA MEJORADA (ESCORIA), DE SIDERÚRGICA SEVILLANA

ANÁLISIS GRANULOMÉTRICO (UNE-EN 933-1:2012)

Tamiz (mm)	Pasa (%)	Huso ZA(0/20)
32	100	100 - 100
20	86	75 - 100
12,5	63	60 - 86
8	46	45 - 73
4	32	31 - 54
2	24	20 - 40
0,5	12	9 - 24
0,25	7	5 - 18
0,063	2,9	0 - 9
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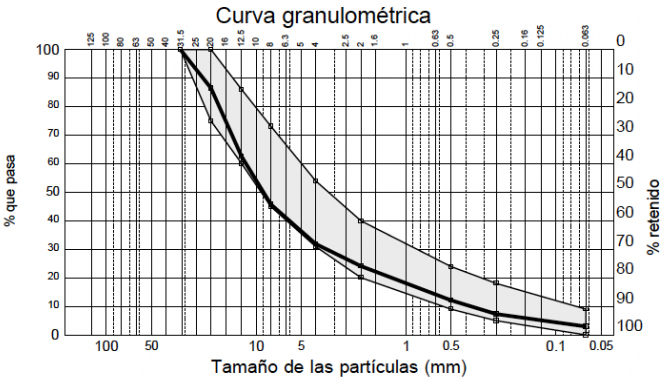


LIMITES DE ATTERBERG (UNE 103103:1994 y UNE 103104:1993)

Límite líquido	No obtenible
Límite plástico	No plástico
Índice de plasticidad	No plástico

EQUIVALENTE DE ARENA (UNE EN 933-8:2012)		
SE(4)	%	61
SE-	%	--

COEFICIENTE DE LOS ANGELES (UNE-EN 1097-2:2010)		
DLA	%	21

ELABORA AGENCIA PARA LA CALIDAD EN LA CONSTRUCCION, S.L. · C.I.F. B-91433988 · Registro Mercantil de Sevilla · Folio 121 · Tomo 4.105 · Hoja SE 61.121 · Inscripción 1ª

D · Polígono Industrial "El Pino". C/ Pino Central, 44. 41016 SEVILLA T · 954 51 55 58/59 F · 954 51 38 21

ACTA DE RESULTADOS DE ENSAYOS DE SUELO

Registro de Laboratorios de Ensayos. Junta de Andalucía. Nº de inscripción AND-L-155

Consulte sus actas en www.elabora.es

Cliente: EMASESA

Muestra: 4833
Albarán: 01759
Fecha de toma: 18/10/2022
Número Acta: 18060
Código: 23101

EMASESA
C/ Escuelas Pías nº 1
41003-Sevilla

Obra: OT 054 EXPTE 250/20 MEJORA REDES DE SANEAMIENTO EN EL P.I. TABLADA DISTRITO LOS REMEDIOS
Localidad: SEVILLA
Procedencia: ACOPIO EN OBRA
Descripción: ZAHORRA MEJORADA (ESCORIA), DE SIDERÚRGICA SEVILLANA

CARAS DE FRACTURA (UNE EN 933-5:1999/A1:2005)		
PARTÍCULAS TRITURADAS, Cz	%	-
PARTÍCULAS REDONDEADAS, Cr	%	-
PARTÍCULAS TOTALMENTE TRITURADAS, Ctc	%	-
PARTÍCULAS TOTALMENTE REDONDEADAS, Ctr	%	-

INDICE DE LAJAS GLOBAL (UNE EN 933-3:2012)		
IL	%	11

VALOR DE AZUL DE METILENO (UNE EN 933-9:2010 + A1:2013)		
MB	g de colorante/kg fracción 0/2 mm	-
MBF	g de colorante/kg fracción 0/0,125 mm	-

Sevilla 28 de octubre de 2022

DIRECTOR DEL LABORATORIO
Fernando Fernández Díaz
Químico

ACTA DE RESULTADOS DE ENSAYOS DE SUELO

Registro de Laboratorios de Ensayos. Junta de Andalucia. Nº de inscripción AND-L-155

elabora

Consulte sus actas en www.elabora.es

Cliente: EMASESA

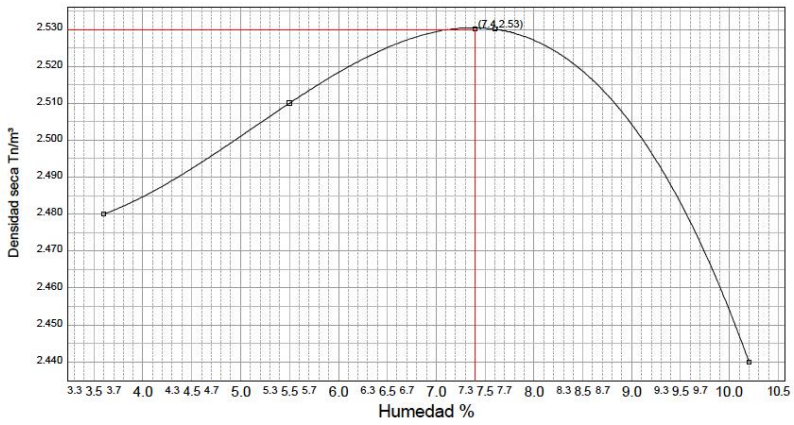
Muestra: 4833
Albarán: 01759
Fecha de toma: 18/10/2022
Número Acta: 18062
Código: 23101

EMASESA
C/ Escuelas Pías nº 1
41003-Sevilla

Obra: OT 054 EXPTE 250/20 MEJORA REDES DE SANEAMIENTO EN EL P.I. TABLADA DISTRITO LOS REMEDIOS
Localidad: SEVILLA
Procedencia: ACOPIO EN OBRA
Descripción: ZAHORRA MEJORADA (ESCORIA), DE SIDERÚRGICA SEVILLANA

ENSAYO PROCTOR MODIFICADO (UNE 103501:1994)

Densidad máxima 2,53 Tn/m³ Humedad óptima 7,4 %



Sevilla 26 de octubre de 2022

DIRECTOR DEL LABORATORIO
Fernando Fernández Díaz
Químico

ELABORA AGENCIA PARA LA CALIDAD EN LA CONSTRUCCION, S.L. C.I.F. B-91433888 Registro Mercantil de Sevilla · Folio 121 · Tomo 4.105 · Hoja SE 61.121 · Inscripción nº

ANNEX VI. EXECUTION CONTROL: COMPACTION TESTS

ACTA DE RESULTADOS DE ENSAYOS DE SUELO

Registro de Laboratorios de Ensayos. Junta de Andalucia. Nº de inscripción AND-L-155

elabora

Consulte sus actas en www.elabora.es

Cliente: EMASESA

Muestra: 5375
Albarán: 03896
Fecha de toma: 11/11/2022
Número Acta: 19986
Código: 23101

EMASESA
C/ Escuelas Pías nº 1
41003-Sevilla

Obra: OT 054 EXPTE 250/20 MEJORA REDES DE SANEAMIENTO EN EL P.I. TABLADA DISTRITO LOS REMEDIOS
Localidad: SEVILLA
Procedencia: CALZADA, ENTRE POZOS 8 y 12, TONG. DE CORONACIÓN
Descripción: ZAHORRA MEJORADA (ESCORIA), DE SIDERÚRGICA SEVILLANA

Determinación "in situ" de la densidad y de la humedad de suelos y materiales granulares por métodos nucleares
ASTM D-6938-17a / UNE 103900:2013

Nº	LOCALIZACIÓN		DATOS DE CAMPO			
		Tongada Capa	Profundidad cm.	Humedad %	Densidad t/m³	Compactación %
1	PUNTO 1	CORONAC.	15	3,1	2,53	100
2	PUNTO 2	CORONAC.	15	4,9	2,52	100
3	PUNTO 3	CORONAC.	15	3,4	2,53	100
	Valores medios (3 puntos)			3,8	2,53	100

PROCTOR MODIFICADO DE REF. 4833	
Densidad máxima	2,53 t/m³
Humedad óptima	7,4 %

OBSERVACIONES:
Los resultados cumplen las especificaciones técnicas.

Operador: Antonio Gonzalo Hernández Molina

Sevilla 14 de noviembre de 2022

DIRECTOR DEL LABORATORIO
Fernando Fernández Díaz
Químico

ACTA DE RESULTADOS DE ENSAYOS DE SUELO

Registro de Laboratorios de Ensayos. Junta de Andalucia. Nº de inscripción AND-L-155

Consulte sus actas en www.elabora.es

Cliente: EMASESA

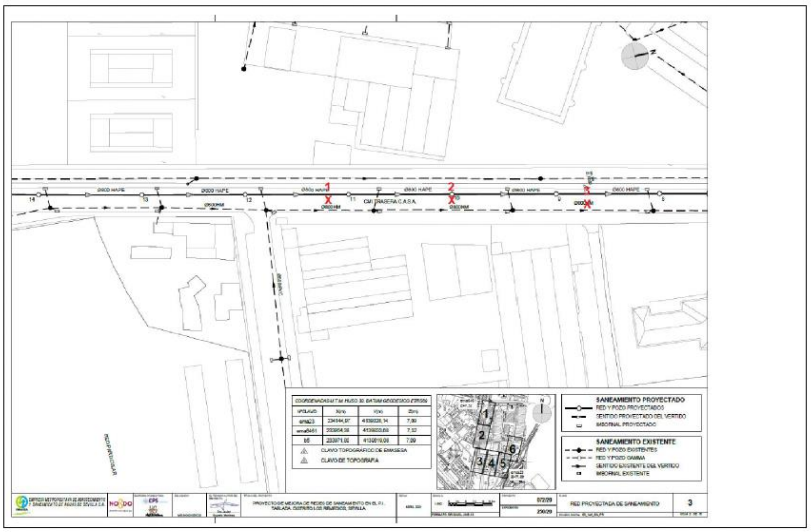
Muestra: 5375
Albarán: 03896
Fecha de toma: 11/11/2022
Número Acta: 19986
Código: 23101

EMASESA
C/ Escuelas Pías nº 1
41003-Sevilla

Obra: OT 054 EXPTE 250/20 MEJORA REDES DE SANEAMIENTO EN EL P.I. TABLADA DISTRITO LOS REMEDIOS
Localidad: SEVILLA
Procedencia: CALZADA, ENTRE POZOS 8 y 12, TONG. DE CORONACIÓN
Descripción: ZAHORRA MEJORADA (ESCORIA), DE SIDERÚRGICA SEVILLANA

Determinación "in situ" de la densidad y de la humedad de suelos y materiales granulares por métodos nucleares
ASTM D-6938-17a / UNE 103900:2013

PLANO DE SITUACIÓN



Operador: Antonio Gonzalo Hernández Molina

Sevilla 14 de noviembre de 2022

DIRECTOR DEL LABORATORIO
Fernando Fernández Díaz
Químico

ELABORA GEOTECNIA PARA LA CALIDAD EN LA OBRA PÚBLICA, S.L. · C.I.F. B91433866 · Registro Mercantil de Sevilla · Folio 121 · Tomo 4.105 · Hoja SE 91.121 · Inscripción 1ª

ACTA DE RESULTADOS DE ENSAYOS DE SUELO

Registro de Laboratorios de Ensayos. Junta de Andalucia. Nº de inscripción AND-L-155

elabora

Consulte sus actas en www.elabora.es

Cliente: EMASESA

Muestra: 5530
Albarán: 03508
Fecha de toma: 24/11/2022
Número Acta: 20719
Código: 23101

EMASESA
C/ Escuelas Pías nº 1
41003-Sevilla

Obra: OT 054 EXPTE 250/20 MEJORA REDES DE SANEAMIENTO EN EL P.I. TABLADA DISTRITO LOS REMEDIOS
Localidad: SEVILLA
Procedencia: CALZADA, TONG. DE CORONACIÓN
Descripción: ZAHORRA MEJORADA (ESCORIA), DE SIDERÚRGICA SEVILLANA

Determinación "in situ" de la densidad y de la humedad de suelos y materiales granulares por métodos nucleares
ASTM D-6938-17a / UNE 103900:2013

Nº	LOCALIZACIÓN		DATOS DE CAMPO			
		Tongada Capa	Profundidad cm.	Humedad %	Densidad t/m³	Compactación %
1	PUNTO 1	CORONAC.	15	3.1	2.53	100
2	PUNTO 2	CORONAC.	15	4.1	2.56	101
3	PUNTO 3	CORONAC.	15	3.4	2.57	102
		Valores medios (3 puntos)		3.5	2.55	101

PROCTOR MODIFICADO DE REF. 4833	
Densidad máxima	2.53 t/m³
Humedad óptima	7.4 %

OBSERVACIONES:
Los resulados cumplen las especificaciones técnicas.

Operador: Antonio Gonzalo Hernández Molina

Sevilla 28 de noviembre de 2022

DIRECTOR DEL LABORATORIO
Fernando Fernández Díaz
Químico

Pág. 1 de 2

ACTA DE RESULTADOS DE ENSAYOS DE SUELO

Registro de Laboratorios de Ensayos. Junta de Andalucia. Nº de inscripción AND-L-155

Consulte sus actas en www.elabora.es

Cliente: EMASESA

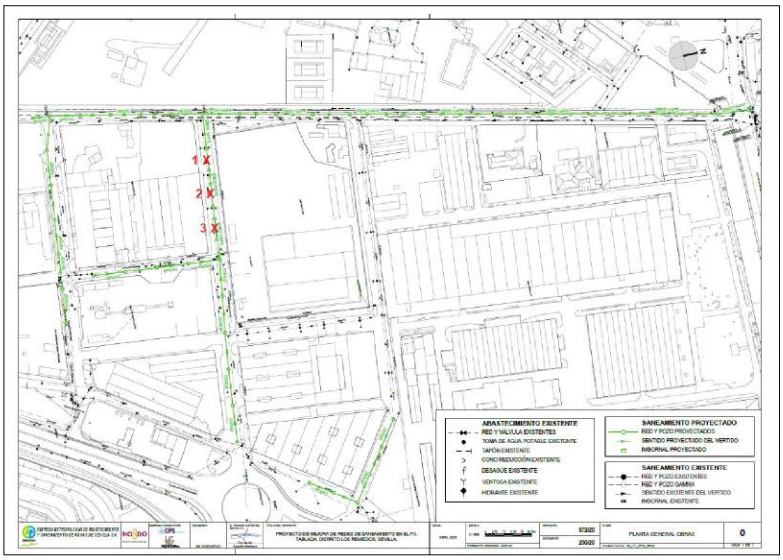
Muestra: 5530
Albarán: 03508
Fecha de toma: 24/11/2022
Número Acta: 20719
Código: 23101

EMASESA
C/ Escuelas Pías nº 1
41003-Sevilla

Obra: OT 054 EXPTE 250/20 MEJORA REDES DE SANEAMIENTO EN EL P.I. TABLADA DISTRITO LOS REMEDIOS
Localidad: SEVILLA
Procedencia: CALZADA, TONG. DE CORONACIÓN
Descripción: ZAHORRA MEJORADA (ESCORIA), DE SIDERÚRGICA SEVILLANA

Determinación "in situ" de la densidad y de la humedad de suelos y materiales granulares por métodos nucleares
ASTM D-6938-17a / UNE 103900:2013

PLANO DE SITUACIÓN



Operador: Antonio Gonzalo Hernández Molina

Sevilla 28 de noviembre de 2022

DIRECTOR DEL LABORATORIO
Fernando Fernández Díaz
Químico

ACTA DE RESULTADOS DE ENSAYOS DE SUELO

Registro de Laboratorios de Ensayos. Junta de Andalucia. Nº de inscripción AND-L-155

Consulte sus actas en www.elabora.es

Cliente: EMASESA

Muestra: 604
Albarán: 03547
Fecha de toma: 07/02/2023
Número Acta: 2580
Código: 23101

EMASESA
C/ Escuelas Pías nº 1
41003-Sevilla

Obra: OT 054 EXPTE 250/20 MEJORA REDES DE SANEAMIENTO EN EL P.I. TABLADA DISTRITO LOS REMEDIOS
Localidad: SEVILLA
Procedencia: ZANJA DE SANEAMIENTO, ENTRE POZOS 39 y 42, TONG. DE CORONACIÓN
Descripción: ZAHORRA MEJORADA (ESCORIA), DE SIDERÚRGICA SEVILLANA

Determinación "in situ" de la densidad y de la humedad de suelos y materiales granulares por métodos nucleares
ASTM D-6938-17a / UNE 103900:2013

Nº	LOCALIZACIÓN		DATOS DE CAMPO			
		Tongada Capa	Profundidad cm.	Humedad %	Densidad t/m³	Compactación %
1	ENTRE POZOS 39 y 40	CORONAC.	15	2,7	2,56	101
2	ENTRE POZOS 40 y 41	CORONAC.	15	3,1	2,54	100
3	ENTRE POZOS 41 y 42	CORONAC.	15	2,1	2,56	101
	Valores medios (3 puntos)			2,6	2,55	101

PROCTOR MODIFICADO DE REF. 4833	
Densidad máxima	2,53 t/m³
Humedad óptima	7,4 %

OBSERVACIONES:
Los resultados cumplen las especificaciones técnicas.

Operador: Antonio Gonzalo Hernández Molina

Sevilla 10 de febrero de 2023

DIRECTOR DEL LABORATORIO
Fernando Fernández Díaz
Químico

ACTA DE RESULTADOS DE ENSAYOS DE SUELO

Registro de Laboratorios de Ensayos. Junta de Andalucia. Nº de inscripción AND-L-155

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Cliente: EMASESA

Muestra: 604
Albarán: 03547
Fecha de toma: 07/02/2023
Número Acta: 2580
Código: 23101

EMASESA
C/ Escuelas Pías nº 1
41003-Sevilla

Obra: OT 054 EXPTE 250/20 MEJORA REDES DE SANEAMIENTO EN EL P.I. TABLADA DISTRITO LOS REMEDIOS
Localidad: SEVILLA
Procedencia: ZANJA DE SANEAMIENTO, ENTRE POZOS 39 y 42, TONG. DE CORONACIÓN
Descripción: ZAHORRA MEJORADA (ESCORIA), DE SIDERÚRGICA SEVILLANA

Determinación "in situ" de la densidad y de la humedad de suelos y materiales granulares por métodos nucleares
ASTM D-6938-17a / UNE 103900:2013

PLANO DE SITUACIÓN

Operador: Antonio Gonzalo Hernández Molina

Sevilla 10 de febrero de 2023

DIRECTOR DEL LABORATORIO
Fernando Fernández Díaz
Químico

ANNEX VII. BEST PRACTICES GUIDELINES

Introduction

This Best Practices Guidelines was born from Emasesa, the Metropolitan Company Supply and Sanitation of Water in Seville in order to create a database of sustainability in their works. It is intended to establish a Reference Manual practical and complete so that the agents involved in the execution of the promoted works by Emasesa, can adopt criteria environmental conditions that support their activity daily minimizing the environmental impact of the works on the environment and reducing the possible inconvenience caused by these the citizenship. Within the environmental objectives of Emasesa are the commitments acquired to in order to develop works where good practices and application of environmental improvements suppose a reference for companies that develop them. The purpose of this Manual is materialized as:

- Reference tool to be able to meet the Development Goals Sustainable Development (SDG) of the United Nations.
- Support instrument for compliance with the Comprehensive Waste Plan of Andalusia and the State Waste Framework Plan.
- Guide for compliance with environmental regulations applicable to works and actions to repair breakdowns, conditioning and extension of the water supply and sanitation networks Emasesa. It will also serve to establish commitments contractual binding for the contractor and the construction management.
- Resource of impulse and motivation for the implantation of an economy circular in the field of development of the activities carried out by Emasesa.
- Implementation method to improve actions and executions of works in a sustainable, responsible and preventive way.
- Acquire and achieve a real environmental commitment in works.
- Tool for the awareness of collaborating companies of Emasesa.
- Instrument to publicize good practices and habits of work of Emasesa, which increase the environmental quality during the execution of his works.

The scope of the guide will be reviewed annually by those responsible for its possible expansion, improvement or correction and its adaptation to social conditions, environmental and prevailing legislation.

Waste Management

We define the circular economy as an economic system in which the value of products, materials and other resources of the economy lasts as long as possible, boosting its efficient use in the production and consumption, thus reducing the impact environmental impact of its use, and reducing waste to a minimum and the release of dangerous substances in all phases of the life cycle, where appropriate by applying of the waste hierarchy. A circular economy seeks to reduce pressure on natural resources, and betting for ambitious waste management. This fact is favoured and facilitated. Construction and Demolition Waste (CDW) holds

characteristics that favour circularity and their life cycle, provided they are reversed efforts in their reduction and in their classification, reuse, recovery and recycling.

The activity carried out by Emasesa in the renovation and maintenance works supply and sanitation networks in Seville and its metropolitan area, is the main source of waste in the entity. That is why it is desired to invest special energy and dedication to promoting good practices in this area, being of great relevance the block Waste Management within the Manual.

The importance of correct waste management in Emasesa works

The generation of waste, as well as the management carried out on them, is one of the main environmental factors to consider in a work Emasesa pays special attention to this aspect, since it knows the possible impacts environmental deriving from poor management and wants to achieve proper sustainable development in all his works.

All the tasks to develop in the management of waste, from the reduction, classification, collection or storage, reuse, recovery, transportation and delivery to managers external factors, are crucial in reducing the impacts environmental that derive from a work. For this, it is necessary to know the obligations laws that each of the actors involved has in a work, so that it can be ensure proper waste management.

Emasesa is committed to the development of good practices aimed at the application of the principles of the circular economy.

Regulations and application planning

The regulations applicable to a work in waste matter is as follows:

- Law 7/2022, of April 8, on waste and contaminated soils for an economy circular.
- Law 5/2013, of June 11, which modifies Law 16/2002, IPPC and Law 22/2011, waste and contaminated soil.
- Law 11/2012, of December 19, on measures environmental issues (which modifies some aspects of the Law 22/2011).
- Royal Decree 105/2008, of February 1, by which regulates the production and management of construction and demolition waste.
- Order APM/1007/2017, of October 19, on general valuation rules of excavated natural materials to its use in landfill operations and works other than those in which generated.
- Royal Decree 553/2020, of June 2, by which regulates the transfer of waste in within the territory of the State.
- Royal Decree 1802/2008, of November 3, by which the Regulation on notification of new substances and classification, packaging and labelling of substances dangerous, approved by the Royal Decree 363/1995, of March 10, with the purpose of adapting its provisions to the Regulation (EC) No. 1907/2006 of the Parliament European Union and of the Council (Regulation REACH).
- Royal Decree 108/1991, of February 1 on pollution prevention and reduction environmentally produced for asbestos.
- Royal Decree 9/2005, of January 14, by which the relationship of activities is established potentially polluting of the soil and the criteria and standards for the declaration of contaminated soils.
- Order PRA/1080/2017, of November 2, which modifies annex I of the Real Decree 9/2005, of January 14, by which the relationship of potentially soil contaminating activities is established and the criteria and standards for the declaration of contaminated soils.
- Decree 73/2012, of March 20, by the that the Waste Regulation is approved from Andalusia.
- Decree 18/2015, of January 27, by which the regulation that regulates the regime is approved applicable to contaminated soils.
- Spanish Circular Economy Strategy. Spain Circular 2030.
- Circular Economy Action Plan 2021-2030.
- Local Circular Economy Strategy. Federation Spanish of Municipalities and Provinces (FEMP) 2019.
- Andalusia Comprehensive Waste Plan. Towards a Circular Economy on the Horizon 2030 (PIRec 2030).

The Comprehensive Waste Plan of Andalusia. Toward a Circular Economy in Horizon 2030 (PIRec 2030) has the purpose of establishing of the sectoral strategic framework for compliance in the Autonomous Community of the obligatory objectives in terms of waste marked by the regulations European and national, as well as reinforcing and accelerate the transition of Andalusia towards a circular economy. Among the waste considered in the PIRec2030 construction waste is found and demolition (CDW).

The CDW, measured in volume, represent the highest EU waste stream. The Commission European Union published in 2018 a new protocol and EU guidelines for construction waste and demolition that aims to increase trust in the management process of construction and demolition waste and the confidence in the quality of recycled materials of this matter. This protocol is framed within the construction strategy 2020 and the circular economy package of the European Commission.

The general objectives that will link prevention and waste management in Andalusia until the year 2030 are:

- Guarantee adequate management of the entire of waste generated and transferred in the territory, ensuring the strict pecking order compliance established in the community directive in waste matter.
- Promote innovation, in the field of those initiatives that promote improvements in production processes aimed at more effective use of resources and less waste generation, to which the value of the products and materials will be kept for the longest possible time, as well as an increase in reuse, recyclability and recovery material that implies a reduction of removal.
- Promote industrial symbiosis in a way that the by-products generated in some activities become subjects' cousins of others. Promote the use, by companies, of materials secondary premiums to take advantage of maximum material and energy resources contained in waste and reduce, where possible, the consumption of natural resources.
- Apply the principle of responsibility of the producer to the agents who put in the market products that with their use become waste, and the principle of "whoever pollutes, pays" to the generators of waste.
- Reduce the dumping of rejects from of the valorisation processes and of the fraction of non-recyclable waste through its valuation.
- Analyse the efficiency of current systems collection, optimize treatments and carry out an integrated assessment of complete management processes, from production to final management.
- Promote the construction of as many facilities recovery and disposal are necessary, so that Andalusia be self-sufficient in terms of management of all your waste is concerned.
- Reduce the contribution to climate change of the activities associated with the generation and waste management.

Waste generated in the works

Waste generated in a construction site or demolition are called Waste of Construction and Demolition (CDW) (article 2.a of Royal Decree 105/2008) and are identified within the European List of Waste (LER) published by Decision 2000/532/CE of the Commission, as amended by Decision 2014/955/UE and subsequent revisions. The list is divided into 20 chapters depending on from the source of the waste. Waste which are marked with an asterisk (*) are considered hazardous waste in accordance with Directive 91/689/EEC. The residues of chapter 17 are the Residues of Construction and Demolition (CDW):

Based on the accumulated experience and the Studies carried out on his own works EMASESA can conclude that the main actions or origin of the CDW in its activity developed are:

• Demolition of pavement and sidewalk.

• Excavation of trenches.

• Demolition of isolated concrete elements.

Regarding the type of waste produced by EMASESA in their works, based on the Reports annual generated, we get that 83% of the waste corresponds to land excavation (LER-170504), residue that is generated in greater proportion in the works, followed by of mixed waste (LER- 170107) and with barely 1% the production of waste corresponding to remains of concrete (LER- 170101) and fibre cement (LER 170605). However, the waste to be managed in a work can be very varied because they depend on the characteristics of the infrastructure or installation to run.

The earths and stones not contaminated by hazardous substances reused in the same work (LER 170504), in a different work or in an activity of restoration, conditioning or filler, as long as it I can reliably prove their destination to reuse, will be included among the materials to be managed by this Manual, since although it is not strictly framed within of the meaning of waste (according to article 3.1.a of RD 105/2008), it is essential to include your management within the scope of the waste generated in a work given that as we have seen corresponds to the largest volume of waste generated.

To the waste generated in the works of construction and demolition that have legislation own (due to its nature or dangerousness) their specific regulations will be applicable, applying the manual for aspects not covered in it.

Main actors in waste management and derived responsibilities

To understand and learn about waste management, the actors involved must be identified, as well as the legal obligations derived from their position.

Emasesa, in its involvement to ensure the least environmental impact derived from its works, is not only limited to ensuring legal compliance in terms of waste but is also committed to establishing additional control mechanisms. We now describe the actors involved, the legal obligations derived from their position and the control established by Emasesa for compliance.

WASTE PRODUCER

Who is it? (According to Art. 2.e RD 105/2008)

• 1st The physical or legal person holding the planning license in a construction or demolition work; In those works that do not require an urban permit, the natural or legal person who owns the real estate object of a construction or demolition work will be considered as producer of the waste.

• 2nd The individual or legal entity that carries out treatment, mixing or other types of operations that cause a change in the nature or composition of the waste.

• 3rd The importer or purchaser in any Member State of the European Union of construction and demolition waste. We can define it as the owner in whom the decision to carry out the work resides (more commonly: the promoter).

Who is it? (According to Art. 2. ab Law 7/2022)

«Waste producer»: any natural or legal person whose activity produces waste (initial producer of waste) or any person who carries out pre-treatment, mixing or other operations that cause a change in the nature or composition of said waste. It falls on the figure of the builder or contractor. (Fourth additional provision RD 553/20) In the case of shipments of construction and demolition waste, the holder of waste defined in article 2.f) of Royal Decree 105/2008 of 1 December 2008 will be considered the initial producer. February, which regulates the production and management of construction and demolition waste.

It falls on the figure of the builder or contractor.

What obligations does the producer have?

According to the Waste Law (art. 20):

• Ensure proper treatment of your waste. Well done by itself; property entrusted to a merchant, or to an entity or company, all of them registered in accordance with the provisions of the Law; or deliver the waste to a public or private waste collection entity, including social economy entities, for treatment.

• The responsibility of the initial producer or holder of the waste will end when the complete treatment of the CDW is duly documented by means of a certificate or declaration responsible for the final treatment facility.

• Provide companies authorized to carry out waste management with the information necessary for its proper treatment.

• Provide the Local Entities with information on the waste that is delivered to them when it has special characteristics that may cause disruptions in transport, collection, recovery or disposal.

• Immediately inform the competent environmental administration in case of disappearance, loss or escape of hazardous waste or of those that by their nature or quantity may harm the environment.

• As small producers of hazardous waste, you will be obliged to take out insurance or another financial guarantee that covers the liabilities that your activities may give rise to. (Exempt producers of hazardous waste that generate less than 10 tons per year).

According to RD 105/2008 specific to CDW:

• Include in the Execution Project a Waste Management Study (WMS) with the following minimum content (art.4 RD105/2008).

• In demolition, rehabilitation, repair or reform works, make an inventory of the hazardous waste that will be generated, which must be included in the WMS, its storage and shipment to external managers.

• Have the documentation that certifies that your waste has been managed correctly and keep said documentation for 5 years.

• Set up the bond or financial guarantee, if applicable.

This document details the procedures implemented by Emasesa for the operational control of the guidelines for works established in terms of waste.

Level of compliance	Work Phase	Responsibility of the waste producer
Normative legal	Drafting of the project	Draft a Construction and Demolition Waste Study (WMS).
Normative legal	Before the start of the work	Make sure that the contractor draws up the Construction and Demolition Waste Management Plan (WMP) following the guidelines set by the Construction and Demolition Waste Study of the project.
Normative legal	Before the start of the work	Approve the WMP through an approval document and include it in the work documentation.
Listed by Emasesa	During execution	Monitor the correct implementation and execution of the WMP.
Listed by Emasesa	During execution	Inspections during site visits to verify the execution of the measures established in the WMP and good practices. Being able to request and verify the environmental documentation of the work.
Normative legal	During execution	In the event that the builder wants to modify the content of the WMP, such modifications must be reported to the property, which must accept them with a new approval document.

Normative legal	At the end of the execution of the work	Prepare the End of Work Environmental Report, making sure that it includes all the monitoring documentation for construction and demolition waste and relevant information on any environmental aspect that requires special mention.

WASTE HOLDER

Who is it? (Art. 2.e RD 105/2008)

The natural or legal person who has construction and demolition waste in his possession and who does not hold the status of waste manager. In any case, the natural or legal person who executes the construction or demolition work, such as the builder, subcontractors or self-employed workers, will be considered as possessor. In any case, employed workers will not be considered holders of construction and demolition waste.

It corresponds to who executes the work and has physical control of those generated in it (the builder or contractor).

What obligations do you have? (art.5. RD105/2008)

• The holder will be obliged to submit a Waste Management Plan (WMP) to the promoter of the project specifying how the mandatory project management study (WMS) will be applied, as well as to cover its cost. cost and provide the producer with documentation proving the proper management of such waste.

• You must manage the waste yourself or deliver it to an authorized waste manager; for this, you must formalize a waste management contract (if you act as an operator), which includes at least: producer, owner, work of origin (licence of the work, if any) the quantity (t and m3), the type of waste delivered (LER code), and the identification of the manager of the destination operations.

• The owner of the waste will be obliged, while it is in his possession, to keep it in adequate hygiene and safety conditions, as well as to avoid the mixture of already selected fractions that prevents or hinders its subsequent recovery or elimination.

• Comply with the obligations derived from the transfer of waste (RD533/2020). If you act as an Operator.

• From certain thresholds clearly defined in RD105/2008, required the mandatory separation at source of different CDW fractions to facilitate their subsequent recovery.

• Article 30 of Law 7/2022 specifies that, as of July 1, 2022, non-hazardous construction and demolition waste must be classified into, at least, the following fractions: wood, fractions of minerals (concrete, bricks, tiles, ceramics and stone), metals, glass, plastic and plaster. Likewise, those elements capable of being reused such as tiles, toilets or structural elements

will be classified. This classification will be carried out preferably at the place where the waste is generated. As of January 1, 2024, demolition must also be carried out selectively. Pending the regulatory development that modifies the regulations that have not been repealed with the publication of Law 7/2022, non-hazardous construction and demolition waste must be classified at Emasesa works, at least: Concrete, Mineral fractions (brick, tiles, ceramics and stone), Metals, Wood, Glass, Plastics, and Paper and cardboard.

• The owner of the construction and demolition waste will be obliged to bear the corresponding management costs and to deliver the certificates to the producer as well as the rest of the documentation accrediting the management of the waste, and to maintain the documentation corresponding to each calendar year during the next 5 years.

This document details the procedures established by Emasesa for the operational control of the guidelines established in its works regarding waste.

Level of compliance	Work Phase	Responsibility of the waste holder
Listed by Emasesa	Drafting of the project	Request the WMS from the promoter if it is not included in the project.
Normative legal	Before the start of the work	The WMP must identify an Environmental Technician or Environmental Manager of the work, which. will be responsible to ensure the correct drafting and implementation of the WMP.
Listed by Emasesa	Before the start of the work	Analyze the feasibility of executing the objectives set by the WMS. The WMS must establish realistic and feasible objectives and must provide the necessary resources. In the event that these objectives are not viable or an increase in the necessary resources is required to achieve them, a solution must be negotiated and agreed upon with the property.
Listed by Emasesa	Before the start of the work	Write a WMP that allows the fulfilment of the objectives set by the WMS. The content will comply with the provisions of section 5.2. of this document.
Normative legal	Before the start of the work	You must be registered as a producer of hazardous waste.
Normative legal	Before the start of the work	You must be registered with the RERA since you carry out work in which there is a risk of materials that contain asbestos.

Normative legal	During execution	Deliver the signed WMP to Emasesa Technical Services, which must in turn approve the WMP by means of a signed act and include it in the work documentation.
Normative legal	During execution	Condition the waste parks of the work and prepare all the necessary infrastructures to facilitate the work of the operators regarding the management of CDW and remains of environmental vectors and to comply with the law, as established in the WMP.
Normative legal	During execution	Control and ensure that all its workers follow the WMP Rules and take the necessary measures to correct incidents.

WASTE MANAGER

Who is it? (Art. 3.f of the Andalusian Waste Regulation)

Person or entity, public or private, registered by means of authorization or communication, that carries out any of the operations that make up the management of waste, whether or not it is the producer thereof.

What obligations do you have? (Art 7. RD105/2008)

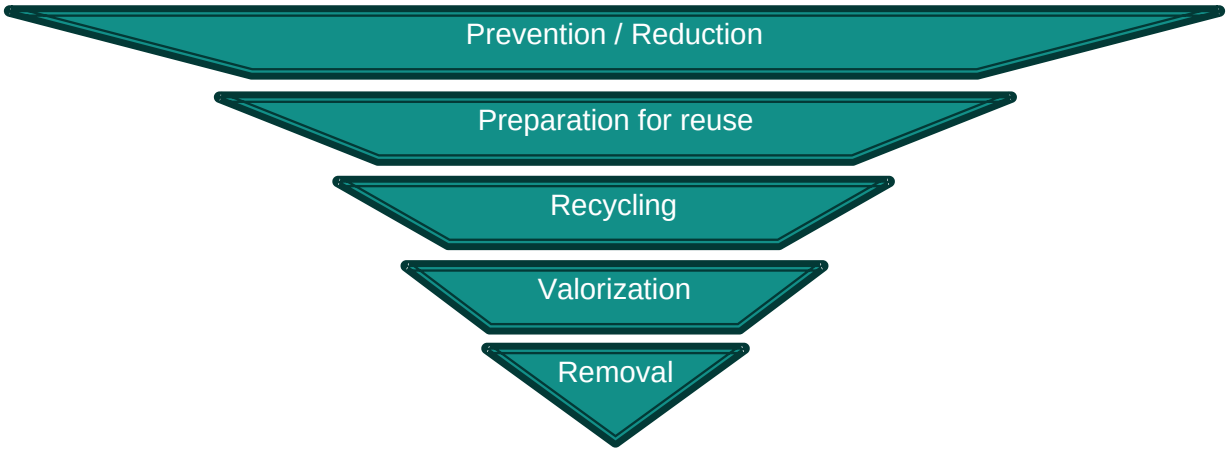
• Keep a Register that ensures the traceability of managed waste (identified by LER) and quantities.

• Keep said information for 5 years and make it available to the competent administration.

• Extend to the holder Certificate of the management carried out, indicating the producer and the License (if applicable) of work. If delivered to a carrier or intermediary, the latter must transmit said Certificate.

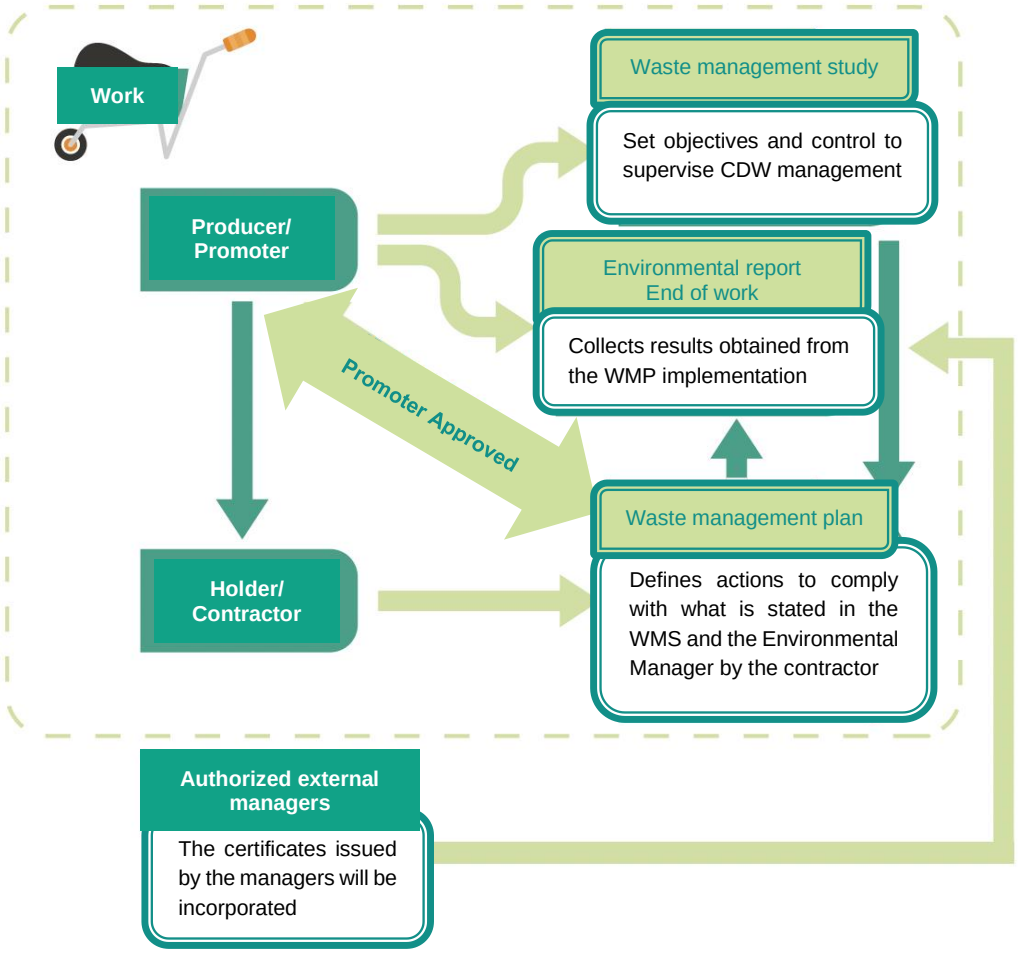
Managers will promote the principles of waste hierarchy by establishing an order of preference of actions in order to reduce and manage waste.

Emasesa will promote the destination of its waste to managers who comply with this hierarchy (art. 8 Law 7/2022).



Documentation generated regarding waste in emasesa works

To understand and learn about waste management, the actors involved must be identified, as well as the legal obligations derived from their position.



WASTE MANAGEMENT STUDY (WMS)

The WMS is carried out by the Producer or Promoter of the work and must contain at least (art. 4 RD105/2008):

1. An estimate of the quantity, expressed in tons and in cubic meters, of the CDW that will be generated in the work, with LER codes.

2. The measures for the prevention of waste in the work object of the project.

3. The reuse, recovery or elimination operations to which the waste generated in the work will be used.

4. The measures for the separation of waste on site for compliance by the holder of the waste, of the obligation established in section 5 of article 5.

5. The plans of the facilities provided for the storage, handling, separation and, where appropriate, other management operations of construction and demolition waste within the work. Subsequently, said plans may be adapted to the characteristics of the work and its execution systems, with the prior agreement of the project management.

6. The requirements of the project's particular technical specifications, in relation to the storage, handling, separation and, where appropriate, other management operations of construction and demolition waste within the work.

7. An assessment of the expected cost of the management of construction and demolition waste that will form part of the budget of the project in an independent chapter.

Emasesa has designed its own system for estimating the amount and type of waste generated in its works and has complemented the Waste Management Study of its works by means of an Environmental annex 2 to the project, which integrates the WMS, the list of possible environmental effects of the action and establishes environmental criteria and good practices that support all phases of the work.

WASTE MANAGEMENT PLAN (WMP)

The WMP is carried out by the Holder or Contractor, must comply with what is stated in the WMS and must be approved by the promoter or producer of the waste.

Below, we indicate the main requirements that must be reflected in the preparation of the WMP:

• The person designated as Environmental Manager who will provide Emasesa with all the information on the measures adopted during the execution of the works must be indicated in the plan.

• Measures that the contractor will adopt as holder of the waste, since it is obliged, while it is in its possession, to keep it in adequate hygiene and safety conditions, as well as to avoid the mixture of already selected fractions that prevents or hinders its subsequent recovery. or deletion.

• How the segregation into fractions of the waste will be carried out, which will preferably be carried out by the holder within the action in which they are produced.

• It will be indicated to which manager the construction and demolition waste is expected to be delivered by the holder, it must be stated in a reliable document, which includes, at least, the identification of the holder and the producer, if applicable. , the work license number, the quantity, expressed in tons or cubic meters, or in both units when possible, the type of waste delivered, coded in accordance with the European list of waste published by Decision 2014/955/ EU of the Commission, of December 18, 2014, which modifies Decision 2000/532/CE, on the list of waste, in accordance with Directive 2008/98/CE of the European Parliament and of the Council or norm that replaces it, and the identification of the manager of the destination operations.

• When the manager to whom the holder delivers the construction and demolition waste only carries out collection, storage, transfer or transport operations, the delivery document must also include the subsequent recovery or disposal manager to whom the waste will be allocated.

• The holder of construction and demolition waste will be obliged to bear the corresponding management costs and to deliver to the producer the certificates and other supporting documentation of waste management, as well as to maintain the documentation corresponding to each calendar year during the five following years.

• Identify the waste that will be generated in accordance with Decision 2014/955/EU of the Commission, of December 18, 2014, by which Decision 2000/532/EC is modified, on the list of waste, in accordance with Directive 2008/98/CE of the European Parliament and of the Council for which the European list of waste is published and to carry out an inventory.

• Plans with the facilities for the management of CDW.

In addition to this, Emasesa establishes in a contractual manner with the contractors, that they must provide together with the WMP:

• Registration as a small producer of hazardous waste.

• Certificate accrediting that it justifies that the hazardous waste originated during the actions that are undertaken because of the service, will be collected by a hazardous waste manager authorized by the competent body.

• Registration as a waste carrier (art. 44 of Decree 73/2012).

• Registration as a producer of non-hazardous waste, if the contractor generates more than 1,000 tons of this type of waste per year, as established in art. 17 of Decree 73/2012, of March 20, which approves the Andalusian Waste Regulation.

Pursuant to the Law on Waste and Contaminated Soils, Law 7/2022, the producer of waste will be the person who produces it as a result of his activity, and it will be this producer who must communicate the activity that produces the waste in accordance with said law, for which reason In the event that non-hazardous non-municipal waste is produced in amounts exceeding 1,000 tons per year, a copy of the annual Declaration of non-hazardous waste producers must be submitted.

• Documentation that certifies the correct final management of non-hazardous waste generated as a result of the contract.

• Documentation proving that all loading, unloading and transport equipment and machinery used in the action are in a position to comply with current regulations: CE marking and/or registration, transport card, ITV, policies and payment receipts for the contracted insurance, maintenance certificates as indicated by the manufacturer.

The contractor in the preparation of the WMP must incorporate:

• Inclusion of the obligations established by the WMS.

• Environmental Responsible for its compliance.

• Manager to whom the previously separated waste will be delivered. Both non-hazardous and dangerous.

• Registration as a waste transporter or contract with an authorized one.

• Registration as a small producer of hazardous waste.

• Responsible Declaration that the machinery has its regulatory documentation.

ENVIRONMENTAL REPORT END OF WORK

In the final phase of the work, when the work Supervisor notifies the end of the work, the producer will prepare the End of work environmental report where the amounts of CDW finally generated will be analysed, the final management carried out with each of the types of waste with landfill canon (earth, clean, mixed, fibre cement), as well as the monitoring of environmental incidents detected in the development of the work during environmental inspections.

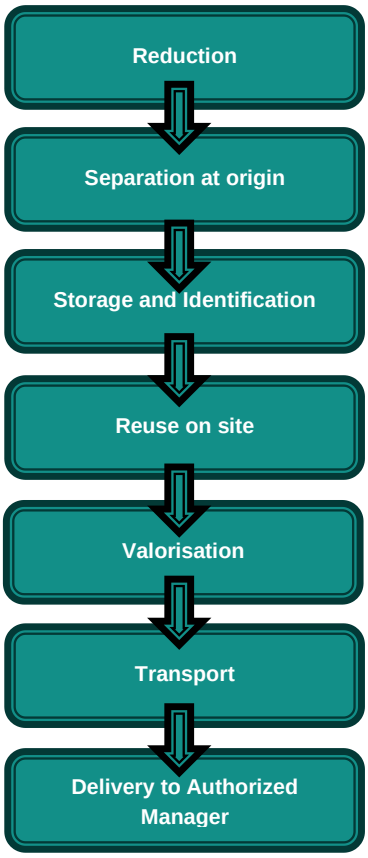
The Final Report is a fundamental link for Emasesa since it is self-instructive in nature and serves to detect deficiencies and/or deviations in the system and thus be able to improve it.

Application requirements in the work phase. Good Practices

In the work execution phase, Emasesa requires the contractor to provide evidence of the correct management of the waste generated, as well as compliance with the environmental requirements that may be applicable, verifying on site that the processes are carried out in an environmentally correct manner.

All the measures established by Emasesa are aimed at applying the principle of waste hierarchy (art. 8 Law 7/2022), for this it is necessary to carry out a correct classification and management on site.

We will focus on good practices to apply in the following operational phases:



REDUCTION IN CDW GENERATION

Emasesa includes in the WMS a series of prevention measures, aimed at reducing the amount of waste generated in the work, for this the contractor must include in the WMP those that have been considered in the design phase and that must be used during the execution phase.

Among the measures aimed at reducing waste generation we find those established in the following Check List, the contractor must establish the measures to be taken in his work, and expose it in the WMP:

PREVENTION IN DEMOLITION TASKS
As far as possible, the demolition tasks will be carried out using selective deconstruction and disassembly techniques in order to favour the reuse, recycling and valuation of waste.
As a general rule, the demolition will begin with the hazardous waste, then the waste destined for reuse, after them the ones that are valued and finally the ones that will be deposited in a landfill.
PREVENTION IN THE ACQUISITION OF MATERIALS
The acquisition of materials will be carried out adjusting the quantity to the actual measurements of the work, adjusting them to the maximum to avoid the appearance of excess material at the end of the work.

Supplier companies will be required to reduce the quantity and volume of packaging as much as possible, prioritizing those that minimize them.
The acquisition of recyclable materials will be prioritized over others with the same benefits but difficult or impossible to recycle.
An inventory of surplus products will be maintained for possible use in other works.
A materials delivery plan will be drawn up detailing the quantity, date of arrival at the work, place and manner of storage on the work, surplus management and, where appropriate, management of waste produced.
The acquisition of "bulk" products will be prioritized in order to limit the appearance of packaging waste on site.
Those containers or material supports that can be reused, such as pallets, will be prevented from deteriorating and will be returned to the supplier.
A penalty clause will be included in the supply contracts for suppliers that generate more waste than expected on site and that can be attributed to poor management.
PREVENTION DURING IMPLEMENTATION
The use of materials on site will be optimized, avoiding overdosing or the execution with waste of material, especially those with the highest incidence in the generation of waste.
Prefabricated materials, in general, especially optimize the use of materials and the generation of waste, so their use will be favoured.
In the commissioning of materials, an attempt will be made to make the various elements to the module of the size of the pieces that compose it to avoid waste of material.
The containers that contain the products are completely emptied before cleaning or disposal, especially if it is hazardous waste.
As far as possible, the production of products in the workshop will be favoured over those made on site, which usually generate a greater amount of waste.
The use of removable or reusable elements will prevail over others with similar non-reusable features.
The useful life of the auxiliary means will be exhausted, favouring their reuse in the greatest number of works for which maintenance measures will be extreme.
All personnel involved in the work will have the minimum knowledge of waste prevention and correct waste management.
PREVENTION IN STORAGE ON SITE

The collection of materials is carried out in an orderly manner, controlling at all times the availability of the different construction materials and avoiding possible damages due to blows, demolition...
Sand and gravel will be collected on a base where it cannot be mixed with other materials to reduce waste.
Materials that harden with water will be protected from soil moisture and stored in areas without moisture.
The prefabricated parts will be stored in their original packaging, in delimited areas for which the circulation of vehicles is prohibited.
Project modifications will be made to favour land compensation or their reuse.
The glass elements that arrive at the work will be protected in order to avoid breaking them. Once the windows with the glasses are in place, they will remain open, with a fixation to avoid the violent closing that could break them.
The liquid products in use will be arranged in areas with little traffic to avoid shocks or blows that could cause spillage due to the overturning of the containers.
A plan of periodic inspections of materials, products and waste collected or stored will be carried out to guarantee that it is maintained in the proper conditions.

SEGREGATION AT ORIGIN

The better the segregation of waste on site, over all that generated in demolition, the better quality of reused material can be produced by managers and which, in turn, could be used in Emasesa's own works: favouring the Circular Economy.

Art.5.5 of RD 105/2008 requires the separation of construction waste from certain production thresholds, and specifically establishes:

Construction and demolition waste must be separated into the following fractions, when, individually for each of said fractions, the planned amount of generation for the total work exceeds the following amounts:

Fraction	Amount (tons)
Concrete	80
Bricks, tiles, ceramics	40
Metal	2
Wood	1
Glass	1

Plastic	0.5
Paper and paperboard	0.5

The art. 30 of Law 7/2022, specifies that, as of July 1, 2022, non-hazardous construction and demolition waste must be classified into, at least, the following fractions: wood, mineral fractions (concrete, bricks, tiles, ceramics and stone), metals, glass, plastic and plaster. Likewise, those elements capable of being reused such as tiles, toilets or structural elements will be classified. This classification will be carried out preferably at the place where the waste is generated.

As of January 1, 2024, demolition must also be carried out selectively. Pending the regulatory development that modifies the regulations that have not been repealed with the publication of Law 7/2022, non-hazardous construction and demolition waste must be classified in Emasesa works, at least:

Non-hazardous construction and demolition waste	Amount (tons)
Concrete Mineral fractions (Brick, tiles, ceramics and stone) Metals Wood Glass Plastics Paper and paperboard	Classification as soon as 0.5 t is generated

However, Emasesa requires its contractors a mandatory segregation in their works regardless of the volume of waste produced.

The segregation into fractions will be carried out preferably by the owner of the construction and demolition waste within the work in which it is produced. When, due to lack of physical space on site, it is not technically feasible to carry out said separation at source, the holder may entrust the separation of fractions to a waste manager at a construction and demolition waste treatment facility outside the site.

Segregation criteria: Adequate separation and not mixing waste with other substances, materials or waste, particularly avoiding those mixtures that are dangerous or make management difficult:

• Hazardous waste will be segregated from non-hazardous waste, storing it independently in accordance with regulations.

• Hazardous waste must be managed in accordance with the specific regulations set forth below.

• Non-hazardous waste will be separated, as a minimum, into inert or stony and non-hazardous.

STORAGE, IDENTIFICATION AND LABELING

The Holder or Contractor is obliged (art.5.4 of RD105/2008) to ensure the hygiene and safety conditions of the waste generated in their works.

We go on to develop the form of on-site storage of waste according to whether it is of a non-hazardous or dangerous nature, given that the regulations on this matter differ from the obligations established for each case. In a generic way we must indicate:

• It must be properly separated, and waste must not be mixed with other substances, materials or waste, particularly avoiding those mixtures that are dangerous or make management difficult (art. 88 Decree 73/2012).

• Likewise, the abandonment, dumping or uncontrolled elimination of waste throughout the national territory and any mixture or dilution of waste that hinders its management is prohibited (art.137 5.e. Decree 73/2012).

• The maximum storage time is defined in the following table (art.23.5.a Law 7/2022) except cases in which the Autonomous Community specifically authorizes it:

Waste type	Storage time
Non-hazardous	Less than 2 years when they are used for recovery and 1 year when they are used for disposal
Hazardous	6 months

Non-hazardous waste

The measures used by Emasesa to achieve correct management in its works involve the application by the contractor of the following requirements:

• The work areas destined for the storage of waste will be suitably signposted and for each fraction there will be signage informing the type of waste contained in each container.

• All waste will be collected in appropriate containers for the waste they are going to contain.

• The waste generated in the work booths produced in office tasks, changing rooms, dining rooms, etc. They will be managed as Solid Urban Waste as stipulated in the regulations governing such waste at the location of the action.

• The metal work containers (vats) must be identified, displaying on the outside, in a visible way, the name of the business name, address and telephone number of the company that owns it, container identification number and municipal code of the responsible company.

• Containers located close to places of public access will be protected outside work hours with tarpaulins or similar to avoid uncontrolled dumping by third parties that may cause mixing or contamination.

• To facilitate waste management, waste collection points will be installed with different containers for each type of waste. For the placement of containers on public roads, the following must be taken into account:

- The containers will preferably be located in front of the performance or as close to it as possible.
- The distances and provisions established for parking lots in the General Traffic Regulations will be respected.
- They may not be located in areas where parking is prohibited, nor in pedestrian crossings, fords, reserves, manhole covers, municipal waste containers, bus lanes, street furniture and other urban elements.
- When located on the sidewalks, a free area will be left for passage, and they must be placed on the edge of the sidewalk, complying in any case with the provisions of current regulations on architectural barriers.

When, due to lack of physical space, in the work, it is not technically feasible to carry out said separation operation at source, the holder may entrust the separation of waste to a manager, in a treatment facility external to the work, obtaining the documentation from the same. accrediting said operation.

In addition to this, the provisions of the Municipal Ordinances of the City Council where the work is located will be addressed:

• Urban hygiene ordinance in the municipality of Camas (Seville).

• Municipal Ordinance for public cleaning and municipal waste management of Dos Hermanas (Seville).

• Municipal Ordinance for street cleaning and urban waste management in Alcalá de Guadaíra (Seville).

• Municipal Ordinance regulating construction and demolition waste in the Municipality of Mairena del Alcor (Seville).

• Municipal Ordinance on public cleanliness and the environment in terms of solid waste in San Juan de Aznalfarache (Seville).

• Regulatory Ordinance No. 12 on the control of waste from works in the municipality of Coria del Río (Seville).

• Municipal Ordinance for public cleanliness of the municipality of La Rinconada (Seville).

In the specific case of Seville, where the Ordinances are highly developed, it is explained below.

Works developed in the municipal term of Seville

The provisions of the Municipal Ordinance on public cleaning and municipal waste management will be followed:

In those works, whose waste production is greater than one cubic meter, the use of works containers will be mandatory.

• Standardized containers designed to be loaded and unloaded on special transport vehicles and which are intended for the collection of construction waste are designated as “containers for works”.

• The placement of construction containers on public roads must be authorized by the Municipal Urban Planning Management by means of the corresponding license, which will indicate the terms for which it is granted.

• The containers of works may only be used by the holders of the authorization. No person can make discharges of any kind in the container, unless authorized by the owner.

• Only construction and demolition waste may be deposited in these containers, and it is expressly prohibited to throw any other kind of waste into them.

• Work containers may only be hired from managers and transporters registered for the management of this waste.

Characteristics of the construction containers

• Notwithstanding the specific descriptions that may be established for the safety of the works in question, to safeguard public safety and urban hygiene, the works containers will have the following characteristics:

- They will be made of metal and their maximum capacity will be determined by the Town Planning Department based on the area and public road.
- They will have the necessary elements for their situation on public roads, as well as for their handling by the vehicles destined for their collection.
- On the outside, in a visible way, they must be identified with the name or business name, address, telephone number and identification number of the container and authorization code as a waste manager of the responsible company, and the person in charge must be reachable by the Services. Municipal.
- They must be painted in colours that highlight their visibility, painting a reflective strip on their corners, and lighting up at night on insufficiently lit roads, when they are occupying the road.

• Construction containers that are not properly identified or are poorly located or outside the established hours may be considered waste and the City Council may acquire their property and may be withdrawn by the municipal services.

Rules for the installation of construction containers

• The containers will be located inside the closed area of the works, or if this is impossible, on sidewalks that are three or more meters wide. Otherwise, the express approval of the proposed situation must be requested.

• In any case, the following prescriptions must be observed in its placement:

- They will preferably be located in front of the work they serve or as close to it as possible.
- The distances and provisions established for parking lots in the General Traffic Regulations will be respected. They may not be located in areas where parking is prohibited.
- They may not be located at pedestrian crossings, fords, parking reservations and stops, unless these reservations have been requested by the work itself.
- They may not interfere with public services, fire hydrants, manhole covers, municipal waste containers, bus lanes, urban furniture and other urban elements.
- Its placement will not modify the location of garbage containers or other urban elements.
- When they are located on sidewalks, a free area will be left for passage, and they must be placed on the edge of the sidewalk, without protruding from the curb and complying, in any case, with the provisions of current regulations on accessibility.
- If they are located on roadways, the free passage will be 3 meters on one-way roads and 6 meters on two-way roads. Likewise, they will be located 0.20 meters from the sidewalk, so that they do not impede the circulation of surface water to the spindles.
- When they are placed in vehicle parking lots, they will be placed so that they take up as little space as possible, placing them perpendicular to the curb when the parking is in a battery, and parallel when the parking is in a line.
- The people or companies that make the vats or containers available to the promoters or owners of the works have the obligation to properly identify them, in accordance with the provisions of article 90.1.

Rules for the use of construction containers

• The installation and removal of the construction containers will be carried out without causing inconvenience to people or goods, without hindering road traffic and respecting, as far as possible, the loading and unloading hours when they are established in the area.

• Construction containers must be used in such a way that their content is not spilled or scattered by the action of the wind or other atmospheric agents.

• The load of waste and materials will not exceed the level of the upper limit of the container box, without authorizing the placement of additional supplements to increase the load capacity.

• In any case, the container must remain closed, except when the waste is deposited in it.

• When vats or containers for construction materials or debris are kept on public roads, full or outside the permitted days and hours, those responsible will be the owners or holders of the works.

• In case of non-compliance with the deadlines, the materials, debris, etc. as well as the vats or containers used may be cleaned and/or removed by municipal services. For its recovery, those responsible must pay the corresponding costs.

Cleanliness and order of the road

In order to prevent and correct the fouling of public roads, the contractor must generally assume the following obligations in relation to cleaning:

• The supply materials, as well as the waste, will be disposed of inside the work in the areas specifically delimited for this purpose.

• The collection of materials on public roads will be carried out in containers and with the appropriate means, always avoiding direct contact with the ground.

• In order to prevent soiling of public roads, the filling of test pits and the replacement of pavements must be carried out as soon as the pipes and/or services that led to their opening have been installed, with the due tests that prove their correct operation. In order to avoid soiling of public roads, immediately after filling the pit, the affected pavement must be replaced. In no case may signs and protective fences be removed until the pavements have been replaced in their original state.

• It is the contractor's obligation to clean the public thoroughfare that is affected by the actions on a daily and systematic basis, including the dirt derived from the transfer of machinery and cargo vehicles through the access and exit road.

• The contracting company will be responsible for cleaning public roads in everything related to loading and unloading manoeuvres, including those corresponding to materials supplied by Emasesa.

• The contractor is responsible, before Emasesa and before the affected City Council, for any non-compliance in this section carried out by transport carried out by vehicles of the company itself, or of subcontracted companies or suppliers of the first, as well as the compensation to which itself could give rise. All costs associated with the necessary measures to ensure this purpose will be assumed by the contractor, understood to be included in the corresponding earthwork prices that make up the project price table, without being considered an independent payment.

Dangerous residues

Hazardous waste is mainly associated with maintenance activities and the use of dangerous substances in construction sites.

The new Law 7/2022, of April 8, on waste and contaminated soils for a circular economy, repeals Royal Decree 833/1988, of July 20, which approved the Regulations for the execution of Law 20/1986, Basic of Toxic and Hazardous Waste (partially in force to date as established

in number 2 of the single repealing provision of R.D. 553/2020, of June 2, which regulates the shipment of waste within the territory of the State).

The bases for the correct management of this type of waste, for its classification, storage and labelling, are based on law 7/2022, of April 8, on waste and contaminated soils for a circular economy.

Based on experience, the main hazardous waste generated in Emasesa works are:

• Material contaminated with fats and oils. Contaminated absorbents (rags, sepiolite).

• Empty contaminated containers (paint, oil).

• Aerosol sprays.

• Used oils.

• Oil filters.

• Pb batteries.

• Fibre cement: LER 17 06 05*Construction materials that contain asbestos.

Although it has been stated and observed in the entity's experience that the volume of hazardous waste generated is very small, we must not forget the measures and standards to be implemented for its storage and identification on site.

The management of hazardous waste according to current regulations is detailed below.

Storage place

• Have a suitable place to store this type of waste, preferably close to its place of origin and with easy access for collection and transportation.

• Keep waste stored in adequate conditions of hygiene and safety. The maximum storage time may not exceed six months.

• Do not mix or dilute toxic waste with other waste, whether classified as hazardous or not, or with other substances or materials.

• It can increase its danger.

• It is a legal obligation.

• It will be necessary to take into account the incompatibilities between the different danger symbols indicated on the identification label. For the elimination of risks based on logical criteria and taking into account the reactivity of the different substances.

• Store toxic waste in accordance with current regulations, including packaging, labelling and signalling actions at its place of production to facilitate its collection, transport and subsequent treatment.

• Identify in detail the spaces dedicated to waste to avoid manipulation.

• The warehouse will follow some guidelines of good environmental practices: waterproof floor, roof, retaining wall around the perimeter of the warehouse, as well as inside it if necessary to divide the space into cells for the placement of different types of hazardous waste in order to avoid mixing in the event of a leak, concrete floor with anti-corrosion paint, retention buckets with collection trays, luminaires.

• The necessary safety and fire extinguishing elements will be available.

• Do not store at a height that makes it difficult to manually remove the container with residue.

• Do not place chemicals or waste exposed to sunlight.

Packing

• Waste must be stored separately according to nature and in approved containers based on its type and danger.

• For liquid waste, the containers themselves may have a spill containment system (IBCs type).

Labelled

All containers or containers containing hazardous waste must be clearly, legibly and indelibly labelled at least in the official Spanish language of the State. In addition to the Authorized manager, this label must include:

a) The identification code of the waste containing LER.

b) Name, address and telephone number of the owner of the waste.

c) Packaging dates.

d) The nature of the risks presented by the waste. Pictograms.

The regulation on the labelling of containers with hazardous waste, Regulation 1271/2008, even though it is in force since June 2017, labels with the old pictograms are still observed.

Asbestos cement

Fibre cement containing asbestos or, generally, construction materials containing asbestos (MCA) is produced during pipe dismantling or replacement works or appears in the remains of old buried pipes. They are regulated by Royal Decree 396/2006 of March 31, which establishes the minimum health and safety provisions applicable to jobs with risk of exposure to asbestos.

Contracting entities must be registered in the RERA (Registry of Companies with Asbestos Risk) and must, depending on the work, have:

• Approval of the Single General Plan, a modality of the work plan for special circumstances of unpredictability or urgency, in which a specific plan is not required, or is not appropriate.

• Specific Plan in case it is certain that the work will generate MCA.

They must execute all the security measures established in said specific documents and only professionals with adequate training and authorized by the competent body may carry out such works.

REUSE

We identify the reuse of materials on site as any operation by which products or product components that are not waste are used again for the same purpose for which they were conceived.

In this sense, the use of elements of the road or the workspace that can be reused for the same initial use would be encouraged, for example, the paving stones of the pavement.

RECYCLING AT THE SITE OF ORIGIN

There are works that, due to their location and size, may be suitable for recycling in situ the separated stone fraction, clean concrete, asphalt, bricks, tiles, etc.

The regulations establish the possibility of being able to recycle this material on the work itself in order to be able to reuse it as filling material, subbases, etc., so that the waste generated on the work is reduced.

In these cases, if the previous tests are satisfactory and the PG-3 requirements of the material foreseen in the project are met, in addition to having the authorizations of the different affected Organizations, Emasesa will favour the use of mobile machinery (screen or crusher). so that they can access the work and can recycle said materials on site in order to be reused in the work itself and minimize the use of natural resources.

As established in article 84 and 85 of the Waste Regulations, said action must be carried out by an Authorized manager for this type of activities, and the following conditions must be met:

• Mobile plants will operate at all times assigned to a work or activity and cannot treat waste that comes from other works or places other than the work in which they are operating, so the use of mobile plants must be provided for in the corresponding works execution project.

• The persons or entities in charge of works or activities that are going to use mobile plants for the recovery of their waste must specify their use in the environmental prevention procedure, so their operation will be subject to the conditions imposed in said procedure.

• In any case, for each planned location of the mobile plant, the person or entity that owns the mobile plant (Authorized Manager) will communicate and present, prior to its entry into service, to the competent body a work plan, which must include, among other things with the written approval of the project management of the means planned for the on-site recovery of construction and demolition waste.

• The time spent by the mobile plant in each work may not, in any case, be greater than the time foreseen for the execution of said work.

VALUATION OF EXCAVATION LANDS. EXCAVATED NATURAL MATERIALS (LER 170504)

As established in article 3.1. an of RD 105/2008, earth and stones not contaminated by dangerous substances reused in the same work, in a different work or in a restoration, conditioning or filling activity, are exempt from the application of said regulations as long as it can be accredited. reliably destined for reuse.

These lands and stones are included in LER 170504 and their valuation is regulated by Order APM/1007/2017 on the general rules for the valuation of natural materials excavated for use in filling operations and works other than those in which they were generated.

In accordance with the Order, those companies that are not registered as managers of non-hazardous waste with the Junta de Andalucía and want to valorise the excavation land produced in a work, the Reference Order applies to them, and they will acquire the status of Valoriser.

The valoriser of the excavated natural lands (entity that will value the lands of one work in another) must comply with the following extremes:

1. The lands must necessarily be used for valorisation, complying with the provisions of article 2.4. of the order.

2. Communication must be submitted prior to the start of the activity before the environmental body: Territorial Delegation of Sustainable Development in Seville (the communication model is Annex I of the Order).

3. It must be verified that the materials to be valued are only excavated and clean natural lands with LER 170504, for this the contractor must deliver to the valoriser a Responsible Declaration ensuring that they comply with the provisions of the legislation applicable to them.

4. They may be valued directly at the destination work or stored there for a maximum period of 2 years (in which case Annex III.B of the Order must be presented along with prior communication).

5. There must be a chronological file of quantity, nature, date, and origin/destination.

6. Once the valuation is completed, a summary of the activity must be presented to the environmental body (the communication model is Annex II of the Order).

The contractor must ensure, in accordance with Order APM/1007/2017, that those companies that are not registered as non-hazardous waste managers by the Junta de Andalucía and act as Valuators, comply with their legal obligations in this regard and specifically:

• Submit communication prior to the start of the activity before the environmental body.

• Present a summary of activity to the environmental body upon completion of the valuation.

Likewise, a sealed copy of having been presented in the registry of the Territorial Delegation of Seville of the Ministry of Agriculture, Livestock, Fisheries and Sustainable Development will be sent to Emasesa.

The documentation proving the delivery must be kept for at least the following five years, in coherence with the provisions of article 64 of Law 7/2022, of April 8.

Emasesa has developed its own models to provide the Valuer with tools for prior and final communication to the environmental agency, making them available to the contractor at the start of the work.

WASTE TRANSPORTATION

In relation to the transport of construction and demolition waste to comply with article 44 of Decree 73/2012 of March 20, which approves the Waste Regulations of Andalusia, only the waste collection and transportation may be carried out by the registered transporting persons or entities.

The contractor must indicate in the Waste Management Plan which companies will transport the waste.

Likewise, it will comply with all the requirements demanded by the legislation for the circulation of vehicles and with those established in the regulations on the transport of dangerous goods, if applicable (circulation permit, technical inspection card in force, etc.).

The vats or containers must be conveniently covered with tarps, in order to avoid falling or spreading dust, and debris must not exceed the side closures.

The transportation of waste must always comply with the requirements established in Royal Decree 553/2020, of June 2, which regulates the transportation of waste within the state. Therefore, all authorized CDW managers must have:

• Waste Treatment Contract between the contractor (acting as producer according to art 2.f of RD553/2020) and the final manager (with Emasesa acting as promoter of the action). The contract must identify the facility of origin and the facility of destination, as well as expressly explain the conditions for accepting the waste.

• Prior notification of the transfer. Applies to all waste shipments that have both their origin and destination in Andalusia:

- All waste intended for disposal.
- Domestic waste mixed and identified with the LER 20 03 01 code, hazardous waste and waste for which it is determined by law, destined for recovery.
- All waste transfers subject to the principle of responsibility of the product producer in the terms established in Title IV of Law 22/2011, of April 8, that are destined for recovery.

Waste shipment operators must submit the notification at least ten days before the shipment takes place.

In order to simplify the process, for the shipments included in Royal Decree 553/2020, of June 2, it is expected that the operator can make a general notification, valid for three years, for waste with similar physical and chemical characteristics that go to the same recipient and installation.

During the transfer, waste transport must be accompanied by its corresponding Identification Document (ID).

DELIVERY TO AUTHORIZED MANAGER

The contractor or holder of the waste will deliver the waste produced in the works to an authorized manager, choosing managers who preferentially allocate it to reuse, recycling or other forms of recovery operations and only, as a last option, its disposal in a landfill.

The contractor must ensure that the managers, both intermediate and final facilities, to whom the waste is delivered, are appropriately authorized, requesting their corresponding GRU and NIMA number.

Regarding Hazardous Waste, the construction contractor, since the production of hazardous waste does not exceed 500 kilograms/year (according to Emasesa's experience), must sign a transfer contract with an authorized hazardous waste manager, through which This is subrogated to the obligations of the producing person or entity, such as the Annual Declaration of Hazardous Waste Producers.

WASTE TRACEABILITY

The traceability of waste is ensured with full compliance with the legal obligations of each of the actors involved in the works.

However, Emasesa requires traceability of all its waste and especially:

• Non-hazardous waste:

- Generation of soil and other excavation and emptying products (LER 170504).
- Generation of metal scrap (LER 170407).
- Generation of mixed CDW (LER 170107).
- Generation of CDW, ceramic material, debris, organic waste, metal, wood, glass, plastic, paper and cardboard.

• Dangerous residues:

- Generation of fibre cement CDW (LER 170605).
- Empty containers (Aerosols, paints, sealants, etc.).
- Filters, remains of paint and asphalt sheets, etc.

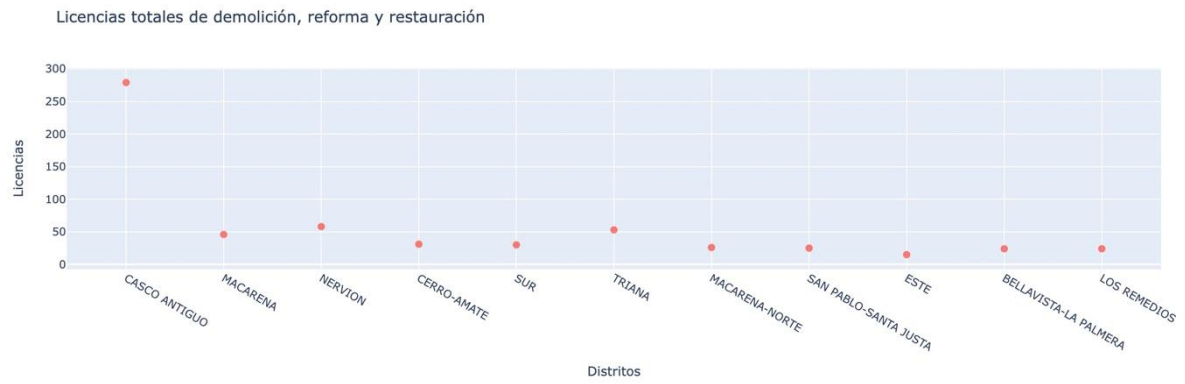
With the frequency indicated by the Emasesa technical services, the holder must deliver a report that includes, at least, the following information:

• Amount of waste generated, segregated by type.

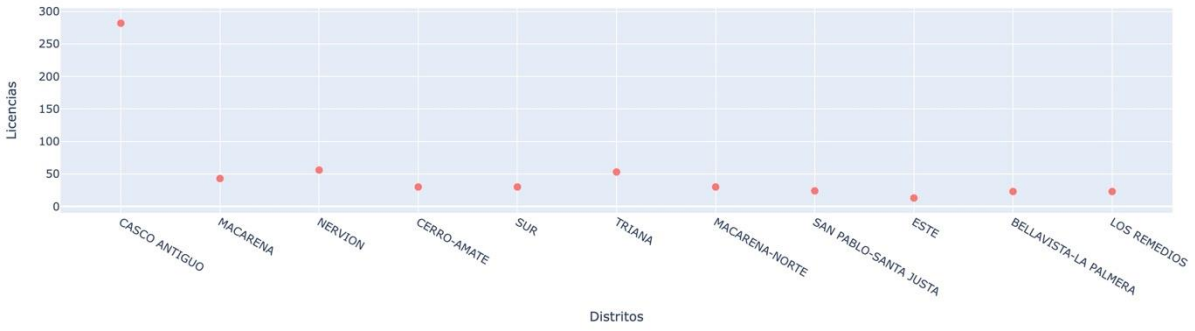
• Documentation proving that the construction and demolition waste produced on the site has been managed, where applicable, on site or delivered to a recovery or disposal facility for treatment by an authorized waste manager.

ANNEX VIII. ML ANALYSIS BY LIPASAM MANAGERS (CDW PRODUCTION)

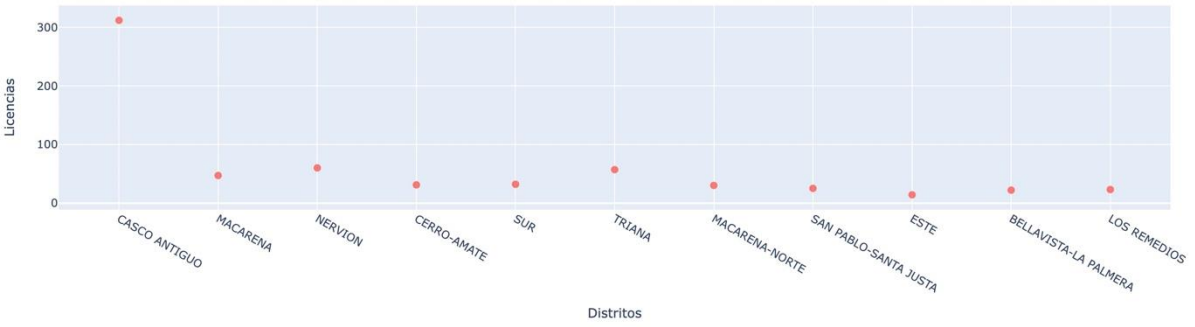
2023_ Evolution of CDW production



2025_ Evolution of CDW production

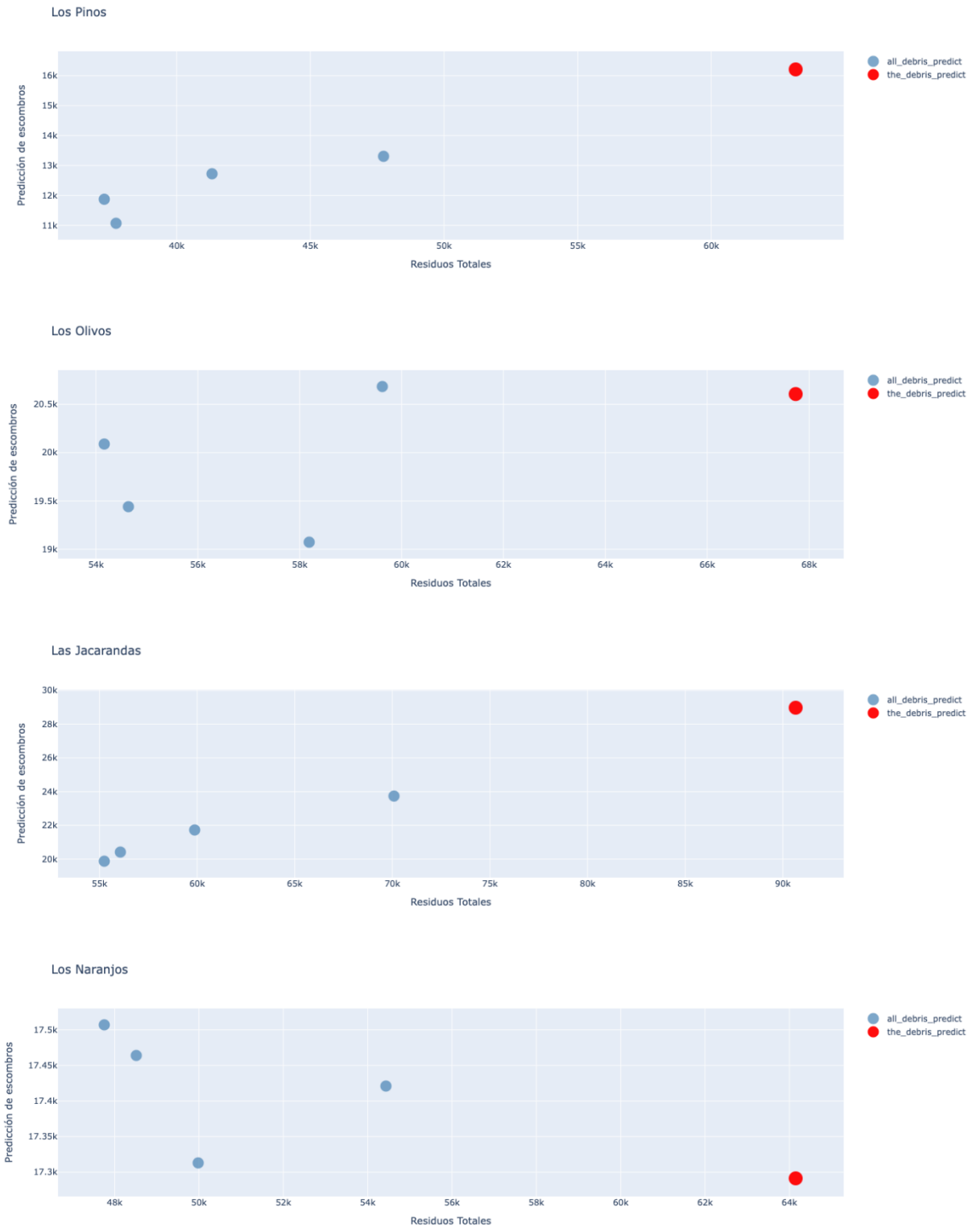


2040_ Evolution of CDW production

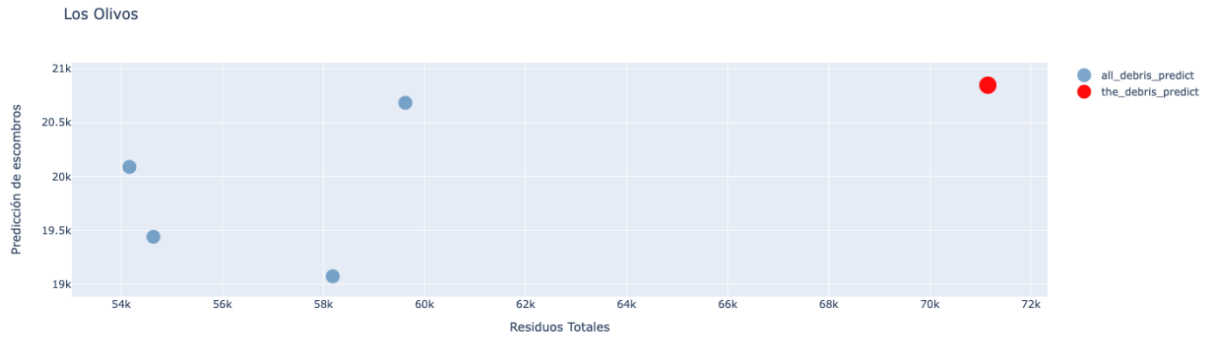


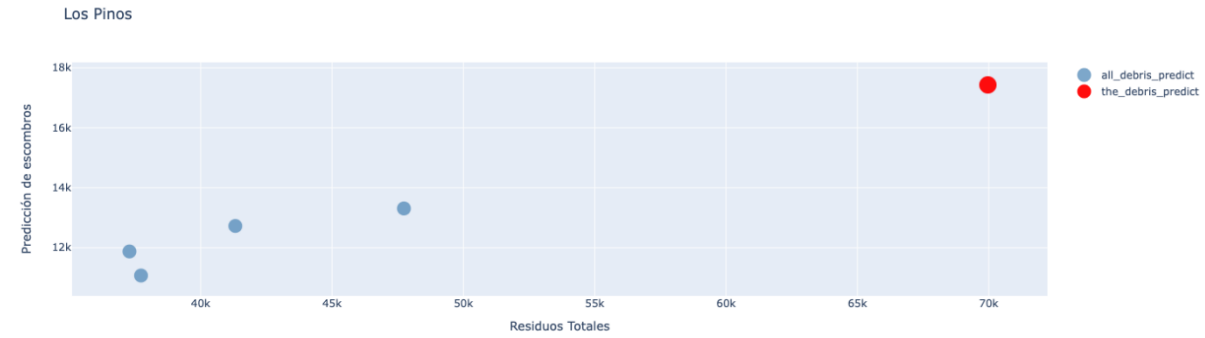
ANNEX IX. ML ANALYSIS BY LIPASAM MANAGERS (CLEAN POINTS)

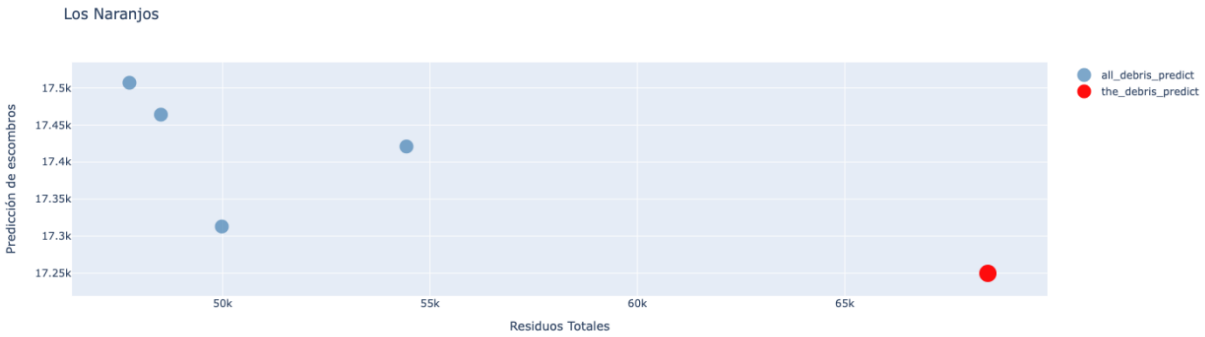
2023_Evolution of CDW collected by Clean Points



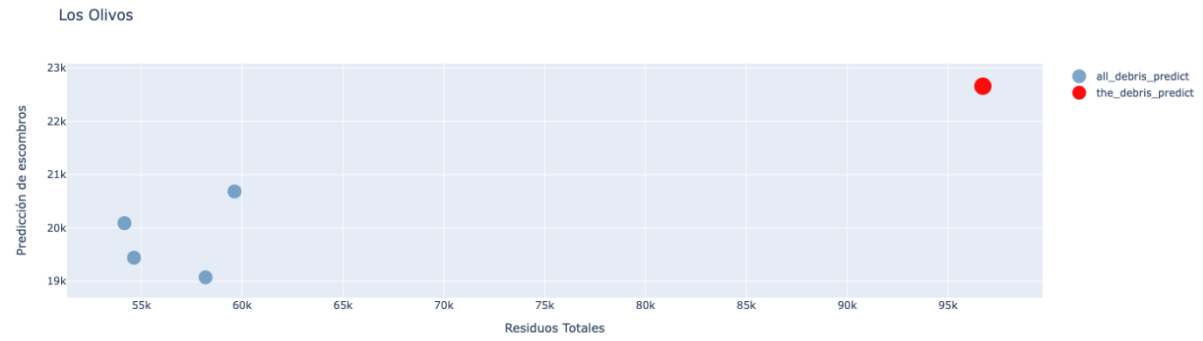
2025_ Evolution of CDW collected by Clean Points

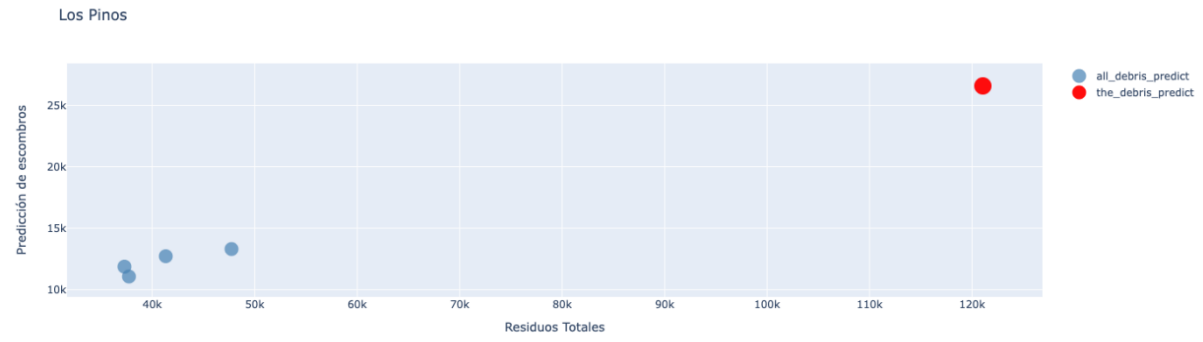


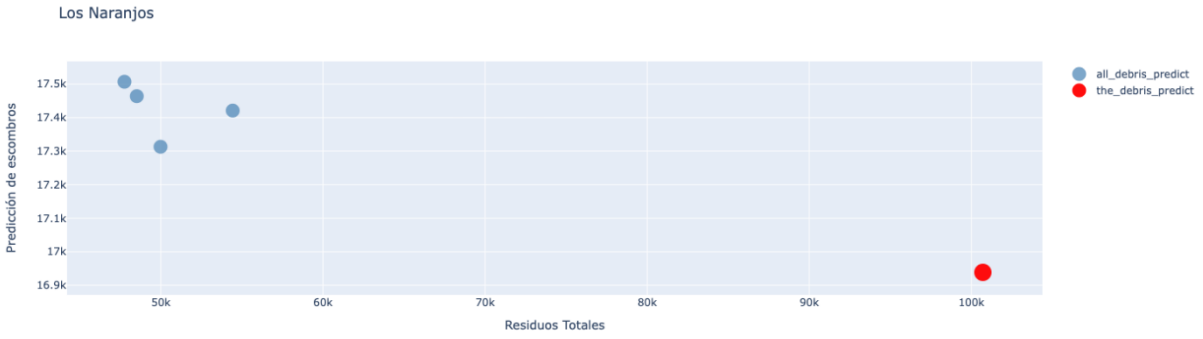


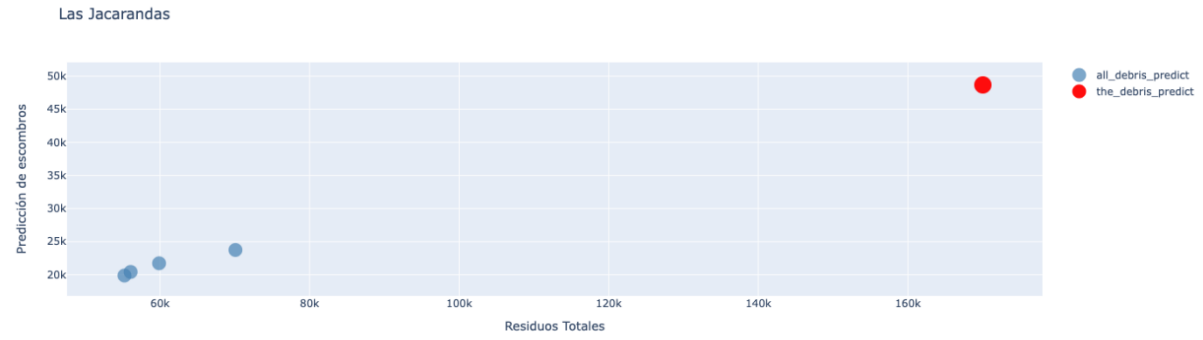


2040_ Evolution of CDW collected by Clean Points









ANNEX X. EXAMPLE OF SURVEY

LIPASAM

CITYLOOPS

PPLL LAS JACARANDAS

ENCUESTA PARA LA MEJORA DE LA PRESTACIÓN DEL SERVICIO DE PUNTOS LIMPIOS.

RESIDUOS DE CONSTRUCCIÓN Y DEMOLICIÓN (ESCOMBROS)

Pedimos su colaboración en la cumplimentación de esta encuesta con la finalidad de mejorar nuestro servicio de recogida de residuos en Puntos Limpios. Los datos recogidos serán usados con fines estadísticos, con objeto de ayudar en el análisis de posibles mejoras, en el marco del proyecto europeo CityLoops, en el que participa LIPASAM.

Marque con una X y rellene cuando sea necesario

P1. TIPO DE USUARIO QUE DEPOSITA LOS RESIDUOS.

☐ Particular

☐ Profesional

P2. CANTIDAD DE RESIDUOS DEPOSITADOS

Aproximación en Kg, volumen (m3), nº de sacas, etc.

_____

P3. ORIGEN DE LA OBRA

Aporte el mayor detalle posible (Distrito y/o Barrio y/o calle).

_____

P4. FECHA DE REALIZACIÓN DE LA ENCUESTA

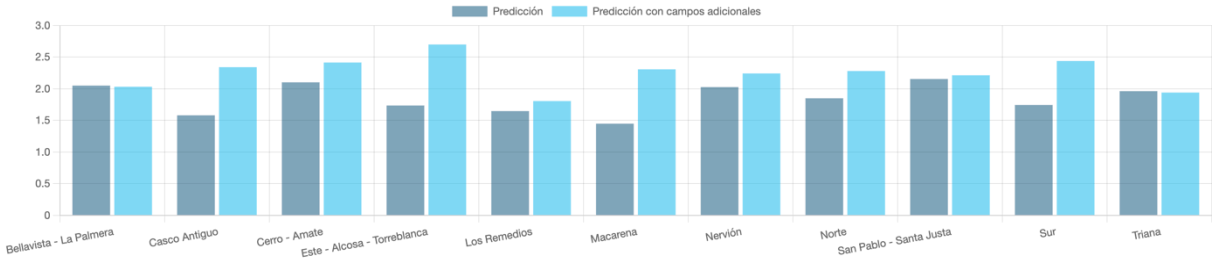
_____

Este proyecto ha recibido financiación del programa de investigación e innovación Horizonte 2020 de la Unión Europea en virtud del acuerdo de subvención n. ° 821033.

Illustration 2. Example of survey carried out in Seville Clean Points to get information for optimising their activity. This survey tries to identify, type of user (citizen/professional), quantity of CDW deposited, spatial origin of the construction work and date of the survey.

ANNEX XI. ML ANALYSIS BY MUNICIPAL MANAGERS

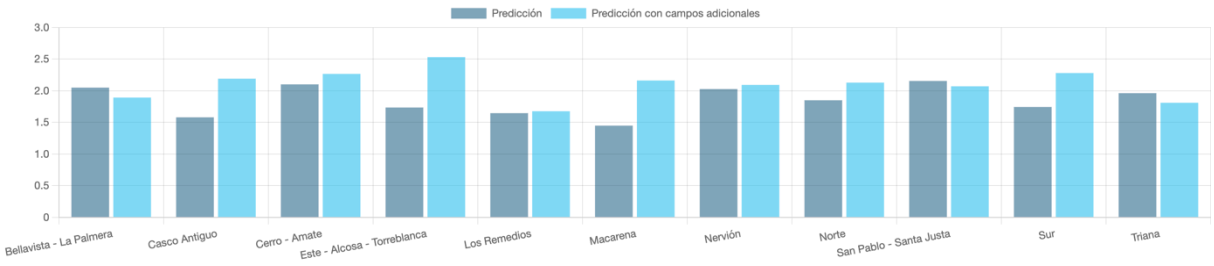
Vehicles_2021 (Environmental data)



Resultados de la Regresión Lineal Multivariante

Distrito	Predicción de Puntuación de Bienestar	Predicción de Puntuación de Bienestar con campos adicionales
Bellavista - La Palmera	2,0508	2,0425
Casco Antiguo	1,5815	2,3525
Cerro - Amate	2,1030	2,4261
Este - Alcosa - Torreblanca	1,7363	2,7114
Los Remedios	1,6484	1,8112
Macarena	1,4494	2,3119
Nervión	2,0277	2,2471
Norte	1,8502	2,2879
San Pablo - Santa Justa	2,1559	2,2263
Sur	1,7452	2,4419
Triana	1,9630	1,9464

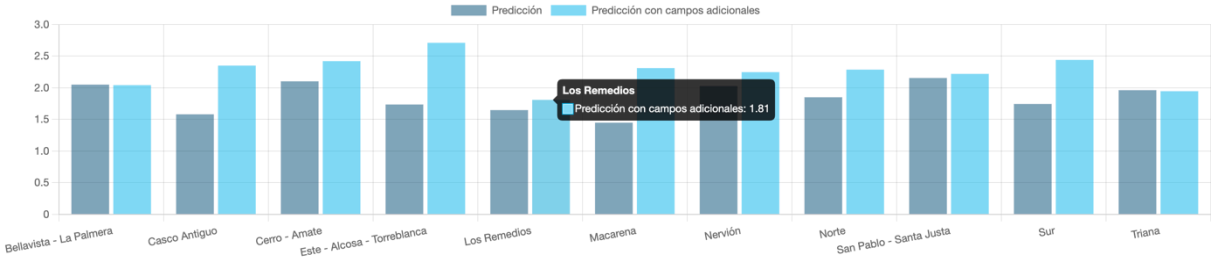
Average Income_ 2021



Resultados de la Regresión Lineal Multivariante

Distrito	Predicción de Puntuación de Bienestar	Predicción de Puntuación de Bienestar con campos adicionales
Bellavista - La Palmera	2,0509	1,8935
Casco Antiguo	1,5815	2,1915
Cerro - Amate	2,1024	2,2676
Este - Alcosa - Torreblanca	1,7365	2,5330
Los Remedios	1,6473	1,6777
Macarena	1,4499	2,1635
Nervión	2,0279	2,0936
Norte	1,8510	2,1298
San Pablo - Santa Justa	2,1562	2,0718
Sur	1,7450	2,2810
Triana	1,9632	1,8111

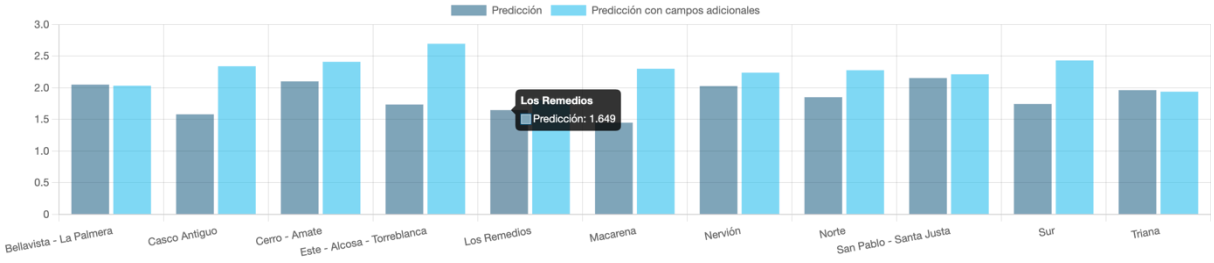
Organic separate collection_2021



Resultados de la Regresión Lineal Multivariante

Distrito	Predicción de Puntuación de Bienestar	Predicción de Puntuación de Bienestar con campos adicionales
Bellavista - La Palmera	2,0506	2,0426
Casco Antiguo	1,5815	2,3514
Cerro - Amate	2,1031	2,4218
Este - Alcosa - Torreblanca	1,7366	2,7113
Los Remedios	1,6484	1,8096
Macarena	1,4491	2,3119
Nervión	2,0279	2,2477
Norte	1,8508	2,2875
San Pablo - Santa Justa	2,1556	2,2202
Sur	1,7450	2,4415
Triana	1,9627	1,9466

Housing rentals_2021



Resultados de la Regresión Lineal Multivariante

Distrito	Predicción de Puntuación de Bienestar	Predicción de Puntuación de Bienestar con campos adicionales
Bellavista - La Palmera	2,0508	2,0339
Casco Antiguo	1,5815	2,3415
Cerro - Amate	2,1024	2,4111
Este - Alcosa - Torreblanca	1,7363	2,6962
Los Remedios	1,6487	1,8072
Macarena	1,4496	2,3016
Nervión	2,0279	2,2395
Norte	1,8519	2,2781
San Pablo - Santa Justa	2,1548	2,2141
Sur	1,7450	2,4328
Triana	1,9635	1,9391

CITYLOOPS

CityLoops is an EU-funded project focusing on construction and demolition waste (CDW), including soil, and organic waste (OW), where seven European cities are piloting solutions to be more circular.

Høje-Taastrup and Roskilde (Denmark), Mikkeli (Finland), Apeldoorn (the Netherlands), Bodø (Norway), Porto (Portugal) and Seville (Spain) are the seven cities implementing a series of demonstration actions on CDW and soil, and OW, and developing and testing over 30 new tools and processes.

Alongside these, a sector-wide circularity assessment and an urban circularity assessment are to be carried out in each of the cities. The former, to optimise the demonstration activities, whereas the latter to enable cities to effectively integrate circularity into planning and decision making. Another two key aspects of CityLoops are stakeholder engagement and circular procurement.

CityLoops started in October 2019 and will run until September 2023.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 821033.

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