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**LIFE11 ENV/ES/000506**

**FINAL Report**

**Covering the project activities from 01/10/2012<sup>1</sup> to 31/03/2018**

Reporting Date: 20/09/2018

**Rehabilitation of a heavy metal contaminated riverbed by  
phytoextraction technique (RIVERPHY)**

Project Data

<b>Project location</b>	Region of Murcia - SPAIN
<b>Project start date:</b>	01/10/2012
<b>Project end date:</b>	31/03/2017 <b>Extension date:</b> 31/03/2018
<b>Total Project duration(in months)</b>	66 months ( including <b>Extension of 12 months</b> )
<b>Total budget</b>	1,714,651 €
<b>Total eligible budget</b>	1,714,651 €
<b>EU contribution:</b>	835,622 €
<b>(%) of total costs</b>	48.8%
<b>(%) of eligible costs</b>	48.8%

Beneficiary Data

<b>Name Beneficiary</b>	Servicio de Planificación y Evaluación Ambiental. Dirección General de Medio Ambiente y Mar Menor Consejería de Empleo, Universidades, Empresa y Medio Ambiente de la Comunidad Autónoma de la Región de Murcia
<b>Contact person</b>	Mr Francisco José Murcia Navarro
<b>Postal address</b>	Calle Catedrático Eugenio Úbeda 3
<b>Visit address</b>	Calle Catedrático Eugenio Úbeda 3
<b>Telephone</b>	+34 968 228 878
<b>Fax:</b>	+34 968 228 828
<b>E-mail</b>	franciscoj.murcia@carm.es
<b>Project Website</b>	www.liferiverphy.eu

**List of key-words and abbreviations**

Ayto Lorca: Ayuntamiento de Lorca  
CHS: Confederación Hidrográfica del Segura  
DGCalAmb: Dirección General de Calidad Ambiental  
DGMA: Dirección General de Medio Ambiente  
DGMedNal: Dirección General de Medio Natural  
EC: European Commission  
GARSA research group: Gestión, Aprovechamiento y Recuperación de Suelos y Aguas  
(Sustainable Use, Management and Reclamation of Soil and Water) research group  
PB: Plenary Board  
PSC: Project Steering Committee  
SDGMA: Subdirección General de Medio Ambiente  
UPCT: Universidad Politécnica de Cartagena

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## 2. Executive Summary

The main objective of this project was to evaluate, demonstrate and disseminate a sustainable alternative for the environmental and landscape rehabilitation of a stretch of the contaminated Guadalentín River after its flow along the industrial area and urban nucleus of Lorca. Riverbed and banks soils were contaminated, and vegetation cover was degraded owing to former direct waste spills coming from industries (mainly tanneries), farms (swine) and agriculture (excess of fertilization with swine slurries). The project has tried to achieve this objective by using the technique of phytoextraction, which contributes to transfer heavy metals and excess of nutrients from soils to plants (which have been removed from the system periodically), and the recovery of native vegetation cover to restore the natural communities of flora and fauna, mitigating soil erosion as well. With the decrease of heavy metals and salts in soil, and restoration of riparian vegetation we have tried to achieve the reestablishment of a stable ecological equilibrium that is coordinated with its surroundings in order to attain ecological holism, taking always into account the role of local population and traditional activities for their integration in the landscape restoration.

In order to achieve the main objective “implementing methods for rehabilitation of a stretch of the contaminated River Guadalentín by means of phytoextraction”, the detailed objectives are summarized as follows:

- To reclaim contaminated soils from riverbed and banks using the technique of phytoextraction. With this, several selected accumulator native plant species were used to uptake metals and ions from the sediments. Plants have been periodically removed for metals final disposal, and new plants have been planted to replace the removed ones.
- To protect slopes, by means of techniques of bioengineering and landscape integration, and restore native vegetation cover in riversides and slopes, to mitigate the erosion process and recuperate the ecological equilibrium of the ecosystem.
- Energetic management of the residual contaminated biomass generated in phytoextraction actions and recovery of the extracted metals to be incorporated in the manufacturing of other product, such as concrete.
- To monitor the evolution of soil properties (mainly metals and ions), as well as vegetation in the restored area.
- To rehabilitate landscape based on ecological planning and design.
- To disseminate and transfer the experience and knowledge generated at provincial, national and European level by means of public information and manual technique adapted to different stakeholders.

Table 2.1. Deliverable products of the project (final report).

<b>Name of the Deliverable</b>	<b>Number of the associated action</b>	<b>Deadline</b>
Initial characterization	B.1	30-09-2013
Monitoring methodology report	B.5	31-12-2015
Landscape design plan	B.6	24-02-2014
Report of seminars, workshops, courses	D.1	31-12-2017

The project consisted of 21 actions from 5 categories (1 preparatory action, 6 technical actions, 2 monitoring actions, 8 dissemination actions and 4 project management actions). The main deliverable products for the project are showed in Table 2.1. Up to date, all actions are concluded:

*A. Preparatory actions:*

Action A.1 Preliminary activities. October 2012 - December 2013.

Completed action. The Hydrological, Geotechnical and Geophysical studies were carried out and delivered. The removal of debris and wastes was moved to actions B.2 and B.3 and carried out immediately before plantation. After evaluation of the hydrological study there was no need for channel creation. A path was improved in the riverbed for provide access to carry out all actions.

*B. Implementation actions:*

Action B.1 Initial characterization of soils and vegetation. February 2013 - September 2013.

Completed action. This action began in February 2013, with the soil and vegetation sampling of the entire river stretch (1500 m length) on 11/02/2013. We collected 120 soil samples at three different depths and samples of the most dominant plant species. Samples were analysed and totally characterized.

Action B.2 Phytoextraction in sediments. March 2014 - December 2017.

Partially completed action. This action started in March 2014 (11/2/2014) with the authorization to write the plantation project. The plantation project was delivered by the subcontracted company INFOSUR S.L. in July 2014 (31/7/2014) but the contract between the DGMA and the joint venture companies (AVANCE Y DESARROLLO DE OBRAS S.L. and URDINTER INFRAESTRUCTURAS, S.L.) was not signed until April 2015. The plantation project did not start in April 2015 due to the weather conditions (heat and dry soil conditions for plants), so the plantation project started in October 2015. In autumn of 2015, the contaminated biomass was harvested and the phytoextractive species were planted in stretch 1 (general area). In autumn of 2016, the contaminated biomass from stretches 1, 2 and 3 (general area) was harvested and the phytoextractive species were planted in the stretches 2 and 3 and were re-planted in the stretch 1. The third and last biomass harvesting were postponed from autumn 2017 to summer 2018. The third harvesting was carried out after the end date of the project in order to meet the project's objectives and the reason of performing the tasks in summer was due to the administrative delays and the problems encounter with the the joint venture companies (AVANCE Y DESARROLLO DE OBRAS S.L. and URDINTER INFRAESTRUCTURAS, S.L.). This last harvesting has been carried out only in stretches 2 and 3 of the general area, in this way, since 2015, 2 biomass harvestings have been carried out in each stretch (2 biomass harvesting in stretch 1 (years 2015 and 2016) and 2 biomass harvesting in stretches 2 and 3 (years 2016 and 2018)). The plots of the experimental area (stretches 1, 2 and 3) were established and planted in October 2015. A total of 5 applications of natural chelating agents and microorganisms were performed (June 2016, September 2016, January 2017, April 2017 and June 2017). This experimental study covered from autumn 2015 to autumn 2017.

Action B.3 Slopes protection and revegetation. September 2016 - March 2018.

Incompleted action. The slope protection and revegetation project was ready since November 2016 and from December 2016 to March 2017 was under tender process. The implementation of the slope project was delayed by the modifications that had to be realized in the proposal and the administrative complexities of the procurement procedure of the Public Administration of Murcia Region. Finally, the project could not be executed due to all the administrative delays that occurred during the hiring period. Given the high cost of execution

of the project, neither the coordinating partner nor the rest of the partners have been able to assume it with their own funds. The coordinating partner in this situation has prioritized the execution of the biomass cleaning tasks (action B.2).

Action B.4 Energetic use of residual contaminated biomass. June 2015 - October 2015; October 2016 - March 2018.

Completed action. The first transport of biomass was made in October 2015. The second transport was made in September 2017. The third transport will be carried out after the end date of the project.

Action B.5 Evolution of soils and vegetation. October 2015 - January 2018.

Completed action. Two annual vegetation and biomass studies and 2 annual soil and vegetation samplings were carried out between 2016 and 2017 (general zone and experimental zone). In October/November 2016 were carried out the studies of the vegetation and the biomass at the general area (stretch 1) and at the experimental plots (stretches 1, 2 and 3). Moreover, in October/November 2016 were carried out the samplings of soil and plant at the general area (stretch 1) and at the experimental plots (stretches 1, 2 and 3).

In October 2017 were carried out the second study of the vegetation and the biomass at the general area (stretches 1, 2 and 3) and at the experimental plots (stretches 1, 2 and 3). And in October 2017 were carried out the samplings of soil and plant at the general area (stretches 1, 2 and 3) and at the experimental plots (stretches 1, 2 and 3).

A total of 27 rhizospheric soil sampling were carried out biweekly (June 2016 - September 2017) for the study and the monitoring of soil properties with the application of natural chelating agents and microorganisms

Action B.6 Environmental recovery and landscape design. October 2013 - February 2018.

Completed action. The Landscape Design Plan was ready since 24/02/2014. The interpretative itinerary project was completed March 2018 (phase 1: spring 2017; phase 2: March 2018(end project)). The decision aid model was completed in February 2018.

*C. Monitoring of the impact of the project actions:*

Action C.1 Monitoring the effectiveness of true soil rehabilitation. January 2016 - March 2018.

Completed action. This action started in January 2016 and was completed with the reports generated in actions B5 and B6.

Action C.2 Monitoring the socioeconomic impact. January 2014 - March 2018.

Completed action. A total of 349 socioeconomic questionnaires were carried out. The socioeconomic questionnaires were mainly delivered to the attendees of the project's dissemination activities. The report of this action was delivered in March 2018.

*D. Communication and dissemination actions:*

Action D.1 Dissemination and Communication Plan. November 2012 - March 2018.

Completed action. The Dissemination and Communication Plan was updated after the extension of the completion date of the project (first amendment). The plan satisfactorily fulfilled all the proposed objectives for the dissemination phase of the project: contacts, dissemination of the main objective of the project, participation in dissemination activities and communication of the objectives and actions and results of the project.

Indicators achieved:

- The Communication and Dissemination Plan of the project is drawn up within the determined / fixed deadlines.
- The dissemination actions included in the plan are implemented.

Deliverable products: **7.3.4. Dissemination and Communication Plan (D.1).pdf** and **7.3.5. Dissemination and Communication plan (D.1, updated 2018).pdf**

Action D.2 Public website. December 2013 - March 2018.

Completed action. The public website of the project ([www.liferiverphy.eu](http://www.liferiverphy.eu)) started on 17 February. Besides, the social networks twitter, facebook, youtube and LinkedIn were used to disseminate information and news of the project.

Indicators achieved:

- There is a public and exclusive website of the project with relevant and updated information on the project, in Spanish <http://liferiverphy.eu/web/> and English <http://liferiverphy.eu/web/en/>
- All the dissemination materials are available on the web.
- The maximum threshold of success defined during the writing of the proposal is exceeded.
- The proposed objectives related to the visits received are satisfactorily fulfilled.

Deliverable products: **7.3.6. Report on website and social networks (D.2).pdf**

Action D.3 Notice boards. April 2014 - March 2018.

Completed action. Two notice boards were designed and installed since April 2014 at the beginning and at the end of the study area to restore, including the objectives, expected results, and main details. Every single month their good conditions have been checked.

Indicators achieved:

- The panels are designed and installed within the set deadlines.
- The panels are installed in the selected locations and will be maintained for at least 5 years after the completion of the project, until the year 2023.

Deliverable products: **7.3.7. Notice boards (D.3).pdf**

Action D.4 Publication of information/publicity material. November 2012 - March 2018.

Completed action. Several publicity materials and informative documents about the project have been disseminated: leaflets, posters, notebooks, folders, stickers, pens, caps, usb´s 4 Gb, methodological manuals of visits, videos, newsletters, scientific papers, presentations, TV interview, radio interviews, news in press, calendars and documents of academic training.

Indicators achieved:

- All the materials included in the Dissemination and Communication Plan are edited and designed (Action D.1).

Deliverable products: **7.3.8. Report on publicity material (D.4).pdf**

Other deliverable products:

- Leaflet: **7.3.9. Leaflet (D.4).pdf**
- Poster: **7.3.10. Poster (D.4).pdf**
- Initial video: **7.3.11. Initial video of the project (D.4).mp4**
- Final video: **7.3.12. Final video of the project (D.4).mp4**
- Newsletters Spanish: **7.3.14. 2014-2018 Newsletter 1-12 (Spanish) (D.4).pdf**

- Newsletter English: **7.3.13. 2014-2018 Newsletter 1-12 (English) (D.4).pdf**
- Layman´s Report: **7.3.1. Layman´s report (EN, ES) (D.1).pdf**

Summary of all advertising material:

- 2.000 leaflets
- 1.000 posters
- 1.100 notebooks
- 200 folders (100 units bicolor and 100 units tricolor)
- 200 stickers
- 500 pens
- 300 caps
- 225 USB´s 4 Gb
- 325 methodological manuals of visits
- 1 initial video (200 units CD/DVD)
- 1 final video (only digital format)
- 12 newsletters
- 4 scientific papers
- 1 Layman´s report
- 26 presentations
- 1 mailing list with more than 100 contacts
- 1 TV interview
- 4 radio interview
- 113 news in press
- 1 calendar
- 4 documents of academic training

Action D.5 Technical visits. January 2014 - March 2018.

Completed action. A total of 13 technical visits (208 visitors) have been performed between 2016 and 2018.

Indicators achieved:

- 208 technical visits organized

The indicators of progress for the visits had a regular success (between 100-500).

Number high and secondary high school: 2

Number of universities: 4

Number of associations: 2

The indicators of progress for the high and secondary schools, universities and associations interested in the project had a regular success (between 2-4). On the other hand, the success of educational entities (high and secondary schools and universities) interested in the project had a good success (>4).

Deliverable products: **7.3.15. Report technical visits (D.5).pdf**

Action D.6 Training course. January 2017 - August 2017.

Incompleted action. The summer course was fully organized for July 2017 but could not be given because the minimum number of students enrolled was not reached.

Indicators achieved:

- The summer course "Contaminated soils: new environmental recovery trends" was organized and prepared (Contaminated soils: new environmental trends of recovery, 11-14 July, 2017) covered from January to July 2017.

- The training course had to be canceled due to not having reached the minimum number of students accepted (10 students) and the indicators of progress for this Action could not be quantified despite all the efforts for its realization.

Deliverable products: **7.3.16. Report training course (D.6).pdf**

Action D.7 Workshops and seminars. January 2016 - December 2017.

Completed action. Between 2016 and 2017 there were 2 workshops (June 2016 with 161 attendees, and November 2017 with 40 attendees) and 2 seminars (February 2017 with 35 attendees and May 2017 with 40 attendees).

Indicators achieved:

- The number of people involved (assistants) and the success obtained in the events held are below:
  - 35 people involved in the seminar 1 carried out in February 2017. Indicator of progress: regular success.
  - 40 people involved in the seminar 2 carried out in May 2017. Indicator of progress: regular success.
  - 161 people involved in the workshop 1 carried out in June 2016. Indicator of progress: good success.
  - 40 people involved in the workshop 2 carried put in November 2016. Indicator of progress: good success.

Deliverable products: **7.3.17. Report on workshops and seminars (D.7).pdf**

Action D.8 Assistance to fairs and conferences. October 2013 - March 2018.

Completed action. Twelve contributions have been presented (5 orals and 7 posters) in national and international congresses between 2013 and 2018.

Indicators achieved:

- Attendance at 12 events: 5 national, 3 European and 4 international, including in all of them the presentation of 12 abstracts of the project (abstracts), in addition to 5 oral presentations and 7 posters.
- The level of the indicator reached is considered "high" with respect to the indicators included in the Communication and Dissemination Plan.

Deliverable products: **7.3.18. Report fairs and confer. (D.8).pdf**

*E. Project management and monitoring of the project progress:*

Action E.1 Project management by DGCalAmb. October 2012 - March 2018.

Completed action. Thirty eight meetings have been organized to control the tasks developed by each beneficiary and to deal with the delays in the project (33 meetings only partners, 4 meetings with the monitor and 1 meeting with the Desks Officers and the monitor).

Indicators achieved:

- All partners are integrated and participate in the daily work of the project.
- The objectives proposed in the project's actions are achieved, and all the milestones and deliverables of the project are achieved.
- All official project reports are completed.

Deliverable products: **7.1.2. Control of attendance 2012-2018 (E.1).pdf**

Action E.2 Networking with other projects. January 2014 - March 2018.

Completed action. There were 4 networking meetings with Life projects. Moreover, there were networking activities with a total of 11 Life projects.

Indicators achieved:

- A networking network is established with the following projects:
  - LIFE+ I+DARTS
  - LIFE+ BIOXISOIL
  - LIFE+ MIPOLARE
  - DISCOVERED LIFE
  - LIFE+ TETRACLINIS-EUROPA
  - LIFE ECOREMED
  - LIFE CLEANSED
  - LIFE BIOREM
  - LIFE RESOIL
  - LIFE HORTISED
  - SEKRET LIFE
- Meetings and networking activities are organized, including field visits: LIFE+ I+DARTS organized the networking in Oviedo (Spain, June 2014). LIFE+ RIVERPHY and LIFE+ MIPOLARE organized the networking in Cartagena (Spain, January 2015). LIFE+ BIOXISOIL organized the networking in Madrid (Spain, October 2015). LIFE+ DISCOVERED LIFE organized the networking in Zaragoza (Spain, April 2016).
- Number of visits to the website (per month): 1443 visits (monthly average from November 2013 to March 2018). The success has been good.
- Number of contributions to the forum (per year): 9 contributions. Only 9 contributions have been made to the Riverphy forum. The reason why no more contributions were made was due to the fact that the interested people who entered in the website preferred to download the information directly from the published news that instead of registering in the forum.
- Number of petitions of information from different stakeholders (per year): 13. The project has received the 13 requests of information between November 2013 and March 2018 (4 requests from university students, 2 from high school teachers, 4 from project managers of Life projects, 3 from companies). The success has been good.
- Number of people involved in the networking: 15-20 people. The success has been between bad and regular.
- Number of stakeholders registered in the webpage: initially, it was thought that the interested people would register on the project website to receive the project information. However, afterwards it was decided that it was better to send updated information to the interested parties: schools of professionals, educational centers, assistants to visits to project events (technical visits, seminars, workshops, etc.). With these contacts, a mailing list was elaborated and the information was sent periodically.

Deliverable products: **7.1.17. Final report networking (E.2).pdf**

Action E.3 Audit.

Completed action. The audit finished on July 31, 2018. The company ACR Auditores audited the Life project Riverphy from July 1 to July 31, 2018. The company was nominated by the

coordinating beneficiary and they verified the statement of expenditure and income provided to the EC.

Indicators achieved:

- A correct audit of the project is carried out by the ACR Auditores.

Deliverable products: **Annex 8.11-Independent Audit Report LIFE11ENVES000506 (E.3).pdf**

Action E.4 After LIFE Communication Plan

Indicators achieved:

- An appropriate plan is developed to continue disseminating and communicating the results of RIVERPHY to all interested parties and the general public once the project is finished.

Deliverable products: **7.3.2. After Life comm. plan (E.4).pdf**

The results obtained in Riverphy project were visible and the indicators of progress were, in general, immediately and some partially. With this project, we carried out the rehabilitation of a stretch of 1500 m of the contaminated Guadalentín River after its flow along the industrial area and urban nucleus of Lorca. The project improved soil physical, chemical and biological conditions, which guarantee the development of microbial communities and plant colonization, essential to long term soil formation and evolution and will decrease the risk of erosion, by water and wind. In the whole, we mean to achieve a landscape restoration based on ecological criteria.

After the end of the project, we will continue the dissemination actions with the aim to involve more potential contaminated soils with tanning and farming activities. Tanning companies, farmers and the public administration will be involved in the process of transferability and replication of this methodology by promoting the adoption of the methodology in the development of future policies affecting the treatment and recycling of potential contaminated soils with tanning and farming activities as well as in Green Public Procurement. On the other hand, Life Riverphy results transferability and replicability could be fostered with the recently created Office for Socioeconomic Promotion of the Environment of the General Secretary of the Ministry of Water, Agriculture and Environment of the Region of Murcia.

The activities of Riverphy, from the technical evaluation to the dissemination, have contributed to consolidate the knowledge base for the development of environmental policy and legislation relative to waste management (related to tanning activities and livestock) and soil functioning at local and regional level. More precisely, the project Riverphy may contribute to the effective implementation of the Thematic Strategy on soil and the achieved results allow updating some directives and policies as. Also, but no less important, Riverphy could contribute to the objectives of the Thematic Strategy of waste and natural resources.

The EU added value of the project is guaranteed by the industry related to leather and pig production, besides the wish of the local and regional administration to regenerated degraded zones derived from tanning and farming activities, in order to reduce risks and recover the natural ecosystems.

### 3. Introduction

#### – Description of background, problem and objectives

In the city of Lorca, the problem arises for the extension of contaminated sediments by heavy metals (mainly Cu, Zn and Cr) along the Guadalentín riverbed. No permanent water flows along the riverbed, carrying water after rainfall events. The transfer of solved metals in water and contaminated sediments contributes to the contamination of Segura River, which is used for irrigation of croplands. The source of the contamination was the spill of tannery wastes (rich in Cr) and pig slurries from close farms (rich in Cu and Zn) in the last century.

The main objective of Riverphy was to evaluate, demonstrate and disseminate a sustainable alternative for the environmental and landscape rehabilitation of a stretch of the contaminated Guadalentín River after its flow along the urban nucleus of Lorca. The project achieved this objective by using the technique of phytoextraction, which contributed to transfer heavy metals from sediments to plants (which have been removed from the system), and the recovery of native vegetation cover to restore the natural communities of flora and fauna, mitigating soil erosion. With the decrease of heavy metals in soil, and restoration of riparian vegetation we achieved the reestablishment of a stable ecological equilibrium that was coordinated with its surroundings in order to attain ecological holism, taking always into account the role of local population and traditional activities for their integration in the landscape restoration. For this purpose, several selected accumulator native plant species were used. An energetic management of the residual biomass generated in the phytoextraction was designed by transportation to a concrete factory, with recovery of the extracted metals to be incorporated in the manufacturing of concrete. To protect slopes, we tried to apply techniques of bioengineering and landscape integration, and to restore, to cover and to mitigate the erosion process and to recuperate the ecological equilibrium of the ecosystem we tried to apply native vegetation.

The expected results of this project were the decontamination of the riverbed stretch and the recovery of the riparian vegetation. The project improved soil physical, chemical and biological conditions, reducing the contents in heavy metals and salts, which guarantee the development of microbial communities and plant colonization, essential to soil functioning. In the whole, we achieved a landscape restoration based on ecological and aesthetic criteria. Thus, since the polishing of metals is a difficult and expensive task, the extraction of metals by use of vegetation, that reduces and prevents the dispersion of the contamination through wind and water erosion, and improves the aesthetic value of the river, has been a possible solution for the rehabilitation of a contaminated river. The harvested biomass was transported to a concrete factory where it was combusted, and fly ashes were incorporated in the production of concrete. We quantified 15880 kg (estimating 4500 kg for the third transport) of dry biomass in total for the entire stretch (12 ha) and for the total duration of the project has been generated, equivalent to 8.85 MW/h of energy. With regards to improvements in soil quality, we quantified at least a decrease in Cr and Zn of 15% in the duration of the project (Cu concentrations remain similar). With regards to vegetation, we expected an increment in vegetation cover from <50 to 75% in the total surface of the riverbed area.

#### – Expected longer term results

The project can help to implement the Soil Thematic Strategy on the protection of soil including soil biodiversity and the restoration of degraded soils, as well as implementing the 'priority area' approach contained in the proposal for Soil Framework Directive for the soil degradation processes. Our results could feed in updates of the Strategy to improve soil recovery and rehabilitation, providing data about the suitability of phytoextraction. These outcomes could be necessary if the Soil Framework Directive proposal is resumed.

## 4. Administrative part

We consider necessary to clarify in this point that the regional administration of Murcia Region has been reorganized several times between 2012 and 2018. The new executive organ of the SDGMA (coordinating beneficiary of the Life project Riverphy) belongs the Consejería de Empleo, Universidades, Empresa y Medio Ambiente and Mr. Antonio Luengo Zapata was appointed as the General Director of Medio Ambiente and the legal representative of the Dirección General de Medio Ambiente y Mar Menor from April 2018. The vat number has always been S-3011001-I for all of them (DGCalAmb, DGMedNal, DGMA and SDGMA) during the whole time of the project.

### 4.1 Description of the management system

The management chart has been the one foreseen in the project proposal and consisted of:

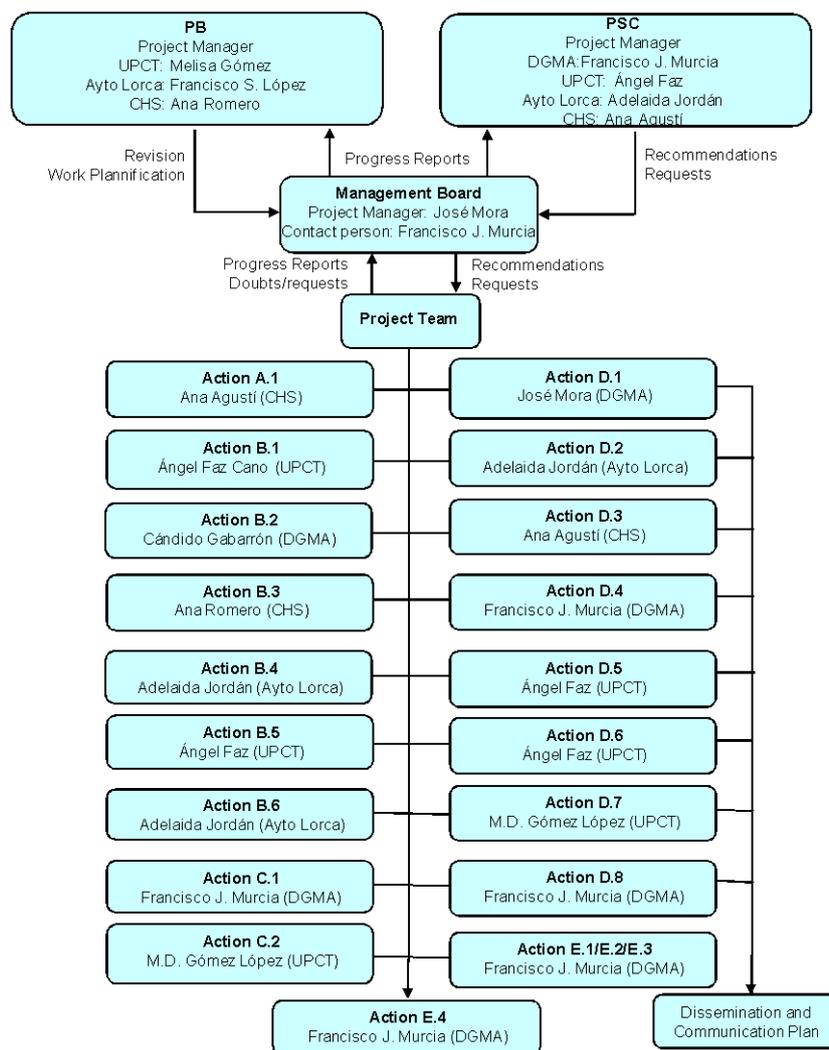


Figure 4.1.1. Management chart of Riverphy project.

The planning and development of the project has been based on 3 fundamental phases:

**PHASE 1: INITIAL PHASE.** Preliminary activities (action A.1). It included the collection of information, planning of dissemination and awareness activities, as well as the consolidation of the project's steering committee. Months 1-15 of 66.

**PHASE 2: EXECUTION PHASE.** Implementation activities (actions B.1-B.6), monitoring the impact of the project activities (actions C.1-C.2), communication and dissemination activities (actions D.1-D.8) and management and monitoring of the project progress activities (actions E.1 and E.2). This was the main phase of the project and covered the months 16-63/66.

**PHASE 3: FINAL PHASE.** Completion activities (action E.3 and E.4). This was the last phase (between the months 63-66) and it was based mainly on the analysis and balance of the costs and results obtained in the actions involved in the initial and execution phases.

All phases have made possible to obtain a final evaluation of the project and to recommend a plan of actions and methodologies to apply to soil decontamination and rehabilitation by the phytoextraction technique. A planning about the progress of the planned actions is shown in the Gantt-chart (**annex 7.1.1**).

#### 4.2 Evaluation of the management system

The management of the project has been developed keeping an updated monthly control of all the actions. Numerous meetings were organized by the coordinator to deal technical, financial and dissemination items about Riverphy project between 23/10/2012 and 13/03/2018 (**annexes 7.1.2-7.1.7**). Besides, several meetings were celebrated with the external monitor of the project (6 meetings, the last one was organized after the end of the project (on 11/4/2018)) and on 8/10/2015 (1 meeting) with the Desk Officers of the EC. All in all, the management (and therefore the execution) of the project has been seriously influenced by administrative difficulties and complexities. In this way, two amendments to the partnership agreements were carried out. The first amendment was signed in October 2016 (for extending the project's end date by 12 months). And the second amendment was notified on 23/3/2018 (explaining the budgetary changes between the costs of the external assistance and consumables categories) and duly signed by the Commission on 24/04/2018; the request for the second amendment also included an extension of the completion date of the project due to the delays mentioned in actions B2 and B3 (this request was not approved). During the implementation of the project there have been 38 meetings among the beneficiaries to deal with the problems encountered, to manage the project plan and the contingency measures, to readjust the schedule, to assist the partners with development of tasks and to solve administrative problems. From the beginning of the project, the coordinating beneficiary intensively worked to get the transfer of the first prepayment done to each beneficiary by the Public Treasury of the Regional Government, and to have all agreements signed. CHS invested a lot of efforts to proceed with all administrative steps to have authorization to sign the bilateral assignment. Ayto Lorca was in charge to contact the company Holcim Carboneras to transport the biomass, since the factory in Lorca, included in the proposal, closed up.

We have encountered 4 main problems during the implementation of the project (during the first 18 months and the last 18 months) which made us have delays, no release of deliverables and no achievement of milestones on time in some cases. However, these problems do not compromise completely the continuity and viability of the project:

- The bilateral agreements between the coordinating beneficiary and the associated beneficiaries were not signed until 22/05/2013 by UPCT and by Ayto Lorca, and until 22/01/2015 by CHS. This delay in the signature of the agreements was due to two main reasons. First of all, the agreements were erroneously established as subsidy, and subsidies

were not allowed in this type of projects by the EC. Thus, a new agreement indicating only transfer of money was developed. Secondly, CHS (as Spanish State Organism) could only sign the agreement after a favourable report of the Lawyer of the Spanish State and authorization of the Council of Ministers.

- The lack of signature of the bilateral agreements, and the bad economic conditions of the Government of the Region of Murcia, with lack of liquid money to face all their expenses, delayed the transfer of the quantities of the first pre-payment made by the EC to the associated beneficiaries. This provoked that no liquid money was available by any beneficiary, so that most tasks, except for some of them developed by UPCT and by CHS, were not executed until summer 2013.

- After the delay of one year for the two problems explained above, we started the procedure to start with action B.2, by writing the phytoextraction project and by choosing the company in charge of its execution. This procedure started by the coordinating beneficiary on 11/03/2014 in order to start with this action in October/November 2014. However, the administrative process in the Regional Department of Water and Agriculture took longer than expected, and the document with the project implementation was not delivered to the Office of Contracts until 14/01/2015. After that, the public tender process started, and the signature of the agreement with the company was not developed until 17/04/2015. Since planting only can be carried out in autumn under the Mediterranean semiarid climate of SE Spain to ensure the survival of vegetation, the works started on 07/09/2015, with the removal of debris and current vegetation in the first stretch. The planting started in October 2015. This meant a delay of two years with regard to the original proposal.

- During the years 2016 and 2017, the development of the actions B.2 (phytoextraction in sediments) and B.3 (slopes protection and revegetation, its execution and contracting) suffered important delays due to several factors. Action B.2 was affected by the bad weather conditions and the breach of the technical specifications and the slowness (along with the lack of a larger number of operators) by the contracted joint venture companies (AVANCE Y DESARROLLO DE OBRAS S.L. and URDINTER INFRAESTRUCTURAS, S.L.). And the action B.3 was affected by the modifications that had to be realized in the project proposal and the administrative complexities of the procurement procedure of the Public Administration of Murcia. These drawbacks modified and delayed the timetable planned. The accumulation of setbacks and the slowness of the regional administration to perform the project contracting have caused a considerable delay in the execution of the actions B.2 and B.3 which have prevented them from being completed totally before the final end of the project (31/03/2018).

The Partnership agreements were submitted to the EC with the inception report on 30/6/2013 (DGMA and UPCT; DGMA and Ayto Lorca) and the mid-term report on 30/9/2015 (DGMA and CHS). See **annexes 7.1.8-7.1.10**. See also the **annexes 7.1.11** and **7.1.12** (personal secondments). The communication with the EC and the monitoring team (Borja Domínguez from NEEMO-IDOM) has been very fluid. When we have had questions or problems regarding any action of the project, first we have contacted the monitoring team who always have helped us clearly, concisely and quickly.

The activity reports have been sent to the EC according to what was established in the proposal and grant agreements:

- Inception report: 30/6/2013 (**annex 7.1.13**)
- Progress report: 1/4/2014 (**annex 7.1.14**)
- Mid-term report: 30/9/2015 (**annex 7.1.15**)
- Progress report: 1/2/2017 (**annex 7.1.16**)
- Final report: 30/6/2018 (postponed to 15/9/2018)

## 5. Technical part

The following actions have been completed after March 2018 (mainly for the release of the reports):

- Action B.4 will finish in September 2018 (depending on the entrance date of biomass to the treatment plant).
- Action B.5 finished in June 2018.
- Action C.1 finished in June 2018.
- Action C.2 finished in April 2018.
- Action D.1 finished in April 2018.
- Action D.6 finished in April 2018.
- Action E.4 finished in April 2018.

### 5.1. Technical progress, per task

Below is the development of each of the actions, taking into account that this final report covers from 1/10/2012 to 31/3/2018 (66 months):

*A. Preparatory actions:*

#### **Action A.1 Preliminary activities.**

**Objectives:** to remove all kinds of debris, wastes, rubbish etc. accumulated in the selected stretch of the Guadalentín riverbed and banks in order to be able to access for site preparation and increasing their aesthetic value; to use a mechanical assistance for creating a drainage system (channel) in the river bed to avoid flooding of the whole area after rainfall episodes and to make different technical studies for the determination of some specific information in the riverbed with respect to the hydrological conditions prevalent in the site, stability of natural layer materials and sediments, identification of layer thickness of artificial fill, delimitation of the contact sediments-substratum, determination of changes in salinity and contamination in a depth, etc.

**Beneficiary responsible for implementation:** CHS.

**Duration:** October 2012 - December 2013 (proposed duration: October 2012 - March 2013).

**Indicators of progress:**

- Degree of completion of the removal of debris, wastes and invasive species in December 2012.
- Report on results from hydrological study in January 2013.
- Report on results from Geotechnical study in March 2013.
- Report on results from Geophysical study in March 2013.

**Tasks performed:** at the beginning of the project and for its correct implementation, it was necessary to remove all kinds of debris, wastes, rubbish, etc. accumulated in the selected stretches of the Guadalentín riverbed and banks in order to be able to access for site preparation and increasing their aesthetic value. Moreover, we thought to use a mechanical assistance for creating a drainage system (channel) in the river bed to avoid flooding of the whole area after heavy rainfall episodes. This channel was thought to be dimensioned taking into account a return period of 10 years. This drainage system would include a trapezoidal

ditch with a superficial stone layer for the purpose of dissipating energy during the high flows and favouring infiltration of water to reduce (prevent) the risks of flooding. On the other hand, we wanted to construct a way in the riverbed in order to provide the access to realize next actions. This way (path) would be used as an item for landscape design (Action B6) and dissemination (action D1). The next activity would be the removal of invasive (non-native) plant species and the maintenance of native species in riverbed and banks to preserve native riparian vegetation. The removal of debris and invasive plants would be carried out not only in the proposed stretch for rehabilitation (12 ha), but also in the surroundings to avoid rapid invasion of exotic vegetation and to transport of debris and wastes to the zone. During these preliminary activities it was also necessary to make different technical studies for the determination of some specific information in the riverbed with respect to the hydrological conditions prevalent in the site, stability of natural layer materials and sediments, identification of layer thickness of artificial fill, delimitation of the contact sediments-substratum, determination of changes in salinity and contamination in a depth, etc. This information was performed in the following studies: a hydrological study, a geotechnical study, and a geophysical study.

After several meetings, all the beneficiaries agreed that it was better to remove debris, wastes and exotic species before any plantation campaign rather than at the beginning of the project, since new flooding or dumps may reintroduce the debris. The same arised for the road amelioration for the passing of trucks. Thus, the beneficiaries agreed to move this task to actions “B.2 Phytoextraction in sediments” and “B.3 Slopes protection and revegetation”, since the result was going to be more efficient to achieve the objective of plantation. This task, which was supposed to be finished by December 2013, was planned in autumn 2015, 2016 and 2017 before each plantation or restoration campaign (actions B.2 and B.3). The hydrological, geotechnical and geophysical studies were carried out. The hydrological study was done on time according to schedule, however the geotechnical and geophysical studies should were ready by March 2013, but owing to the exposed problems encountered the studies were ready in December 2013. The three studies were delivered in the Progress Report (1/4/2014), see **annexes 7.2.1-7.2.3**).

After a thorough assessment of the hydrological study, the partners realized that there was no need for a channel construction within the riverbed. The reduced flow of this river is retained upstream by two dams, where water is used for irrigation. Even though the river periodically reaches important flows after torrential precipitation events, the normal situation is the absence of a permanent flow. In any case, after a water avenue by torrential rainfall the functionality of the drainage channel disappears, since the flow becomes so high that a simple channel is not able to drain the high volume of water flowing. We attached a report from CHS, the Basin Authority, explaining this fact as annex in the progress report (**annex 7.2.4**). Thus, the budget assigned for debris removal, invasive plants removal and improvement of access has been used in action B.2. And the budget originally foreseen to create the drainage channel has not been incurred finally.

## ***B. Implementation actions:***

### **Action B.1 Initial characterization of soils and vegetation.**

**Objectives:** to characterize the riverbed soil and vegetation.

**Beneficiary responsible for implementation:** UPCT.

**Duration:** February 2013 - September 2013 (proposed duration: April 2013 - September 2013).

#### **Indicators of progress:**

- Report on results for soils before phytoextraction.
- Report on results for vegetation cover, richness and biodiversity.
- Report on results for metals in plants.

**Tasks performed:** the characterization of soil sediments is essential (the riverbed is covered by sediments transported by flooding that become soil with their stabilization and development of vegetation), with the purpose of analyzing its environmental risks, restoration possibilities and ecological stabilization. Although we have information about the degree of contamination of the river, a detailed sampling and characterization was crucial to establish different patches with different degree of contamination in the selected stretch, necessary to adopt strategies for phytoextraction (action B.2) and ecological and landscape planning (action B.6). In addition, before starting restoration activities based on phytoextraction, a general characterization was necessary, since the obtained information was very useful to determine the changes that would take place in soil and vegetation. This characterization consisted of determining the physical, chemical and biochemical properties of soil samples from the riverbed and sides, and the inventory of vegetation, vegetation cover and level of contaminants in plants. On the base of the results of this characterization, the plantation of different accumulator native species and the maintenance of present vegetation was decided.

The initial characterization of soils and vegetation began in February 2013, with the sampling of the entire river stretch (1500 m length) on 11/02/2013. This action had to start in April 2013, but we decided to start in advance to justify that we were prone to implement the project despite the problems which made us delay most actions. We selected 60 sampling spots and collected soil samples at three different depths in half spots (0-20 cm, 20-50 cm, 50-100 cm) and from 0-20 cm in the remaining 30 sampling spots (Figure 5.1.1). In addition, 10 individuals of the most dominant plant species along the riverbed (*Suaeda vera*, *Atriplex halimus*, *Tamarix africana* and *Salsola oppositifolia*) were collected, separating roots, stems and leaves for analyses. Soil and plants samples were taken to GARSA research group laboratory at UPCT and were pre-treated for analyses. All analyses were carried out and reports were written by September 2013, under schedule. The Deliverable “Initial Characterization of the Sediments” was delivered as **annex 7.2.5** in the progress report (1/4/2014). Within this action, an analysis of the heavy metals content in the sediments of the Guadalentín riverbed was carried out. Afterwards, their relationship with other soil properties were assessed, and we determined if there were contamination in the riverbed. Later, we carried out the delimitation of the specific areas where sediments had to be decontaminated. For this purpose, we selected those spots where the total concentration of heavy metals exceeds the reference generic levels proposed for the Region of Murcia (32 mg/kg for total Cu, 105 mg/kg for total Zn and 66 mg/kg for total Cr). Total concentration of Cu was not very

high in the riverbed, with only two contaminated areas up to one meter depth at the western side of the studied stretch (the nearest area to the city of Lorca).

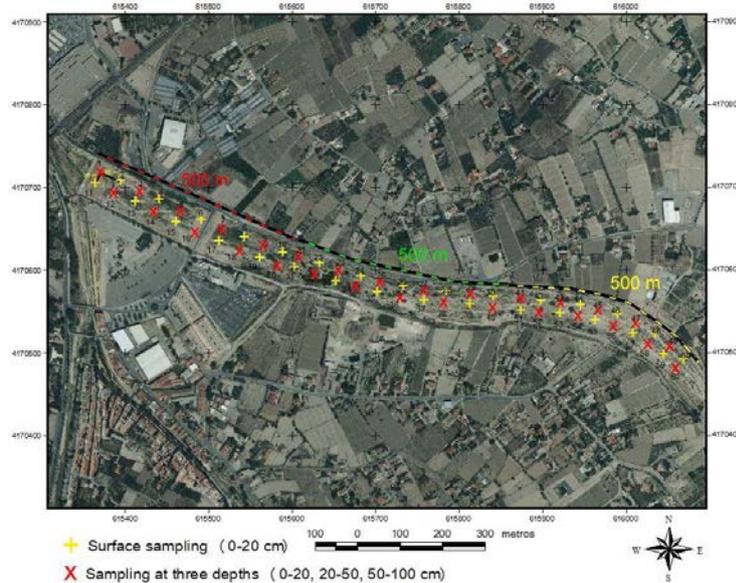


Figure 5.1.1. Sampling grid.

The total concentration of Zn was below the reference levels in practically all the studied stretch. The total concentration of Cr surpassed the reference generic levels for Murcia Region in most of the riverbed at all sampled depths, indicating contamination of sediments up to one meter depth. The highest degree of contamination was found in the first 600 m from the city of Lorca, and in the last 300 m of the studied stretch. Thus, the former direct spills of wastewater and sludge from tanneries caused the pollution of the riverbed by chrome, with affection up to 1 m depth.

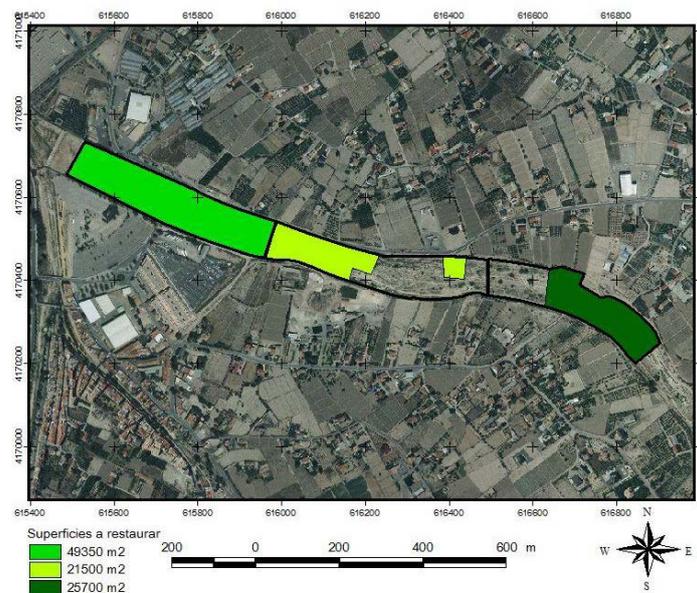


Figure 5.1.2. Contaminated area in the Guadalentín riverbed, which had to be decontaminated by the phytoextraction technique.

The previous figure shows the general area that needed decontamination by phytoextraction in the selected stretch of the Guadalentin River. Only the first part (0-500 m) of the stretch (adjacent to the city of Lorca at the western side) had its entire surface polluted (49 350 m<sup>2</sup>). The central stretch (500-1000 m) showed contamination in 21 500 m<sup>2</sup> of the total surface. The eastern stretch (1000-1500 m) showed contamination in 25 700 m<sup>2</sup> of the total surface. The total surface to recover by means of the phytoextraction technique was 96 550 m<sup>2</sup>.

## **Action B.2 Phytoextraction in sediments.**

**Objectives:** the main goal of this action was the development of a vegetated landscape with positive values in the context of aesthetics, productivity, or nature conservation. There were a careful selection of plant species adapted to semiarid conditions, high potential evapotranspiration, salinity, and the presence of metals. Thus, we focused on different plant species able to accumulate soil pollutants by absorption. The aim was to provide a primary vegetation structure capable of guaranteeing the extraction of pollutants. Nonetheless, the rehabilitation goal was to give to the area a new ecological condition. In addition, the improvement of soil quality has allowed the initialization of a secondary succession by spontaneous colonization of the surrounded vegetation.

**Beneficiary responsible for implementation:** DGCalAmb.

**Duration:** March 2014 - December 2017 (proposed duration: autumn 2015 - autumn 2017).

### **Indicators of progress:**

- Plantation completed according to the landscape design in November 2017.
- Report with the successful achievement of this action.

**Tasks performed:** according to the proposal schedule, the first plantation in the first stretch of 500 m along the riverbed was supposed to take place in autumn 2013. However, owing to the problems encountered, this action had to be delayed two years, until autumn 2015, since planting in other time would compromise the proper development of vegetation under semiarid Mediterranean conditions.

This action already started on 11/03/2014 with the authorization to write the project of phytoextraction. The project was delivered by the subcontracted company INFOSUR SL on 31/07/2014. This project included some modifications with regard to the initial proposal, designed to enhance the efficiency of the procedure, taking into account the limitation of time and budget. We have also included the use of different chelating agents in some demonstrative plots (experimental area) to assess if the phytoextraction efficiency improves; if so, the agents can be used in the entire stretch for the last months of the project or it would be recommended for future phytoextraction experiences. We enclose this project as **annex 7.2.6**. The tasks of the phytoextraction project approved and delivered to the consortium were the following:

- Harvest, pruning and collection of the biomass in the first stretch of intervention of 500 m (summer 2015).
- Planting and sowing of species for phytoextraction in stretch 1 (autumn 2015).
- Assays with chelating agents in demonstrative plots in the three stretches of 500 m. Initially we wanted to use nine species and four treatments (DTPA, EDDS, MGDA and effective microorganisms). The chelating agents are organic acids, of natural or synthetic origin, which would be apply to the soil and favour the mobility of the heavy metals, increasing the uptake by plants. The effective microorganisms are biostimulant agents based on microbial populations that are added to the soil and also favour the mobility of the heavy metals (autumn 2015-autumn 2017). Finally, the selected treatments were 3 natural organic chelating agents (oxalic acid, citric acid and aminoacids) and 1 plant growth promoting bacteria (*Pseudomonas fluorescens*). Regarding the number of native plant species, only 3 plant species were used; the experiment started with 9 plant species but only 3 plant species developed favourably (*Atriplex halimus*, *Salsola oppositifolia* and *Suaeda vera*).

- Harvest, pruning and collection of the biomass in the stretches 1, 2 and 3 (summer 2015).
- Planting and sowing of species for phytoextraction in stretches 1, 2 and 3 (autumn 2016).
- Harvest, pruning and collection of the biomass in the stretches 1, 2 and 3 (summer 2017).
- Planting and sowing of species for in stretches 1, 2 and 3 (autumn 2017).

The species chosen for phytoextraction were:

- *Atriplex halimus*
- *Hyparrhenia sinaica*
- *Lygeum spartum*
- *Piptatherum miliaceum*
- *Salsola oppositifolia*
- *Suaeda vera*
- *Silybum marianum*
- *Tamarix africana*
- *Dittrichia viscosa*
- *Foeniculum vulgare*
- *Stipa tenacissima*
- *Phagnalon saxatile*
- *Nerium oleander*

The tasks were tendered to the companies AVANCE Y DESARROLLO DE OBRAS S.L. and URDINTER INFRAESTRUCTURAS, S.L. in April 2015. On 17/04/2015 the implementation contract was signed for the plantation project, named “Project of planting for phytoextraction in the Project LIFE+11 ENV/ES/506 “REHABILITATION OF A HEAVY METAL CONTAMINATED RIVERBED BY PHYTOEXTRACTION TECHNIQUE”. Actions B.2 and B.3”. The first visit to the implementation area by the winning companies took place on 20/04/2015 in order to analyze the place where plantation was developed. The cutting, harvest, pruning and collection of the biomass in the first stretch of intervention of 500 m started on 07/09/2015 (outside the period of justification of this report). The first planting and sowing took place and was completed in October 2015.

The following months of the year 2015 coincided with the beginning of a severe drought, which prevented the germination of the seed species and caused a delay in the growth of the planted species. This severe drought was officially declared by the royal decrees 355/2015 and 356/2015 which declared the drought situation in the territorial area of the Segura Hydrographic Confederation and adopted exceptional measures for the management of the water resources (declared the years 2015, 2016, 2017 and 2018). For this reason, in April 2016, June 2016 and July 2017 auxiliary irrigations were carried out (general area and experimental area). Between the months of October-December 2016 the tasks of cleaning, harvesting and collecting of plant biomass were carried out in the stretches 1, 2 and 3. These tasks should have been completed by October 2016 but it could not be possible due to the delay of the joint venture companies (AVANCE Y DESARROLLO DE OBRAS S.L. and URDINTER INFRAESTRUCTURAS, S.L) in the execution of the cleaning tasks in the riverbed area and the weather conditions. Finally, between January-February 2017 the plantations of the stretches 2 and 3 began and suffered delays due to the weather conditions. The plantations in these stretches finished in June 2017. Finally, in July 2018 were carried out the tasks of cleaning, harvesting and collecting of plant biomass in the stretches 2 and 3 by the

company AMM OBRA CIVIL, CONSERVACIÓN Y CANALIZACIONES DEL LEVANTE, S.L. (CIF B54824818).

The number of the performed plantations during the project has been 39989: 17540 plants (stretch 1, autumn 2015), 14343 plants (stretch 2 and 3, autumn 2016) and 8106 plants (replanting stretch 1, autumn 2016). According to the plantation project the number of plantations was 43649 plantations (without considering the stretch 1 replanting, 8106 plantations). From these 43649 plantations, the number of plantations for the third cycle and for the slopes protection according to the plantation project was 11766 plantations (3469 plantations for the third cycle and 8297 plantations for the slopes protection, without performing).

The **annex 7.2.7** contains all the documentation related to the contracting process, including the authorization of the CHS to carry out the work in the Guadalentín River. See the summary of all field inspections (32 inspections) realized between January 2016 and July 2018 in the **annex 7.2.8** and the report with the successful achievement of this action in the **annex 7.2.9**. See also the Table 5.3.3 of this report.

Regarding the experimental area (demonstrative plots), in October 2015 the demonstrative plots were set in the stretches 1, 2 and 3 before planting the stretch 1. Since October 2015 – October 2017 the conditions of the plots and their plants were verified with biweekly soil sediments samplings. The applications of chelating agents and microorganisms were carried out in June 2016 (29/6/2016), September 2016 (29/9/2016) and January 2017 (25/1/2017), April 2017(28/4/2017) and June 2017 (28/6/2017).

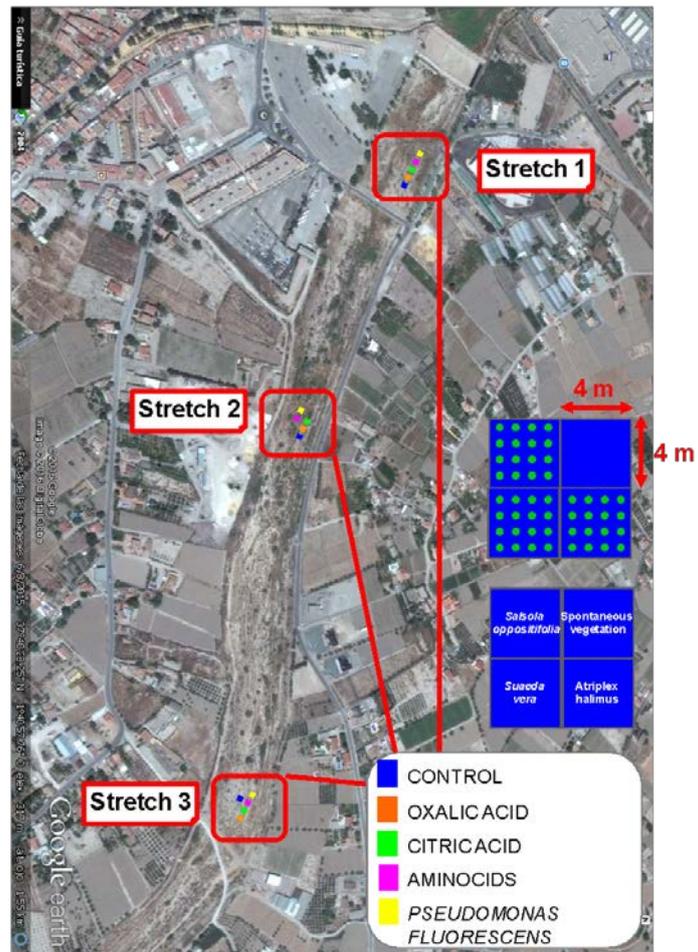


Figure 5.1.3. Experimental area with plots in the riverbed area (stretches 1, 2 and 3).

To see photographs from this action and from all the actions of the project see the **annex 7.2.10**.

### **Action B.3 Slopes protection and revegetation.**

**Objectives:** the main goal of this action was the development of vegetated slopes, with the help of integrated barriers, which minimize the risk of erosion and soil degradation.

**Beneficiary responsible for implementation:** CHS.

**Duration:** September 2016 - March 2018 (proposed duration: January 2016 - November 2016).

**Indicators of progress:**

- Mulching and barriers/gabions against erosion established in November 2016.
- Plantation complete according to ecological landscape design in November 2016.
- Report with the successful achievement of this action.

**Tasks performed:** after a bibliographic research about studies based on vegetation developed in the zone, and analyses of the results of similar studies in other areas, we found that the main plant species which accomplish the criteria exposed above were *Anthyllis cytisoides*, *Artemisia barrilieri*, *Artemisia herba-alba*, *Asparagus albus*, *Asparagus horridus*, *Atriplex glauca*, *Cistus albidus*, *Cistus clusii*, *Dorycnium pentaphyllum*, *Helianthemum almeriense*, *Lavandula dentata*, *Lycium intricatum*, *Pistacia lentiscus*, *Periploca angustifolia*, *Rhamnus lycioides*, *Rosmarinus officinalis*, *Salsola genistoides*, *Stipa tenacissima*, *Suaeda fruticosa*, *Thymelaea hirsuta*, *Thymus hyemalis*, *Ziziphus lotus* and *Zygophyllum fabago*. The first 500 m stretch is channelized with concrete walls, so there was no need for revegetation of this first part. The other two stretches needed slopes protection and revegetation, which would be carried out after the last planting/sowing for phytoextraction (Autumn 2018).

In August 2016, the CHS gave to the rest of the partners the slopes protection and revegetation project (**annex 7.2.11**) with the purpose of executing it in the last quarter of 2016, as planned. The drawbacks happened in the slopes project were the following:

- The implementation of the slope project was delayed by the modifications that had to be realized in the proposal and the administrative complexities of the procurement procedure of the Public Administration of Murcia Region, everything is shown chronologically:
  - September 2016: the CHS partner delivered the slopes project to proceed with its evaluation and approval by all the partners (DGMA, UPCT and Ayto Lorca). During this month several aspects of the project were discussed among the partners and it was decided to modify part of the project: the budget of plantation was eliminated from the final restoration because that budget was included in the plantation project (action B.2) and the plant density on slopes was reduced from 2 plant/m<sup>2</sup> to 1 plant/m<sup>2</sup> to coincide both projects (plantation project and slopes protection and revegetation project).
  - October and November 2016: the slope project was modified and approved by all the partners.
  - December 2016: a report requesting a tender for the works of the slopes project was emitted.
  - January 2017: between the slopes project and the phytoextraction project were detected similarities (reduction of interventions in the slopes, duplicity in the plantations of the slopes, plantation frames, etc.). Then, the CHS revised the slopes project proposal: the plantation frame in the slopes project was reduced so that it was the same as in the phytoextraction project and the budget was modified because the budget for the plantation tasks and the plants were included in the phytoextraction project. The updated document was delivered in May 2017.

- June 2017: the project proposal is approved by all the partners.
- July 2017: the modified slopes project was sent to the contracting service of the Consejería de Turismo, Cultura y Medio Ambiente to continue with the tender process. A report was also issued requesting the tender process of the Health and Safety Coordination contract regarding the slope project.
- September 2017: the vicesecretary of the legal services of the Consejería de Turismo, Cultura y Medio Ambiente requested a rectification requirement to the partners of the project. The rectification report was submitted the same month to the vicesecretary and the DGMA demanded the continuation of the tender procedure in order to execute the slopes project before the end of the project (31/03/2018).
- December 2017: the contracting service informed to the DGMA that it was not possible to continue with the tender process because there was no credit available for this year (2017).
- January 2018 - March 2018: the credit is incorporated and difficulties arise with the administrative process due to the entry into force of a new contract law. In order to continue with the hiring process, several writings are prepared.
- April 2018 - June 2018: the tender process was suspended due to its high cost of execution; neither the coordinating partner nor the rest of the partners can assume it with their own funds. The coordinating partner in this situation has prioritized the execution of the biomass cleaning tasks (action B.2).

#### **Action B.4 Energetic use of residual contaminated biomass.**

**Objectives:** the combustion of biomass by a concrete factory located in Carboneras (Almería, Spain).

**Beneficiary responsible for implementation:** Ayto Lorca.

**Duration:** June 2015 - October 2015; October 2016 - March 2018 (proposed duration: August - September 2015, August - September 2016 and August - September 2017).

**Indicators of progress:**

- Report on results for biomass weight taken to the concrete factory. For this, the gross and net trucks weight has been determined (or estimated) for each transport.

**Tasks performed:** this action was planned to start out after the first harvest in 2014. However, owing to the delays suffered it started in June 2015 with the contacts with the company to transport the biomass (Los Trincheras) and with the concrete factory (Holcim) by the Ayto Lorca to make suitable the arrangements (**annex 7.2.12**, Holcim letter of intends). The Holcim staff indicated us the physical requirements that the biomass had to meet to be accepted by the treatment plant in Carboneras and the documents that had to be filled out. Technicians from Holcim visited the implementation area of the Riverphy project on September 2015 and on March 2017 to collect a samples of the biomass that later were transported to the company for their internal physicochemical characterization (in the year 2015 for the first transport and in the year 2016 for the second transport). The harvested biomass was transported to the concrete factory Holcim Carboneras in October 2015 (report in **annex 7.2.13**) and September 2017 (report in **annex 7.2.14**). To see photographs from this action and from all the actions of the project see the **annex 7.2.10**.

The first transport in 2015 was carried out in a favorable manner and the problems happened were resolved quickly. However, the implementation of the second transport for the year 2016 was delayed more than expected according to the foreseen schedule (autumn 2016) due to several disadvantageous circumstances. The transport of the contaminated biomass foreseen for autumn 2016 was delayed until autumn 2017 as a result of:

- The delay by the joint venture companies (AVANCE Y DESARROLLO DE OBRAS S.L. and URDINTER INFRAESTRUCTURAS, S.L) in the harvest, the cleaning and the storage of contaminated biomass along the 1500 m of the Guadalentín riverbed. The tasks finished in December 2016.
- Once the tasks of harvest, cleaning and collection of the biomass were completed by the joint venture companies (AVANCE Y DESARROLLO DE OBRAS S.L. and URDINTER INFRAESTRUCTURAS, S.L), there were heavy rains and an episode of snow (after 12 years without snow in the municipality of Lorca) that prevented for weeks the entrance of machinery in the riverbed area to grind and to take samples of the contaminated biomass. The soil and biomass moisture conditions made it difficult to collect the biomass samples to be sent to the Holcim treatment plant and thus verify that the biomass residue meets the entry size conditions. In the month of February of 2017 we were able to collect samples of vegetal residue to send them to the Holcim treatment plant in order to receive their approval and an entrance date for vegetal residues. Moreover, during this month, the machinery could enter to the riverbed area to properly collect the biomass piles collected along the three stretches to certain

storage points. By doing this, the access was provided for the machinery in charge of grinding, loading and transporting the biomass.

- The transport of plant biomass from the riverbed to the Holcim treatment plant (Almería) was initially planned for March 2017, at which time the plant biomass samples were analyzed by the company and received a favorable approval for its entry into the plant. This transport could not be carried out due to a temporary closure of the treatment plant and to a subsequent excess of input raw material. The plant biomass from stretches 1, 2 and 3 of Riverphy riverbed was finally transported to the treatment plant for incineration in September 2017.

All tasks carried out in the riverbed area were executed with the previous authorization (requested by the Ayto Lorca) of the CHS under the Ministry (authority that oversee the Public Hydraulic Domain).

Regarding the third transport of biomass (initially planned for autumn 2017 and delayed to 2018), it have not been done yet because we still are standing for the entrance authorization from the treatment plant that it is expected to be resolved soon (autumn 2018). . The **annex 7.2.15** contains the price that must be paid to the treatment plant in Carboneras (Almería, Spain) for each tonne of contaminated biomass introduced and the waste card signed by the general director from DGMA (coordinating partner). The treatment plant is the same as the previous biomass transports and the company in charge of grinding and transport the grinded biomaas will be the same company that was commissioned in 2015 and 2016 (postponed to 2017). This expense is outside the project execution period and will be assumed with the funds of the coordinating partner.

Below is a summary of the results recorded on the 3 biomass transport carried out (2015, 2017 and 2018):

- Contaminated biomass harvested (kg): 15880 (estimating 4500 kg for the third transport).
- Generated energy (MW/hour): 8.85 (estimating 2.50 MW/hour for the third transport).
- Generated ashes (kg): 481.4 (estimating 140 kg for the third transport).

### **Action B.5 Evolution of soils and vegetation.**

**Objectives:** perform various samplings of soil and vegetation in the rehabilitated areas in order to monitor the changes in soil properties and specifically verify the decrease in Cr, Zn and Cu content, as well as the evolution of the species planted and their accumulation of Cr, Zn and Cu in their tissues. The evolution of soils and plant species has been referred on data from initial characterization (action B1).

**Beneficiary responsible for implementation:** UPCT.

**Duration:** October 2015 - January 2018 (proposed duration: August / September 2016 - January 2018). This action was finally completed in June 2018.

#### **Indicators of progress:**

- Report on results for soils.
- Report on results for vegetation cover, richness and biodiversity.
- Report on results for produced biomass.
- Report on results for metal accumulation in roots and leaves.
- Report on results for translocation factors calculated in plants.
- Report on results for removal efficiency of soil metals in the rehabilitated stretches.

**Tasks performed:** the first sampling in the general area was planned to be developed in October 2014 after the harvesting of the introduced species in the stretch 1. However, since the plantation did not start until October 2015, with the consequent harvest in October 2016, this task started in October 2016. In addition to the initial sampling of soil and vegetation (action B.1), in October/November 2016 and October 2017 were done a soil and plant samplings in the general area, in October/November 2016 was sampled only the stretch 1 because in 2015 was planted only this stretch and in October 2017 were sampled the stretches 1, 2 and 3 since in 2016 these stretches were planted.

This action began in October 2015 with the establishment of the demonstrative plots (action B.2) in the experimental area (stretches 1, 2 and 3). Besides, an initial soil sampling was carried out before planting in October 2015 (45 soil samples were collected, 15 samples from each stretch). Since the first application was made (June 2016), 15 soil samples from the experimental area were collected every 2 weeks. In October/November 2016 and October 2017 another soil and plant annual sampling was carried out in the experimental area (75 soil samples and 180 plant samples). Moreover, a study of the vegetation and the biomass was carried out in October/November 2016 and October 2017. In summary, 3 annual samplings of soil (2015, 2016 and 2017), 2 annual samplings and studies of vegetation (2016 and 2017) and 27 samplings of soil with biweekly periodicity (June 2016 - September 2017) were carried out.

See the deliverable on monitoring methodology report as **annex 7.2.16**, the reports on soil and vegetation from 2016 sampling (**annexes 7.2.17-7.2.21**) and the report on soil and vegetation from 2017 samplings (**annexes 7.2.22-7.2.26**).

## **Action B.6 Environmental recovery and landscape design.**

**Objectives:** it was proposed that a landscaping project was developed to transform the degraded environment into a new space with new functional ecologic conditions. Also, this landscaping plan would include the creation of an environmental itinerary so that the public can visit the area and learn about the history of the place, the environmental risks that present themselves with the spills of contaminated water, as well as the strategies of this project and so that they can feel part of the regenerated landscape. Besides, it was proposed the establishment of guidelines for action and of a methodology that can be employed for the regeneration of any area with similar characteristics. For this reason, the landscaping was accompanied by a Decision Aid Model which will serve as a benchmark for future restoration projects.

**Beneficiary responsible for implementation:** DGCalAmb.

**Duration:** October 2013 - February 2018 (proposed duration: October 2013 - February 2018).

### **Indicators of progress:**

- Visual perception of soil quality improvement and vegetation communities development integrated into the landscape design.
- Integration of rehabilitated area into the surrounded environment in terms of land use facilities and plantation adaptation.
- Final interpretative manual with the guidelines and strategies which explains the accomplishment of this action.

**Tasks performed:** this action should have started in April 2013, but owing to the explained problems encountered, it started in October 2013 and finished in February 2018. The landscape design plan was delivered with the progress report 1/4/2014 (**annex 7.2.27**), indicating the guidelines for the recovery of the stretch. It was subcontracted by DGMA and revised by CHS as regional and national responsible for fluvial landscape restorations.

To write the phytoextraction project (**annex 7.2.6**) and the slopes protection and revegetation project (**annex 7.2.11**) (actions B2 and B3) there were a joint work among actions B.2, B.3 and B.6 to establish a plantation following the current mosaics of vegetation and to enhance integration in the landscape.

The environmental trial (**annex 7.2.28**) could not be executed during 2016 due to several modifications that were considered necessary with respect to the initial design that was drafted by the company Tatra Ambiental contracted by the DGMA. The design did not foresee some aspects that have been appearing with the time and others that have been recommended by the staff from the Ayto Lorca. These aspects were the need of a safety fence, ground leveling, rejection of the planting of woody plant species (five recommended plant species as alternative were been studying currently) to choose the best alternative and the overlapping of the itinerary plantation and slope project tasks. With regard to the execution of the itinerary, two phases of implementation were planned:

- Phase 1 (until spring 2017): acquisition and installation of the posters along the 200 m route on the Zorrolobo road and the installation of the security fence.
- Phase 2: plantations that delimit the itinerary (with its irrigations), leveling the path inside the riverbed area and others (axis installation and wheelie bin cover). This phase was executed during the last months of the project.

One of the main reasons for which the itinerary was planned in 2 phases was to show the posters to the technical visits (action D.5). See **annex 7.2.10** to see the photographs of the execution of both phases of the itinerary. Unfortunately, months after the execution of the itinerary was completed, the wheelie bin cover was burned by acts of vandalism. To deal with this situation, the Ayto Lorcal will be responsible for its replacement and will assume its expense. The replacement date has not yet been defined.

For the decision aid model (**annex 7.2.29**), firstly, an exhaustive bibliographical work was done in order to test if there was any model in the bibliography that could cover all the necessary fields. So, it was concluded to propose an easy and intuitive decision-making model that allows versatility in areas and end uses. Similarly, in order to identify the greatest number of typologies and restrictions, different contaminated areas of the Spanish southeast were visited and documented. These areas were documented exhaustively, making inventories of the weather data and the plant species present. To formulate a model to be used as a reference in decision-making processes for administrations and companies (public and private), the UPCT personnel met with the different agents involved, as well as the future users of these contaminated areas. With this phase of interviews, the different alternatives and areas to differentiate within the contaminated sites were identifying. Besides, identification sheets of the main plant species (susceptible of being used for revegetation and phytoextraction) were made of the contaminated areas. These sheets include the physiological and phenological characterization of plants, the characteristics of growth restrictions and the phytoextractor character. In the same way, the possible landscape associations that can be susceptible of proposal in the improvement to be realized were documented. The decision aid model is an interesting resource for landscape restoration of degraded areas and other areas with similar soil and weather conditions. This model is very useful for public administrations and companies since it simplifies the decision-making with respect to other models of great complexity.

### ***C. Monitoring of the impact of the project actions:***

#### **Action C.1 Monitoring the effectiveness of true soil rehabilitation.**

**Objectives:** to analyze the results of the samplings for the evolution of soil and plant characteristics, and the ecological landscape design implementation (actions B.5 and B.6) has allowed researchers and technicians to optimize the process. The thorough evaluation of the results of analyses and reports on actions B.5 and B.6 has let us gain knowledge about the achievement of the objectives and the viability of the actual rehabilitation of a contaminated river in terms of soil, plant and general landscape.

**Beneficiary responsible for implementation:** DGCalAmb.

**Duration:** January 2016 - March 2018 (proposed duration: January 2016 - March 2018). This action was finally completed in June 2018.

#### **Indicators of progress:**

- Reports regarding the evolution of the parameters in each sampling for soils and plants, indicating the actual achievement of the objectives, which guarantee from short to long-term true landscape restoration and soil functioning and minimization of risks. Specific quantifiable indicators of progress related to the expected results:  
Cr  $\leq$  150 mg kg<sup>-1</sup>.  
Cu  $\leq$  35 mg kg<sup>-1</sup>.  
Zn  $\leq$  80 mg kg<sup>-1</sup>.  
Vegetation cover  $\geq$  75%.  
Vegetation richness  $\geq$  20.  
Bioaccumulation factor  $>$  1.

The removal degree of total Cu, Zn and Cr in soil sediments between the years 2013 and 2017 was favourable and evident for total Zn and total Cr and less evident for total Cu, with a rate of metal removal that reach 5% of the total amount. The observed variations in the concentrations were remarkable, although the variations were not statistically significant. The implanted vegetation has been influenced by the periods of water scarcity and by the meteorological conditions, both facts could have conditioned the phytoextraction of metals by the vegetation present in the riverbed and therefore the concentrations of total metals registered in the samples of the soil sediments, especially in horizons of 0-20 cm and 20-50 cm.

On the other hand, it would be convenient to highlight that the actual efficiency of phytoextraction or accumulation of metals by plants (and therefore the decontamination of metals from the soil) has been higher than the reflected in the reports and in the analysis of soil and vegetation. This was due to the fact that the tasks of harvesting of the contaminated biomass were carried out in July 2018 instead of autumn 2017 (as it was initially planned). So, the amount of harvested biomass has been higher (a greater amount) in July 2018 than if it had been done in autumn 2017 and also a higher amount of soil metals has been removed.

**Tasks performed:** according to the proposal schedule, this action started when reports from actions B.2 and B.5 were available. This action started in January 2016 and finished in June 2018 with the release of the reports. See Table 5.3.8, the **annex 7.2.30** (2016) and the **annex 7.2.31** (2017).

## **Action C.2 Monitoring the socioeconomic impact.**

**Objectives:** to increase social awareness and acceptance of the benefits of protecting the environment.

The traditional natural uses of the region would be considered to be more appropriated and these could be combined harmoniously with leisure and low-density recreational activities.

**Beneficiary responsible for implementation:** UPCT.

**Duration:** January 2014 - March 2018 (proposed duration: January 2014 - March 2018). This action was finally completed in June 2018.

### **Indicators of progress:**

- Changes in employment and income-generating opportunities. Number of employees:  
Bad: 0.  
Regular: 1-3.  
Good: >3.
  
- Number of visits to the river stretch (per year):  
Bad success: 0-100.  
Regular success: 100-500.  
Good success: >500.

**Tasks performed:** this action started in January 2014 as scheduled. Action C.2 activities focused on the collection of data to be used for the assessment of the socioeconomic impact of the project. As the project aims to increase social awareness and acceptance of the benefits of protecting the environment, the evaluation of the socioeconomic impact of the project relied on the assessment of the impact of the dissemination and communication activities. For this purpose, we developed a questionnaire to be answered by adult stakeholders attending technical visits, workshops and training courses celebrated under the D actions. Among other issues, the questionnaire asked them, both before and after the dissemination activity, about their perception of different environmental problems, including soil contamination. It also asked them about their perception of the impacts of the project for the Lorca society. The data from the questionnaires completed was codified and revised to check for inconsistent answers.

Throughout the project all the partners (especially UPCT and Ayto Lorca) have made a constant effort to attract groups interested in attending technical visits by all possible ways (letters, web page, dissemination events, etc.). A total of 349 stakeholders filled the questionnaire that supposes a regular success of the expected results. The final number of respondents was directly proportional to the level of attendance to the dissemination activities. On this way point that visitant from secondary schools could not complete the questionnaire because they were minor of age. An analysis of their answers showed that participants perceive the soil pollution problem to be less relevant than other environmental threats such as water scarcity and climate change, but of similar severity than air pollution, soil erosion or nature conservation. However, the majority declared that their prior knowledge about the soil pollution problem was poor and that their perception of its severity has increased after the attendance to the dissemination activity. See report of this action in the **annex 7.2.32**.

## ***E. Project management and monitoring of the project progress:***

### **Action E.2 Networking with other projects.**

**Objectives:** to exchange information among different regional, national and international projects, LIFE III and/or LIFE+ projects, among others; experiences, methodologies used, and results obtained in projects about restoring contaminated river stretches and related issues.

**Beneficiary responsible for implementation:** DGCalAmb.

**Duration:** January 2014 - March 2018 (proposed duration: January 2014 - March 2018).

#### **Indicators of progress:**

- Number of visits to the website.
- Number of contributions to the forum.
- Number of petitions of information about the project from different stakeholders.
- Number of people involved in the networking.
- Number of stakeholders registered in the website.

The results gathered with the progress of the project, by monitoring of indicators, have shown to the consortium the success of the networking depending on the following estimated ratios:

Table 5.1.1. Indicators of success of networking.

<b>Indicator</b>	<b>Success of networking</b>		
	<b>Bad</b>	<b>Regular</b>	<b>Good</b>
Number of visits to the web page (per month).	0-100	100-200	>200
Number of contributions to the forum. (per year)	0-20	20-50	>50
Number of petitions of information from different stakeholders (per year).	0-5	5-10	>10
Number of people involved in the networking.	0-15	15-30	>30
Number of stakeholders registered in the webpage.	0-5	5-10	>10

**Tasks performed:** this action started by making contacts in January 2014, with one year of delay owing to the problems encountered. We defined three lines of networking, since the Riverphy project was quite multidisciplinary: landscape and environmental rehabilitation, soil reclamation and biomass management.

The networking was created on 17 February 2014 with the following projects:

- Landscape and environmental rehabilitation:
  - o CONSERVASTRATRAGALUS-MU. LIFE11 BIO/ES/000727  
Web: [www.lifegarbancillo.es](http://www.lifegarbancillo.es)
  - o LIFE SEGURA RIVERLINK. LIFE12 ENV/ES/001140  
Web: [www.segurariverlink.eu](http://www.segurariverlink.eu)
  - o LIFE-QUF - Quick urban forestation. LIFE12 ENV/ES/000092  
Web: [www.quickurbanforest.eu/](http://www.quickurbanforest.eu/)
  - o Teruel Balance+Positivo - Recovery of the natural periurban area "Las Arcillas": Sustainable "Environmental Balance". LIFE11 ENV/ES/000515

- Web: <http://life.teruel.es/>
- CONSERVATION OF HABITAT “9570 \* *Tetraclinis articulata* FOREST” IN THE EUROPEAN CONTINENT. LIFE13 NAT/ES/000436  
Web: <http://lifetetraclinis.eu/proyecto-life/>
- Soil reclamation:
  - LIFE+ Mipolare. LIFE09 ENV/ES/000439. Web: [www.mipolare.eu](http://www.mipolare.eu)
  - BIOXISOIL - New approach on soil remediation by combination of biological and chemical oxidation processes. LIFE11 ENV/ES/000505  
Web: <http://www.bioxisoil.eu/>
  - I+DARTS - Innovative and Demonstrative Arsenic Remediation Technologies for Soils. LIFE11 ENV/ES/000547. Web: <http://www.lifeidarts.eu/>
  - LIFE ReSoil - Demonstration of innovative soil washing technology for removal of toxic metals from highly contaminated garden soil. LIFE12 ENV/SI/000969. Web: not available yet
  - CHARM - Chromium in Asopos groundwater system: remediation technologies and measures. LIFE10 ENV/GR/000601.  
Web: <http://www.charm-life.gr/charm/index.php/en/>
- Biomass management:
  - LIFE+ Metabioresor. LIFE08 ENV/E/000113. Web: [www.metabioresor.eu](http://www.metabioresor.eu)
  - AGROWASTE. LIFE10 ENV/ES/000469. Web: [www.agrowaste.eu](http://www.agrowaste.eu)
  - ENERING - Demonstrative industrial installation for the reduction of greenhouse gas LIFE11 ENV/ES/000542. Web: <http://www.eneringlife.eu>
  - LIFE Eucalyptus Energy - Eucalyptus Integrated Wood Processing Project. LIFE12 ENV/ES/000913. Web: <http://eucalyptusenergy.com/>

This networking was considered successfully developed because of the number of participant (15-20), obtaining a regular score according to the indicators proposed.

Since September 2014 we had in the project website a forum section where participants of the networking could exchange messages, start discussions and exchange information. Dissemination activities and information about news of all projects could be also shared through this forum (<http://liferiverphy.eu/foro/>). Only registered users can access to ensure confidentiality of the information included by the different projects. Currently the networking forum has 20 registered members achieving the objective with a regular score.

We have developed a close networking with periodical meetings with the following projects:

- Life+ Mipolare. LIFE09 ENV/ES/000439
- Bioisoil. LIFE11 ENV/ES/000505
- I+Darts. LIFE11 ENV/ES/000547
- Life Discovered. LIFE12 ENV/ES/000761
- Life Tetraclinis-Europa. LIFE13 NAT/ES/000436

Life+ I+Darts organized the first networking in Oviedo (Spain, June 2014). Life+ Riverphy and Life+ Mipolare organized the second networking in Cartagena (Spain, January 2015). The third networking was organized by Life+ Bioisoil in Madrid (Spain, October 2015). And Life+ Discovered Life organized the fourth and last networking meeting in Zaragoza (Spain, April 2016). With other Life projects (Life EcoRemed, Life Cleansed, Life Biorem, Life Resoil, Life Hortised and Sekret Life) we have exchanged technical information. Besides, in the networking tab of their website they have been included the Riverphy logo, information and a link to the web page of the Riverphy project. See **annex 7.1.17**.

During the project, the following indicators have been quantified:

- Number of visits to the website (per month): 1443 visits (monthly average from November 2013 to March 2018). The success has been good according to the indicators rank.
- Number of contributions to the forum (per year): 9 contributions. Only 9 contributions have been made to the Riverphy forum. The reason why no more contributions were made was due to the fact that the interested people who entered in the website preferred to download the information directly from the published news that instead of registering in the forum.
- Number of petitions of information from different stakeholders (per year): 13. The project has received the 13 requests of information between November 2013 and March 2018 (4 requests from university students, 2 from high school teachers, 4 from project managers of Life projects, 3 from companies). The success has been good.
- Number of people involved in the networking: 15-20 people. The success has been between bad and regular.
- Number of stakeholders registered in the webpage: initially, it was thought that the interested people would register on the project website to receive the project information. However, afterwards it was decided that it was better to send updated information to the interested parties: schools of professionals, educational centers, assistants to visits to project events (technical visits, seminars, workshops, etc). With these contacts, a mailing list was elaborated and the information was sent periodically.

### **Action E.3 Audit.**

**Objectives:** verify the final statement of expenditure and income provided to the Commission when the maximum Community contribution set in the Special Provisions exceeds 300 000 €

**Beneficiary responsible for implementation:** DGCalAmb.

**Duration:** May 2018 - July 2018.

**Indicators of progress:**

- Final Audit Report.

**Tasks performed:** the company that audited the Riverphy project was the company ACR auditores consultores from 1/7/2018 until 12/9/2018. This company was nominated by the coordinating beneficiary and they verified the statement of expenditure and income provided to the Commission.

The final audit report is sent in this report as indicator of progress. See **annex 8.11**.

## 5.2 Dissemination actions

### 5.2.1. Objectives

The aim of the dissemination activities was to reach every stakeholder main interests and to introduce the phytoextraction technique for soil decontamination and to reclaim degraded areas is possible and, furthermore, that it can be environmental and economical profitable. The dissemination activities were carried out throughout the development of the project, starting from November 2012 up to the end of the project, and communicated the evolution of the project and the preliminary and final results obtained in its different stages. This dissemination effort globally aimed to make possible the technological transfer of the innovative phytoextraction technique in a short period of time and to achieve a high dissemination amongst potential stakeholders.

The large scope of the innovative soil decontamination technique developed in this project implied that the stakeholders have been diverse. Riverphy project intended to involve the livestock sector (farmers, cooperatives and authorities) and the tannery sector (producers and authorities) from the local to the European level, since the issue at stake (sustainable waste revalorization and land reclamation) is of the utmost importance for the environmental and health objectives of the European Union.

Thus, the success of this kind of green decontamination for reclaimed degraded areas depends on the adequate dissemination of information targeted especially (in form and content) to several stakeholders:

- administrative authorities, in charge of waste management and land reclaimed policies, from the local to the European;
- farmers, which must respect the livestock waste regulations;
- tannery companies, showing the new and innovative phytoextraction technique.
- owners of degraded areas, showing that it is possible to reclaim their lands with a minimum cost using a friendly environmental technique.
- academic and research centers, which must validate the results of the project.
- general public, which must be inform about the environmental values of the reclaimed area.

The dissemination activities were coordinated by the DGMA, with the support of the rest of the partners to assure the best dissemination among different targets. Activities started at the beginning of the project and they lasted until the end of the project. The LIFE and RIVERPHY logos have been showed in all the activities carried out and in all the material produced.

### 5.2.2. Dissemination: overview per activity

The dissemination activities were carried out throughout the development of the project, starting in November 2012. The dissemination activities were based on the dissemination and communication plan, first task of this activity. The Communication and Dissemination Plan was approved in October 2013 and updated in February 2017 (due to the first amendment) by all beneficiaries of the project, together with the corporative identity.

#### *D. Communication and dissemination actions:*

##### **Action D.1 Dissemination and Communication Plan.**

**Objectives:** to reach every stakeholder main interests and to introduce the idea that a different way of restoring contaminated river stretches was possible and, furthermore, that it could be environmental and economical profitable.

**Beneficiary responsible for implementation:** DGCalAmb.

**Duration:** November 2012 - March 2018 (proposed duration: November 2012 - March 2018). This action was finally completed in April 2018.

##### **Indicators of progress:**

- Plan ready 10/10/2013.
- Actions and release of materials on time according to the Plan.

**Tasks performed:** the communication and dissemination plan and the corporative image were ready by October 2013, with 9 months of delay with regard to schedule owing to the explained problems encountered. The communication and dissemination plan were updated until March 2018 (due to the first amendment). The modified dissemination actions were the technical visits, training course, seminars and workshops and conferences. See **annexes 7.3.3-7.3.5**).

Regarding the employed methods, the dissemination activities were based on the dissemination and communication plan, first task of this action. It covered the preparation of methodological and managing information, with different supports and approach (as leaflets, and posters, to detailed methodological and scientific guides and reports), technical visits, seminars and workshop, focused to different stakeholders and using different approaches, from the classical ones to web-based resources and activities.

Other activities were also the publication of two articles in national and international journals, and the preparation of two video documentaries, the recording of radio and TV interviews and reports, a public webpage, notice boards describing the project displayed at strategic places accessible to the public (the Riverphy logo appears on them), and a final report (Layman's Report) addressing the obtained results and other activities that were set on the dissemination plan. The different stakeholders were targeted differently: the scientific aspects of the project were disseminated among researchers and technicians, mainly of the public sector; the technical and management aspects were disseminated among tannery companies, farmers, local, regional and national administrations; the environmental benefits of the project and its European added value were largely disseminated. The dissemination materials were also different, and adapted to the stakeholder concerns, the media used and the event targeted (where applicable). The Office for Research Transfer of the UPCT was in charge of the preparation of the methodological information targeted to research institutions and other stakeholders.

## Action D.2 Public website.

**Objectives:** to create a project website for the dissemination of project activities, progress and results.

**Beneficiary responsible for implementation:** Ayto Lorca.

**Duration:** December 2013 - March 2018 (proposed duration: November 2012 - March 2018).

### **Indicators of progress:**

- Number of visits of the website (per month):  
bad success: 0-100.  
regular success: 100-200.  
good success: >200.

**Tasks performed:** the public website was subcontracted by Ayto Lorca in December 2013; the platform was created on 22 January 2014, and has been available online at [www.liferiverphy.eu](http://www.liferiverphy.eu) since 17 February 2014. Since 22 January 2014 we have had active profiles on Facebook (account: Proyecto LIFE+Riverphy), Twitter (account: @Life\_Riverphy), Youtube and LinkedIn as complementary supports for dissemination of project objectives, results, events, etc.

In the following table we show the visits to the website per month since the beginning:

Table 5.2.2.1. Statistics of the web page.

Month	Visits	Unique visitors	Month	Visits	Unique visitors	Month	Visits	Unique visitors
feb-14	385	170	jul-15	2195	815	Dec-16	1260	579
mar-14	643	233	Aug-15	1747	842	Jan-17	1693	996
Apr-14	638	208	sep-15	667	366	feb-17	1498	928
may-14	989	320	oct-15	1693	768	mar-17	1396	818
jun-14	603	228	nov-15	1467	702	Apr-17	1320	797
jul-14	914	387	Dec-15	1051	626	may-17	3365	2159
Aug-14	2061	711	Jan-16	1198	712	jun-17	2369	1011
sep-14	2634	1203	feb-16	1014	545	jul-17	1422	873
oct-14	4241	2117	mar-16	1112	588	Aug-17	1599	914
nov-14	792	372	Apr-16	1462	715	sep-17	1164	1922
Dec-14	2907	1443	may-16	1336	696	oct-17	2799	1901
Jan-15	2088	863	jun-16	1394	667	nov-17	1828	1201
feb-15	1672	975	jul-16	1122	532	Dec-17	837	623
mar-15	1894	1133	Aug-16	1202	582	Jan-18	997	736
Apr-15	1296	702	sep-16	1018	577	feb-18	1453	959
may-15	1169	567	oct-16	1411	701	mar-18	2319	1253
jun-15	1752	714	nov-16	1222	668	<b>Total</b>	<b>76308</b>	<b>41118</b>

In view of the extension of the project until 31<sup>st</sup> March 2018, it was necessary to extend the contract for rendering technical assistance services of updating the website and social networks of the project for one more year because the contract made between the Ayto Lorca and the Entorno Natural Company did not provide for any type of extensions. This additional money was taken from the remaining budget from action A.1. The contracting offers were requested and the credit retentions are approved. Although it was not necessary to request more offers, it was justifiably detailed in the report made by the Environment Council (from Ayto Lorca) to the Municipal Intervention Service that due to technical compatibility criteria the same company that was hired at the time and that created all the platforms has to perform this work.

In the next figures we show the evolution of the number of followers on Twitter and Facebook, with an increase trend during all this time. We have 645 followers on Twitter (1722 tweets) and 171 on Facebook (6374 likes), that suppose a good success of the expected results.

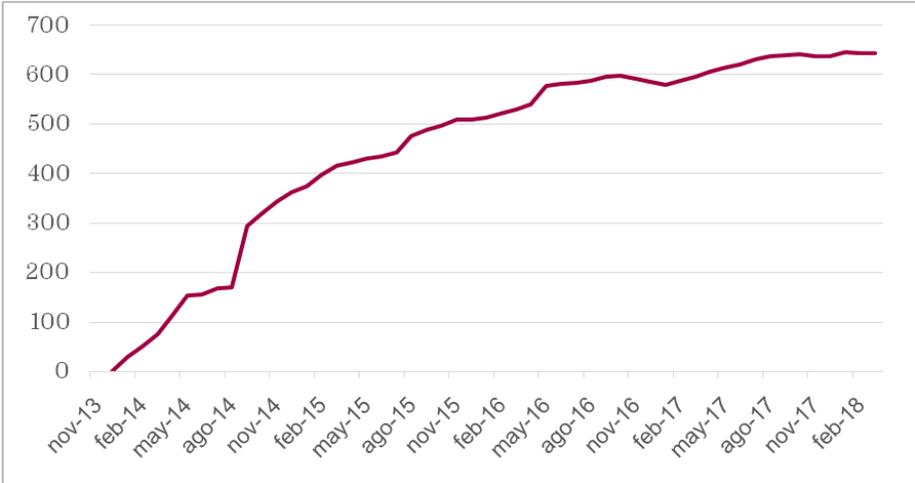


Figure 5.2.2.1. Evolution in the name of followers on Twitter.

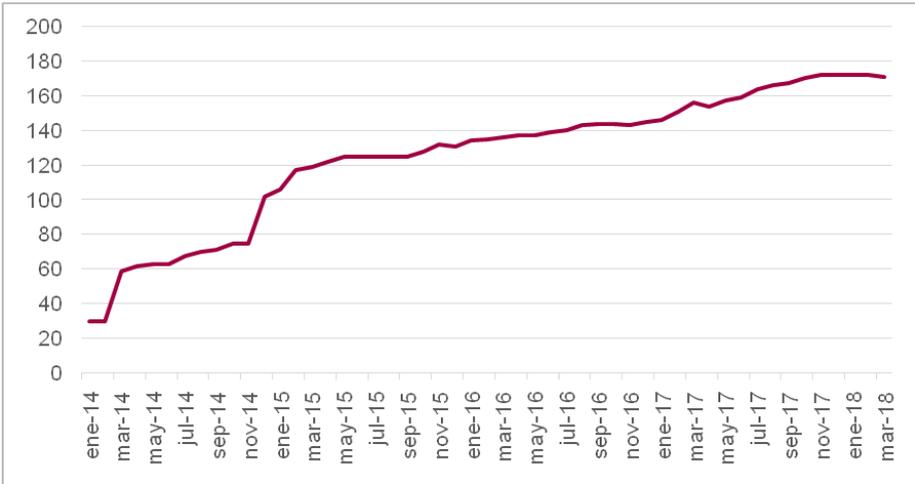


Figure 5.2.2.2. Evolution in the name of followers on Facebook.

Below is a summary of statistics from the start of the Youtube channel of the project until March 31<sup>st</sup>, 2018:

Table 5.2.2.2. Youtube statistics by video.

<b>Title</b>	<b>Number of visualizations</b>
Initial video LIFE Riverphy Lorca	1.985
Presentation Riverphy in Agenda 21 Lorca (20 <sup>th</sup> August 2015)	87
LIFE Riverphy in 7 TV Murcia Region (2 <sup>nd</sup> May 2017)	223
Seminar LIFE+ Riverphy (30 <sup>th</sup> May 2017)	128
Final video LIFE Riverphy Lorca	86
<b>TOTALS</b>	<b>2.509</b>

By the use of the professional channel LinkedIn we established contacts with several professionals in areas related to the project (engineering, environmental consulting, environmental education, geology, biology, research, etc). We have 40 contacts so far.

See the report with this information in the **annex 7.3.6**.

### **Action D.3 Notice boards.**

**Objectives:** to erect and to maintain 2 notice boards about the project at the upper and lower part of the river stretch, at strategic places accessible and visible to the public.

The notice boards included the logos of LIFE, Riverphy and the different beneficiaries. They include synthetic information. They have provided key information about the project and what it is doing. They were designed to catch people's attention and allow them to understand quickly what was happening at that site.

**Beneficiary responsible for implementation:** CHS.

**Duration:** April 2014 - March 2018 (proposed duration: November 2012 - March 2018).

#### **Indicators of progress:**

- Notice boards present in the locations from 25/04/2014 to at least 5 years after the end of the project

**Tasks performed:** the partner CHS subcontracted the design and installation of 2 notice boards. This action should have started in November 2012, and boards installed by March 2013, but owing to the explained problems we had a delay in action as well as. Finally, 2 notice boards were designed and installed since April 2014 at the beginning and at the end of the study area to restore, including the objectives, expected results, and main details. The layout of the notice board was delivered as in the progress report (1/4/2014) (**annex 7.3.7**). Every single month (until March 2018) their good conditions have been checked.



Figure 5.2.2.3. Notice boards installed just next to a road the crosses the riverbed, and very close to the urban nucleus of Lorca.

#### **D.4 Publication of information/publicity material.**

**Objectives:** with the information and publicity material is intended to reach every stakeholder main interests and introduce the idea that a different way of restoring contaminated river stretches was possible and, furthermore, that it can be environmental and economical profitable.

**Beneficiary responsible for implementation:** DGCalAmb.

**Duration:** November 2012 - March 2018 (proposed duration: November 2012 - March 2018).

#### **Indicators of progress:**

- Number of petitions of information from different stakeholders (per year):  
Bad success: 0-5  
Regular success: 5-10  
Good success: >10
- Release of the number of information/publicity materials according to the Communication and Dissemination Plan

**Tasks performed:** the communication and dissemination plan and the corporative image were ready by October 2013. Following the plan, all the expected objectives set regarding the publication of information and preparation publicity material have been achieved. Below is a summarize:

Table 5.2.2.3. Publication of information/publicity material.

<b>Task</b>	<b>Target audience</b>	<b>Foreseen objective</b>	<b>Reached objective</b>
Leaflets	General	2000	2000
Posters	General	1000	1000
Notebooks	General	1000	1100
Folders	General	200	200
Stickers	General	200	200
Pens	General	500	500
Caps	General	300	300
Usb's 4 Gb	General and specialized	250	225
Methodological manual of visits	General and specialized	325	325
Initial video	General	200	200
Final video	General	0	0
Newsletters	General	four-monthly periodicity	12
Scientific papers	General and specialized	5	4
Presentations (included congresses)	General and specialized	Unspecified	26
Mailing list with more than 100 contacts	General and specialized	1	1
Radio interviews	General	Unspecified	4

News in press	General	Unspecified	113
Layman's report	General	1	1
<b>Unforeseen activities carried out</b>			
Riverphry calendar	General	0	1
Documents of academic training	General and specialized	0	4
TV interview	General	0	1

For more details, see **annex 7.3.8-7.3.14**.

### **Action D.5 Technical visits.**

**Objectives:** the aim of the technical visits was to reach every stakeholder main interests and introduce the idea that a different way of restoring contaminated river stretches was possible and, furthermore, that it can be environmental and economically profitable.

**Beneficiary responsible for implementation:** UPCT.

**Duration:** January 2014 - March 2018 (proposed duration: October 2012 - March 2018).

**Indicators of progress:**

- Number of visits to the river stretch (per year):  
Bad success: 0-100  
Regular success: 100-500  
Good success: >500
- Number of high and secondary schools interested in the project:  
Bad success: 0-2  
Regular success: 2-4  
Good success: >4

**Tasks performed:** according to the communication and dissemination plan, the first technical visits should have started in the second trimester of 2014 (April-June 2014). We had a delay in the beginning of this action owing to the problems explained previously. It was important that one stretch of 500 m of the riverbed was planted so that population know about the strategy carried out. Thus, technical visits started from autumn 2015 with students and members of regional associations as visitors. We developed a joint effort with the Regional Department of Education to reach most high schools in the area of influence of the project. In October, at the beginning of the course, primary and secondary schools, many entities and associations received the information of this dissemination event by the Regional Department of Education so that teachers could join the initiative. Moreover, the associated beneficiaries UPCT and Ayto Lorca contacted also with local associations and developed the script to start the technical visits. Between the years 2016 and 2018, the people attending the technical visits (208 visitors) were able to appreciate the active execution of the different phases of the project's execution throughout the technical visits, in addition to knowing the project. A total of 4 technical visits were carried out in 2016, 6 visits in 2017 and 3 visits in 2018 (13 technical visits between 2016 and 2018). The indicators of progress for the visits had a regular success (100-500). More information about the execution of the technical visits in **annex 7.3.15**.

### **Action D.6 Training course.**

**Objectives:** to visit the river stretches and understand and to learn about the rehabilitation techniques carried out.

**Beneficiary responsible for implementation:** UPCT.

**Duration:** January 2017 - August 2017 (proposed duration: January 2017 - August 2017). This action was finally completed in April 2018.

**Indicators of progress:**

- Number of students registered in the course:  
Bad success: 0-10  
Regular success: 10-20  
Good success: >20

**Tasks performed:** it was scheduled a summer course of 30 hours in summer 2015. However, owing to the delays, this summer course was planned for summer 2017, when all the river stretch was planted. The preparation of the summer course “Suelos contaminados: nuevas tendencias ambientales de recuperación” (Contaminated soils: new environmental trends of recovery; 11-14 July, 2017) covered from January to July 2017. The necessary documentation to present the summer course proposal at the UPCT was prepared between the months of January and February 2017, being 10 the minimum number of students accepted to teach the course and to receive the certificate from the Universidad Internacional del Mar, Campus Mare Nostrum 2017 (main organizing entities). The approval of the summer course was received by the Student Commission in the month of March. From that moment, the UPCT website disseminated the training course among their students. On July 3 and 7, 2017, it was possible to check at the UPCT's electronic office that only 1 student was registered in the training course, being the registration period from April 7 to July 7, 2017. Under these circumstances the training course had to be cancelled for not having reached the minimum number of students accepted (10 students) and the indicators of progress for this action could not be quantified despite all the efforts for its realization. The report on this action was completed in June 2018. For more details, see **annex 7.3.16**.

### **Action D.7 Workshops and seminars.**

**Objectives:** the aim of this action was to reach specialised audience and to show the idea that a different way of restoring contaminated river stretches was possible and, furthermore, that it can be environmental and economical profitable.

**Beneficiary responsible for implementation:** UPCT.

**Duration:** January 2016 - December 2017 (proposed duration: years 2016 and 2017).

#### **Indicators of progress:**

- Number of people involved in the workshops (specialised audience):  
Bad success: 0-15  
Regular success: 15-30  
Good success: >30
- Number of people involved in the workshops (very specialised audience):  
Bad success: 0-5  
Regular success: 5-10  
Good success: > 10
- Number of people involved in the seminars (general public):  
Bad success: 0-30  
Regular success: 30-60  
Good success: >60

**Tasks performed:** this action was carried out in the months of 2016, 2017 and 2018 and was organized by all the partners (Ayto Lorca, UPCT, CHS, DGMA and other organizers (depending on the event)). The objectives, actions and results of the project were mainly shown through the most appropriate approach for the attendees, which varied according to the group to which they were addressed. According to the approved project memory, the two proposed seminars were organized in 2015 and 2016. The seminars were addressed to general public. On the other hand, two workshops were scheduled for 2016, with a duration of 2 complete days (with a visit to the field area). However, owing to the delay in the implementation of actions B.2 and B.3, this action was delayed to have data and indicators to show to audience, as well to have the riverbed planted to show the real implementation in the field. So, according to the updated dissemination and communication plan, the two seminars were organized in 2016 and 2017. With regard to the workshops, one of them was organized in 2016 and the other one in 2017. The workshop scheduled for 2016 was jointly organized by the Life projects: Riverphy, Bioisotil (LIFE11 ENV/ES/000505), I+DARTS (LIFE11 ENV/ES/000547) and LIFE Discovered (LIFE12 ENV/ES/000761). We created a network among these projects dealing with decontamination and soil rehabilitation, and in the last networking meeting held in Cartagena on 20-21 January 2015, we agreed to jointly organize a Workshop. This joint collaboration to organize a unique workshop enhanced the visibility and quality of the event, with wider reach and higher successful. This would provide higher dissemination and attendees. On the other hand, on 15 February 2017 and on 30 May 2017 the first and second dissemination seminars were organized by the Life project Riverphy in Lorca and Murcia respectively. In autumn 2017 (On November 22 and 23, 2017), the workshop on “Rehabilitación de Emplazamientos Contaminados Mediante Técnicas Biológicas” (Rehabilitation of Contaminated Sites Using Biological Techniques) was held at the Caminos y Minas School of the UPCT. The event was organized by the GARSA research group, the Doctoral Program in Technology and Modeling in Civil, Mining and Environmental

Engineering and the Master's Degree in Water and Ground Science and Technology from the UPCT.

The number of people involved (assistants) in the events held are below:

- 35 people involved in the seminar 1 carried out in February 2017. Indicator of progress: regular success.
- 40 people involved in the seminar 2 carried out in May 2017. Indicator of progress: regular success
- 161 people involved in the workshop 1 carried out in June 2016. Indicator of progress: good success
- 40 people involved in the workshop 2 carried put in November 2017. Indicator of progress: good success.

The level of specialisation of assistant involved in this action and a specific report is explained in the **annex 7.3.17**. Based on these data the action D.7 has been successfully performed.

### **Action D.8 Assistance to fairs and conferences.**

**Objectives:** to attend to national and international conferences and to disseminate the results of the project by means of poster and oral presentations.

**Beneficiary responsible for implementation:** DGCalAmb.

**Duration:** October 2013 - March 2018 (proposed duration: October 2014 - March 2018).

**Indicators of progress:**

- Presentation of travel tickets, certificate of attendance, certificate of presentation and abstract of communication presented.

**Tasks performed:** attendance at conferences, exhibitions and congresses of national and international character has been a fundamental part for the dissemination of the results of the Life project Riverphy among the specialized personnel as well as to know experiences of other projects and similar works. These events have been very useful to know the evolution of the different fields of research in the project and also for their implementation and have been served to share the results. This action was programmed to start at the end of 2014, but we decided that it was interesting to show the first results of the project in this congress (Santander congress, 2013), make contacts and learn about techniques for soil reclamation and energy recovery. So, we started this action at the end of 2013. We attended and presented communications to 12 congresses:

1. 2013/10/3-5. “XIII Congreso Internacional en Energía y Recursos Minerales” (XIII International Congress in Energy and Mineral Resources”. Santander (Spain). Oral presentation.
2. 2014/7/29-30. International Congress Phytoremediation of Polluted Soils. Vigo (Spain). Oral presentation.
3. 2014/11/24-27. 12º Congreso Nacional de Medio Ambiente - CONAMA2014 (12th National Congress on Environment). Madrid (Spain). Poster presentation.
4. 2015/3/9-12. 3rd UNCCD Scientific Conference. Cancún (Mexico). Poster presentation.
5. 2015/6/9-11. II Congreso Ibérico de restauración fluvial - RestauraRíos 2015. Pamplona (Spain). Poster presentation.
6. 2015/5/4-6. “International Conference of Soil”. Tirana (Albania). Poster presentation.
7. 2017/4/23-28. European Geosciences Union General Assembly 2017 (EGU). Vienna (Austria). Poster presentation.
8. 2017/5/7-11. Society of Environmental Toxicology and Chemistry (SETAC). Brusels (Belgium). Poster presentation.
9. 2017/6/27-28. EU Platform Metering. Life Water Platform. One River Many Interests. Koblenz (Alemania). Poster presentation.
10. 2017/9/20-22. Remediation of contaminated sites, Land Management and Reclamation (REMTECH). Ferrara (Italy). Oral presentation.
11. 2017/11/6-9. 2nd International Conference on Pollutant Toxic Ions and Molecules (PTIM2017). Costa da Caparica (Lisboa, Portugal). Oral presentation.
12. 2018/6/20-22. VIII Congreso Ibérico de las Ciencias del Suelo. Donostia-San Sebastián (Spain). Poster presentation.

See **annex 7.3.18**.

#### **Action E.4 After LIFE Communication Plan.**

**Objectives:** to develop an “After-LIFE Communication Plan” as a separate chapter of the final report. This plan will continue disseminating and communicating the project results after the end of the project.

**Beneficiary responsible for implementation:** all beneficiaries.

**Duration:** after the end of the project (from June 2018).

**Indicators of progress:**

- – Number of visits to the webpage.
- – Number of visits to the river stretches.
- – Number of petitions of information about the project from different stakeholders.
- – Number of people involved in the workshops, courses, seminars.
- – Number of the high and secondary schools interested in the visit to the regenerated mining zones.

**Tasks performed:** since the project ended, the After-LIFE Communication Plan and the Layman report have been disseminated through the project website.

See **annex 7.3.2.**

### 5.3 Evaluation of Project Implementation

We provide here the evaluation of the results obtained so far.

#### A. Preparatory actions:

##### Action A.1 Preliminary activities. October 2012 - December 2013.

The methods employed were:

- Trips and samplings to collect information about slopes, vegetation cover, sediments and accessibility.
- Use of topographical maps, aerial images.
- Electrical tomography for riverbed profiles.
- Hydrological study.
- Geotechnical study with mechanical drilling. Collection of the column of sediment in three mechanical drillings. The mechanical drillings were done up to 10 m depth. The width of each drilling was 101 mm up to the first 3 m, and 86 mm from that level to the end. Depending on the identified materials in the lithological column, different samples were collected at different depths for analysis in the laboratory.
- Physicochemical analysis of the samples from the regular sampling grid (including metals Cu, Zn and Cr contents)
- Review about the disposal history in the area and the cultural activities.

This methodology resulted satisfactory for the purpose of this action, which was to assess the hydrological behaviour of the river, the nature of the sediments in depth, the current vegetation present in the riverbed, the location and availability of access, and identification of possible hotspots of contamination. The achieved results in this action of the project are compared with the objectives in the following table, showing, therefore, the efficacy or not of the methodology used:

Table 5.3.1. Results achieved in action A.1 against the objectives.

Foreseen in the revised proposal	Achieved	Evaluation
Complete removal of debris, wastes and invasive plant species	Yes	It was decided that it was more effective to carry out these activities just before the planting/sowing of each stretch that at the beginning of the project. This was because a river is a dynamic system and water flows can transport new materials. This task was moved to action B.2.
Data regarding soil mechanical and physicochemical properties for samples from the geotechnical study	Yes	The geotechnical study and the analyses of the column of sediments was useful to assess the nature of the sediments to estimate the degree of movement or retention of metals to the particles (finest particles have more affinity for pollutants), and the stability of the material to support circulation of machinery.
Data regarding hydrological and hydraulic regime (hydrological study)	Yes	These results provided information about the flooding regime to design the planting/sowing strategy. With this study it was assessed that no channel was needed to address the water flow owing to the hydrological behaviour of the river

Data regarding tomography profiles (geophysical study)	Yes	These results, in combination with the mechanical drillings permitted us to assess the nature of the sediments in the riverbed in the entire section. This was needed to estimate the degree of movement or retention of metals to the particles (finest particles have more affinity for pollutants), and the stability of the material to support circulation of machinery.
Determination of the thickness of the natural material layers and artificial fill materials	Yes	Results from geophysical and geotechnical studies indicated that no artificial fill material is present.

*B. Implementation actions:*

Action B.1 Initial characterization of soils and vegetation. February 2013 - September 2013.

The methods employed were:

- Soil sampling using a regular sampling grid of 2000 m<sup>2</sup>, with a total of 60 sampling points. Soil was collected at three depths (0-20 cm, 20-50 cm and 50-100 cm) to assess the movement of metals in the profile and the depth the pollution reached.
- Physicochemical analysis of the samples from the regular sampling grid.
- Metal content (Cu, Zn and Cr) in total and in different fractions of the samples from the regular sampling grid.
- Biological analysis of the samples from the regular sampling grid and the drillings.
- Estimation of vegetation cover and richness in field.
- Collection of 10 individuals of the main plant species for laboratory analysis, to assess the accumulation of metals in roots and shoots.

This methodology resulted satisfactory since we determined the concentration of the metals in the riverbed in the studied area (general area) and at different depths at to 10 m. We have related the mobility and availability of the metals with the physicochemical and biological properties to infer how mobility can be increased for phytoextraction. We observed that the current vegetation was accumulating metals, and new vegetation was needed to support the phytoextraction. The achieved results in this action of the project were compared with the objectives in the following table, showing, therefore, the efficacy or not of the methodology used:

Table 5.3.2. Results achieved in action B.1 against the objectives.

Foreseen in the revised proposal	Achieved	Evaluation
Data regarding soil physical properties	Yes	The determination of properties such as particle size distribution or pH were essential to relate metals distribution with particles sizes and areas with more or less pH.
Data regarding soil chemical properties	Yes	These properties were essential to assess if metal concentration was linked to some other chemical compound in the soil. In some cases metals were related with salts. In addition, the determination of nutrients was needed to assess if fertilizer application is needed for phytoextraction in different spots.

Data regarding metal contents in soil	Yes	These results permitted us to estimate the degree of pollution, the depth at which pollution arrived and the areas that were polluted and those that were not polluted. With this information we designed the phytoextraction strategy (phytoextraction project).
Data regarding soil microbiological properties	Yes	These results informed about the influence of microbial populations and their activity on metals mobility. No relationship between metals and microorganisms were found.
Data regarding vegetation cover, richness and biodiversity	Yes	With these data we identified the invasive plant species that have to be removed. In addition the identification of spots with natural vegetation was needed for the design of the phytoextraction plan, since some of these spots could be maintained in the riverbed cutting the aerial biomass to stimulate the growth of green shoots, which accumulate more metals.
Content in heavy metals in plants	Yes	These results informed about the suitability of the current species to extract heavy metals from the riverbed. None of the studied species accumulated high quantities of heavy metals.

### Action B.2 Phytoextraction in sediments. March 2014 - December 2017.

The methods employed were:

- Selection of native plant species present in the riverbed or plant species of interest in revegetation works.
- Contact with nurseries and companies to carry out the gardening and plantation tasks.
- Selection of zones without vegetation for the implantation of the selected plant species.
- Selection of the plant species to be implanted in the zones without vegetation of the riverbed area.
- Selection of the planting framework of the selected plant species to be implanted in the general area and in the experimental area.
- Realization of irrigations for plantations.
- Realization of field inspections to verify the tasks of planting and irrigations in the general area and in the experimental area (complying with the technical specifications).
- Realization of replanting tasks.
- Manual application of treatments (natural chelating agents and microorganisms) in the experimental area.
- Realization of field inspections to verify the performance of the tasks of mowing, cleaning, storing and grinding of contaminated biomass (complying with the technical specifications).
- Maintenance of the experimental plots (experimental area): stakes and signaling tapes.

The achieved results in this action of the project were compared with the objectives in the following table, showing, therefore, the efficacy or not of the methodology used:

Table 5.3.3. Results achieved in action B.2 against the objectives.

Foreseen in the revised proposal	Achieved	Evaluation
Acquisition of the selected species for phytoextraction ( <i>Atriplex halimus</i> , <i>Hypparrhenia sinaica</i> , <i>Lygeum spartum</i> , <i>Piptatherum miliaceum</i> , <i>Salsola oppositifolia</i> , <i>Suaeda vera</i> , <i>Silybum marianum</i> , <i>Tamarix africana</i> , <i>Dittrichia viscosa</i> , <i>Foeniculum vulgare</i> , <i>Stipa tenacissima</i> , <i>Phagnalon saxatile</i> , <i>Nerium oleander</i> ). The quantities are indicated in the phytoextraction project for actions B2 and B3 ( <b>annex 7.2.6</b> ).	Yes	The vegetal species indicated in the plantation project were selected and acquired for the first plantation (autumn 2015). For the second plantation (autumn 2016) the vegetal species indicated in the plantation project were also selected, although the vegetal species that did not develop well after the first plantation (46.2%) were replaced by plant species that developed favorably when the second plantation was made. The plant species <i>Atriplex halimus</i> , <i>Salsola oppositifolia</i> and <i>Suaeda vera</i> were mainly planted. The number of plantations were 39989: 17540 plants (stretch 1, autumn 2015), 14343 plants (stretch 2 and 3, autumn 2016) and 8106 plants (replanting stretch 1, autumn 2016).
Plantation of the seedlings in autumn 2015 for first cycle, autumn 2016 for second cycle and third cycle, and autumn 2017 for the entire area once all plants have been harvested.	Partially	The plantations of the first and second cycle were carried out in accordance with the plantation project. The plantations of the third cycle were not undertaken due to administrative delays and due to the breach of the cleaning tasks by the contracted joint venture companies (AVANCE Y DESARROLLO DE OBRAS S.L. and URDINTER INFRAESTRUCTURAS, S.L.) and the need to contract another company. It was also considered that the percentage of mortality in the second cycle was very low (~ 5%). The coordinating partner assumed the cost of the third biomass cleaning in order to achieve the project's objectives. The plantations of the third cycle were not assumed because they were very few (considering the low death rate of the plant species of the second cycle, ~ 5%) and on the other hand they did not compromise the project's objectives (aesthetic factor). The number of performed plantations during the project has been 39989: 17540 plants (stretch 1, autumn 2015), 14343 plants (stretch 2 and 3, autumn 2016) and 8106 plants (replanting stretch 1, autumn 2016). According to the plantation project, the number of plantations was 43649 plantations (without considering the stretch 1 replanting, 8106 plantations). From these 43649 plantations, the number of plantations for the third cycle and for the slopes protection according to the plantation project was 11766 plantations (3469 plantations for the third cycle and 8297 plantations for the slopes protection, without performing).

Action B.3 Slopes protection and revegetation. September 2016 - March 2018.

The implementation of the slopes protection and revegetation project was delayed by the modifications that had to be realized in the proposal and the administrative complexities of the procurement procedure of the Public Administration of Murcia Region. Finally, the project could not be executed due to all the administrative delays that occurred during the hiring period. Given the high cost of execution of the project, neither the coordinating partner nor the rest of the partners have been able to assume it with their own funds. The coordinating partner in this situation has prioritized the execution of the biomass cleaning tasks (action B.2).

Table 5.3.4. Results achieved in action B.3 against the objectives.

Foreseen in the revised proposal	Achieved	Evaluation
Acquisition of the selected species (Anthyllis cytisoides, Artemisia barrilieri, Artemisia herba-alba, Asparagus albus, Asparagus horridus, Atriplex glauca, Cistus albidus, Cistus clusii, Dorycnium pentaphyllum, Helianthemum almeriense, Lavandula dentata, Lycium intricatum, Pistacia lentiscus, Periploca angustifolia, Rhamnus lycioides, Rosmarinus officinalis, Salsola genistoides, Stipa tenacissima, Suaeda fruticosa, Thymelaea hirsuta, Thymus hyemalis, Ziziphus lotus and Zygophyllum fabago)	No	-
Plantation of the seedlings in autumn 2016	No	-
Establishment of mulching and barriers against erosion in autumn 2016	No	-

Action B.4 Energetic use of residual contaminated biomass. June 2015 - October 2015; October 2016 - March 2018.

The methods employed were:

- Samplings of contaminated biomass.
- Grinding of contaminated biomass to fulfil the physical requirements that the biomass had to meet to be accepted by the treatment plant.
- Biomass transport to the treatment plant.
- Incineration and combustion of the contaminated biomass.
- Preparation of all the necessary documentation (by Ayto Lorca and DGMA) for the entry of waste into the treatment plant.
- Fulfillment of all the administrative and security requirements demanded by the treatment plant to the transport company.

The achieved results in this action of the project were compared with the objectives in the following table, showing, therefore, the efficacy or not of the methodology used:

Table 5.3.5. Results achieved in action B.4 against the objectives.

Foreseen in the revised proposal	Achieved	Evaluation
Technological developments have facilitated the efficient use of waste from other industries as alternative fuels or raw materials in concrete production. These waste materials are an important source of energy for the concrete industry and at the same time they improve waste management. Also, they contribute toward the aim of decreasing fossil fuel use and costs while also conserving natural resources, lowering global CO <sub>2</sub> emissions and reducing the need for landfills. In this project, 15880 kg (4500 kg estimated for	Yes	With the first (2015) and second (2016 delayed until 2017) biomass transport, 11380 kg of contaminated biomass were introduced at the treatment plant (3400 kg with the first transport and 7980 kg with the second transport). In total, 6.3 MW/h were generated. For the third transport (summer 2018) it is estimated that a maximum of 4500 kg of biomass will be introduced at the treatment plant, equivalent to 2.5 MW/h.

the third transport) dry biomass for the total stretch of the river and the total duration of the project has been generated and has been introduced in the co-processing of the concrete factory as a source of energy with combustion. The volume of biomass has reduced 2-5% as fly ash that has been used as cementitious material. This amount of dry biomass is equivalent to 8.85 MW/h of energy.

Action B.5 Evolution of soils and vegetation. October 2015 - January 2018.

The methods employed were:

- Soil sampling using a regular sampling grid of 2000 m<sup>2</sup> (general area), with a total of 60 sampling points (20 sampling points per stretch). Soil was collected at three depths (0-20 cm, 20-50 cm and 50-100 cm) to assess the movement of metals in the profile and the depth the pollution reached. A total of 40 and 120 soil sediments samples were sampled in autumn 2016 (stretch 1) and autumn 2017 (stretches 1, 2 and 3) respectively.
- Physicochemical and biological analysis of the samples from the regular sampling grid.
- Metal content (Cu, Zn and Cr) in total and in different fractions of the samples from the regular sampling grid.
- Estimation of vegetation cover and richness in field in autumn 2016 (stretch 1) and autumn 2017 (stretches 1, 2 and 3).
- Collection of 3 individuals of the main plant species for laboratory analysis, to assess the accumulation of metals in roots and shoots.
- Soil sampling using composites samples from plots of 8 x 8 m (experimental area). To assess the movement of metals in the profile and the depth the pollution reached rizospheric soil was collected at three depths (0-20 cm, 20-50 cm and 50-100 cm) and non rizospheric soil was collected at two depths (0-20 cm and 20-50 cm). A total of 75 soil sediments samples were sampled in autumn 2016 and autumn 2017 respectively.
- Manual applications of the natural chelating agents and microorganisms in the plots.
- Physicochemical and biological analysis of the samples from the experimental area.
- Metal content (Cu, Zn and Cr) in total and in different fractions of the samples from the experimental plots.
- Estimation of vegetation cover and richness in field in autumn 2016 and autumn 2017 at the spontaneous subplots (experimental area).
- Collection of 3 individuals of the main plant species and the spontaneous vegetation from plots for laboratory analysis, to assess the accumulation of metals in roots and shoots.

The achieved results in this action of the project were compared with the objectives in the following table, showing, therefore, the efficacy or not of the methodology used:

Table 5.3.6. Results achieved in action B.5 against the objectives.

Foreseen in the revised proposal	Achieved	Evaluation
Data obtained for soil physical properties.	Yes	The objectives of this action were achieved and justified in a complete report ( <b>annexes 7.2.19 and 7.2.24</b> ).
Data obtained for soil chemical properties.	Yes	The objectives of this action were achieved and justified in a complete report ( <b>annexes 7.2.19 and 7.2.24</b> ).
Data regarding to metal contents in soil (total, bioavailable and soluble).	Yes	The objectives of this action were achieved and justified in a complete report ( <b>annexes 7.2.19 and 7.2.24</b> ).
Data regarding to soil microbiological properties.	Yes	The objectives of this action were achieved and justified in a complete report ( <b>annexes 7.2.19 and 7.2.24</b> ).
Data regarding to vegetation cover, richness, vigour, changes and plant biomass.	Yes	The objectives of this action were achieved and justified in a complete report ( <b>annexes 7.2.17 and 7.2.22</b> ).
Data regarding to number of plants.	Yes	The objectives of this action were achieved and justified in a complete report ( <b>annexes 7.2.17 and 7.2.22</b> ).
Data obtained for metal (Cr, Cu, and Zn) uptake of plants.	Yes	The objectives of this action were achieved and justified in a complete report ( <b>annexes 7.2.18 and 7.2.23</b> ).

Action B.6 Environmental recovery and landscape design. October 2013 - February 2018.

The methods employed were:

- Inventories of the autochthonous vegetation from the riverbed.
- Exhaustive bibliographic researches.
- Map design programs.
- Meetings and field visits with the companies in charge of preparing the proposals and executing the projects.

The achieved results in this action of the project were compared with the objectives in the following table, showing, therefore, the efficacy or not of the methodology used:

Table 5.3.7. Results achieved in action B.6 against the objectives.

Foreseen in the revised proposal	Achieved	Evaluation
To bring to the riparian area a new land-use and create a new ecological condition	Yes	For this purpose, the areas without plantations have been revegetated, see phytoextraction project ( <b>annex 7.2.6</b> ).
To rehabilitate the riparian area by ensuring the integration with its surroundings	Yes	This has also been achieved through the revegetation of areas without plantations. In this way there was a total integration of the vegetation in all the riverbed area of the project.
Appropriate and creative design, which provides a dynamical recreational site and centre of attraction	Yes	By the interpretive itinerary project, it has been possible to create a space designed for the recreational use of regular users and users who are interested in visiting the project.
To create or enhance ecologically functioning system	Yes	The ecological functionality has been improved by the tasks of mowing and cleaning of the contaminated biomass (native vegetation) from the riverbed. Through these tasks the vegetation has been revitalized and re-sprung so that it continues to exert its phytoextracting function.
To create circulation along the rehabilitated riparian area, so that general public can visit the area and learn about the history of the area, the environmental risks that appeared after pollution, rehabilitation strategies that are carried out with this project, and make the local people feel a part of this regenerated landscape.	Yes	The environmental trial had an initial path designed for these recreational purposes. To improve the conditions this path has been leveled and delimited with plantations on both sides of the ornamental plant species <i>Nerium oleander</i> . In addition, axis have been placed at the beginning and at end of this path to prevent vehicles from entering the path. See <b>annex 7.2.10</b> with photographs.
To provide the professionals from different disciplines of science and art will play an important role in the rehabilitation process.	Yes	The development of the reports and projects of this action (landscaping design, environmental trial project and decision support model) has been carried out with the help of professionals in these fields and with the collaboration (and contributions) of all the project partners.

*C. Monitoring of the impact of the project actions:*

Action C.1 Monitoring the effectiveness of true soil rehabilitation. January 2016 - March 2018.

This action was supported by a considerable amount of data coming from actions B.2 and B.5, and has given support to the viability of large scale rehabilitation of riverbed areas. The achieved results in this action of the project were compared with the objectives in the following table, showing, therefore, the efficacy or not of the methodology used:

Table 5.3.8. Results achieved in action C.1 against the objectives.

Foreseen in the revised proposal	Achieved	Evaluation
Decrease in Cr from > 230 mg kg <sup>-1</sup> to 150 mg kg <sup>-1</sup> .	Partially	Although the expected results has not been reached, for each soil horizons the following decreases for total Cr have been reached between 2013 and 2017: From 501 mg/kg to 153 mg/kg on the horizon of 0-20 cm, being the value of 153 mg/kg is very close to 150 mg/kg. From 1170 mg/kg to 402 mg/kg on the horizon of 20-50 cm. From 701 mg/kg to 313 mg/kg on the horizon of 50-100 cm.
Decrease in Cu from > 50 mg kg <sup>-1</sup> to 35 mg kg <sup>-1</sup> .	Yes	Although the expected results has not been reached, for each soil horizons the following decreases for total Cu have been reached between 2013 and 2017: From 21 mg/kg to 29 mg/kg on the horizon of 0-20 cm. From 23 mg/kg to 24 mg/kg on the horizon of 20-50 cm. From 23 mg/kg to 30 mg/kg on the horizon of 50-100 cm.  The average concentrations of this metal in the soil sediments between 2013 and 2017 are similar (omitting the standard deviation) and have not been reduced. The concentrations for both years are very similar.
Decrease in Zn from > 150 mg kg <sup>-1</sup> to 80 mg kg <sup>-1</sup> .	Yes	The expected results has been reached, for each soil horizons the following decreases for total Zn have been reached between 2013 and 2017: From 84 mg/kg to 57 mg/kg on the horizon of 0-20 cm. From 78 mg/kg to 51 mg/kg on the horizon of 20-50 cm. From 47 mg/kg to 48 mg/kg on the horizon of 50-100 cm.
Increase in vegetation cover from <50% to 75%.	Partially	The threshold value for the vegetation cover was ≥ 75%. The vegetation cover values quantified in stretches 1, 2 and 3 (period 2015-2017) had values between 20-80%, part of these values were below the threshold value and another part above of the threshold value (≥ 75%), being the vegetation cover average values around 46%. The detected values of vegetation cover were very influenced by the drought conditions that occurred in the riverbed area (from October 2015 - November 2017) and affected the growth of the implanted vegetation causing a 46.2% of replanting of the implanted plant species and a slow development of the surviving plant species. On the other hand, all the contaminated surfaces without vegetation were revegetated according to the phytoextraction project (action B.2). The vegetation cover of the years 2016 and 2017 has been calculated based on the vegetation cover quantified in the vegetation studies and the variations are due to the random selection of the plots or study quadrants.
Increase in vegetation richness from <10 to 20.	No	The objective threshold value was ≥ 20 plant species for the vegetation richness. The value of vegetation richness

	<p>obtained in the stretches 1, 2 and 3 (autumn 2017) ranged between 83 and 971 plant species. These values correspond to a total number of types of plant species between 5-13 different plant species. This indicator was not set correctly since the beginning of the project because the plant species used for the phytoextraction technique were the same autochthonous species present in the riverbed area. Therefore, the vegetal richness of the years 2016 and 2017 has been calculated based on the number of plant species identified in the vegetation studies and the variations are due to the random selection of the study plots or quadrants.</p>
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Action C.2 Monitoring the socioeconomic impact. January 2014 - March 2018.

The recruitment of people (over 18 years of age) to voluntarily carry out the surveys were mainly captured during the dissemination activities of the project. The achieved results in this action of the project were compared with the objectives in the following table, showing, therefore, the efficacy or not of the methodology used:

Table 5.3.9. Results achieved in action C.2 against the objectives.

Foreseen in the revised proposal	Achieved	Evaluation
Changes in employment and income-generating opportunities	Yes	During the project 4 hiring of research personnel has been carried out. There have also been more than 10 contracts that have generated work at the local and regional level.
Alteration of access and use of land	No	During the project, accesses and land use have not been altered or modified for environmental and safety (possible cases of flooding) reasons.
Changes in social networks and community integrity	Partially	The informative material and the project have been disseminated in social networks and stakeholder groups. The groups of local stakeholders have manifested in the questionnaires the need of more interventions and the problems related to the contamination of soil, vegetation and waste management. The most specialized interested groups manifest the need of more interventions by the municipal, regional and national administrations.
A melioration of the psychosocial well-being of displaced individuals	Yes	In this aspect it is worth to mention that the place where all the events were held was adapted for displaced individual. The informative panels (action B.6) and the notice boards (action B.3) were located so that they were clearly visible to the interested public.
Scholars and general public would be able to visit the zones and understand and learned about the rehabilitation techniques carried out.	Yes	The technical visits to the study area were made by the research staff of the UPCT and the Lorca City Council. In addition, during the visits the methodological manuals of visits, merchandising and information material of the project were distributed. The methodological manual is also available in digital on the website for those interested in visiting the riverbed on their own.
Enhancement of other activities such as ecotourism	Yes	The realization of the interpretive itinerary and the visit of the riverbed area encourage the realization of environmental activities. Simultaneously it is possible to learn about the background of the riverbed, about the natural environment and about the project (background, objectives, execution, results, etc.)

*D. Communication and dissemination actions:*

Action D.1 Dissemination and Communication Plan. November 2012 - March 2018.

There was an identification of all stakeholders and targeted audience, and there were a selection of communication and dissemination media and pathways for each targeted audience to increase the efficiency. This plan covered the preparation of all kinds of information with different supports and approach. So far, this plan was effective for the communication and dissemination of the project objectives, methodology and results, despite the problems encountered and the delays suffered. The achieved results in this action of the project were compared with the objectives in the following table, showing, therefore, the efficacy or not of the methodology used:

Table 5.3.10. Results achieved in action D.1 against the objectives.

Foreseen in the revised proposal	Achieved	Evaluation
Establishment and development of the communication and dissemination plan on time	Yes	To have a communication and dissemination plan from the beginning of the project helped in the fluency of the release of information and dissemination materials, since everything was previously identified and scheduled.
Fulfilment of the plan actions during the project duration	No	Owing to the delays in the implementation of actions B.2 and B.3, some materials/events could not be released/developed in the time indicated by the plan. After the second amendment the plan was updated. All the activities and publicity material were achieved, except the training course (action D.6). The materials/events were identified and were developed as indicated in the plan.

Action D.2 Public website. December 2013 - March 2018.

A website was created with different content subjects. This webpage allowed the visitors to find information about different project aspects. The website was created and maintained by an external company that has been subcontracted for this aim. The achieved results in this action of the project were compared with the objectives in the following table, showing, therefore, the efficacy or not of the methodology used:

Table 5.3.11. Results achieved in action D.2 against the objectives.

Foreseen in the revised proposal	Achieved	Evaluation
Public website with enough information and regular updates	Yes	The website was dynamic with sections covering all issues of the project, with images, videos, interviews, publications and reports. Its dissemination and visibility was good since we had approximately 1000 visits per month, which was a very good success according to our initial indicators.

Action D.3 Notice boards. April 2014 - March 2018.

Two notice boards were installed in visible areas of the riverbed, just next to a road the crosses the riverbed, and very close to the urban nucleus of Lorca. The boards were designed to present the situation of the project, objectives, methodology used and expected results, by using illustrations that make easy the understanding and takes the attraction of the visitor. The achieved results in this action of the project were compared with the objectives in the following table, showing, therefore, the efficacy or not of the methodology used:

Table 5.3.12. Results achieved in action D.3 against the objectives.

Foreseen in the revised proposal	Achieved	Evaluation
Design of layout	Yes	The design was successful since the use of images and illustrations in colour makes people to stop and rapidly read the board, understanding the strategy of Riverphy.
Installation of notice boards	Yes	Notice boards were installed on 25/04/2014, with one year of delay. However, since we requested an extension of a year in the duration of the project, no real drawback was expected with this delay. The two notice boards keep in the area with no deterioration.

Action D.4 Publication of information/publicity material. November 2012 - March 2018.

The information and publicity has been based on the communication and dissemination plan. The activities developed include the creation and delivery of newsletters, the preparation of a video documentary, press notes, news in press, interviews, speeches, emailing lists, publication of articles targeted and presentations to different stakeholders. The methodology used was effective, since different media and approaches were used, and the targeted audience was reached and knew about the existence of the project, its objectives and strategy to rehabilitate a contaminated riverbed. The achieved results in this action of the project were compared with the objectives in the following table, showing, therefore, the efficacy or not of the methodology used:

Table 5.3.13. Results achieved in action D.4 against the objectives.

Foreseen in the revised proposal	Achieved	Evaluation
Design of dissemination material	Yes	We designed the project template for newsletters and reports, the leaflets, posters, methodological manual for visits, notebooks, folders, pens and bags.
Mailing lists	Yes	We gathered an emailing list with different stakeholders to send the newsletters, dissemination materials and news about some dissemination events or achievement of milestones.
CD-DVD making (dissemination film)	Yes	We recorded, edited and released the initial video (documentary) about the objectives and methodology of the project, showing the first tasks and the expected results. We also recorded a final video (documentary) only in digital format with the phytoextraction procedure that was released at the end of the project.
Newsletters (three per year)	Yes	There was a continuous release of newsletters, three per year, since January 2014. A total of 12 newsletters. We included all the progresses of the project in the newsletters, informing about the dissemination events developed, and the upcoming actions and dissemination events. We also included information about the different concepts used for the project (phytoextraction, zero residue, accumulation of metals), and presentation of the project staff.
Translation of technical and dissemination material	Yes	Practically all materials were produced in Spanish and English to reach most stakeholders.
Papers in national and international journals	Yes	We have published two articles in national journals and 2 articles in international journals. More papers could be written with the final results of the project.
Layman´s report	Yes	We edited and disseminated the Layman´s report with the final results of the project.

Action D.5 Technical visits. January 2014 - March 2018.

Following the dissemination and communication plan, the preparation of documentation and contact with the attendees interested in the technical visits began in the autumn of 2015 and covered until the end of the project (March 2018). The achieved results in this action of the project were compared with the objectives in the following table, showing, therefore, the efficacy or not of the methodology used:

Table 5.3.14. Results achieved in action D.5 against the objectives.

Foreseen in the revised proposal	Achieved	Evaluation
Three technical guided visits per year	Yes	A total of 13 technical visits (208 visitors) were carried out between 2016 and 2018. High and secondary high schools, universities and environmental associations were the main interested centers in knowing the project. The indicators of progress for the high and secondary schools, universities and associations interested in the project had a regular success (between 2-4). On the other hand, the success of educational entities (high and secondary schools and universities) interested in the project had a good success (>4).

Action D.6 Training course. January 2017 – August 2017.

The preparation of the summer course ““Suelos contaminados: nuevas tendencias ambientales de recuperación” (Contaminated soils: new environmental trends of recovery; 11-14 July, 2017) covered from January to July 2017. The achieved results in this action of the project were compared with the objectives in the following table, showing, therefore, the efficacy or not of the methodology used:

Table 5.3.15. Results achieved in action D.6 against the objectives.

Foreseen in the revised proposal	Achieved	Evaluation
Organization of a summer course of 30 hours by summer 2017	No	The training course had to be cancelled for not having reached the minimum number of students accepted (10 students) and the indicators of progress for this action could not be quantified despite all the efforts for its realization.

Action D.7 Workshops and seminars. January 2016 - December 2017.

The workshops and seminars offered the possibility to establish contact and share experiences between professionals as well as to transmit knowledge among the public specialized in the subjects and themes on which the project was developed. These technical events had a positive effect such as changes in the attitude and the responsibility of the interested groups, but also in the progress of the project, since there was a mutual learning through the sharing of experiences and knowledge and networking. The achieved results in this action of the project were compared with the objectives in the following table, showing, therefore, the efficacy or not of the methodology used:

Table 5.3.16. Results achieved in action D.7 against the objectives.

Foreseen in the revised proposal	Achieved	Evaluation
Two seminars in 2017. Each seminar day would have a duration of 1 day, at a rate of 5 hours per day (from 9:00 am to 14:00 pm or from 16:00 pm to 21:00 pm).	Yes	<ul style="list-style-type: none"> <li>• 35 people involved in the seminar 1 carried out in February 2017. Indicator of progress: regular success.</li> <li>• 40 people involved in the seminar 2 carried out in May 2017. Indicator of progress: regular success. •</li> </ul>
Two workshops, one in 2016 and another one in 2017. The workshops would have a duration of two complete days, with a visit to the field area. For the specialised audience workshop we expect a participation of 50 persons. For the very specialised audience workshop we expect.	Yes	<ul style="list-style-type: none"> <li>• 161 people involved in the workshop 1 carried out in June 2016. Indicator of progress: good success.</li> <li>• 40 people involved in the workshop 2 carried put in November 2016. Indicator of progress: good success.</li> </ul>

#### Action D.8 Assistance to fairs and conferences. October 2013 - March 2018.

Conferences were selected to be specialized in the field of phytoextraction, sediments rehabilitation, energy use of biomass, landscape recovery, to make a good dissemination of the results and gain knowledge about the advance in the field by researchers and companies. We had always selected “Oral Presentation” when submitting the communication to increase the dissemination of the project, but in some occasions the assignation by the organizing committee has been poster presentation. One person, so far, have attended the conference to disseminate the project. The methodology used was effective, since different stakeholders from the international community, at scientific, technical and political have been reached. The achieved results in this action of the project were compared with the objectives in the following table, showing, therefore, the efficacy or not of the methodology used:

Table 5.3.17. Results achieved in action D.8 against the objectives.

Foreseen in the revised proposal	Achieved	Evaluation
Attendance to three international conferences and three national conferences	Yes	A total of 12 abstracts or contributions have been presented in 12 events (5 national events, 3 european events and 4 international events) with 5 oral presentations and 7 posters.

#### *E. Project management and monitoring of the project progress:*

##### Action E.1 Project management by DGCalAmb. October 2012 - March 2018.

The coordination activities were developed from the beginning of the project. The main activities developed have been:

- Monitoring of the project schedule, assisting partners in the development of their activities and assuring that deliverables were completed on time and milestones are reached. The project manager followed the project evolution and asked partners for information and help them on methodological issues and on the implementation of coordinated activities with other partners.
- The coordinator provided the Riverphy Consortium the communications infrastructure to coordinate the required work for the successful completion of the project. Monthly updates were carried out and various tables and graphics were used to demonstrate

project progress, based on the feedback and reports received by the partners. The typical graphics include Gantt chart, Network diagram and various histograms depicting resources employed and/or costs were used as appropriate. In case of deviations, corrective recommendations were communicated to the technical manager and to the Action leaders, so that they could be taken in a timely manner in order to achieve optimum performance.

Therefore, the project manager and contact person monitored the following project items:

- Identify risks, potential project problems, as early as possible.
- Identify when goals may not be met.
- Identify when constraints may be violated.
- Ensure that contingency plans occur before unrecoverable problems occur.
- Provide and receive project status for the phases and total project.

This methodology has worked, but has not avoided the appearance of problems which made delays during the project. However, this is not related to the efficiency of the project manager and management structure, but with the internal processing of the Government of Murcia (the coordinating beneficiary), and the times required for approval of costs, processing and tenders. The achieved results in this action of the project were compared with the objectives in the following table, showing, therefore, the efficacy or not of the methodology used:

Table 5.3.18. Results achieved in action E.1 against the objectives.

Foreseen in the revised proposal	Achieved	Evaluation
Integration of all partners in the day to day project work	Yes	The coordinating beneficiary has achieved this goal and all partners have been involved in the problems encountered, their solution, writing of reports and administrative monitoring.
An appropriate progress of the project activities and the fulfilling of the obligations in terms of reporting and justification, reaching all milestones and completing all deliverables on time	Partially	The project management has achieved the achievement of some milestones, and ensures the achievement of the rest of milestones and submission of deliverables. However, there have been delays that the project manager was not able to foresee and correct.
The development of efficient, widespread dissemination activities	Yes	Dissemination was effective with release of different materials and development of events, following the communication and dissemination plan. The project management was controlling and monitoring that all responsible beneficiaries for each dissemination material/event correctly carry out their tasks. In fact, dissemination has been one of the most successful aspects of Riverphy in opinion of all the partners.

Action E.2 Networking with other projects. January 2014 - March 2018.

For the creation of a networking with other projects, a research of current projects with similar topics was done and an email was sent to establish contact and to start networking. We also created a forum of networking and exchanged of information and materials with those that favourably responded. This forum was included in the Riverphy website. In addition, we created a networking community with some of those projects from Spain and we realized 4 meetings in different locations in each event. This methodology turned out to be effective since we contacted different projects, with information about new deliverables, newsletters, milestones achievements, dissemination materials, etc. The physical meetings with the reduced group of projects was positive to learn from others' experience, and we achieved close collaboration for synergistic effects. The achieved results in this action of the project were compared with the objectives in the following table, showing, therefore, the efficacy or not of the methodology used:

Table 5.3.19. Results achieved in action E.2 against the objectives.

Foreseen in the revised proposal	Achieved	Evaluation
Creation and update of a website	Yes	We used the Riverphy website to avoid excess of different websites, and included 2 links to an internal forum for networking and the other link (networking) to visit the project's webpage. This was useful to exchange information which should not be public (in some cases).
Establishment and development of a networking plan	Yes	This plan was the base to create the forum in the website, to search the projects, to establish the different networking topics, and to define a core group to carry out physical meetings. The number of stakeholders involved in the networking was 20, which is a regular success according to our initial indicators. We aimed to increase this number during the project by contacts with new projects and organizations.
Broad knowledge about Riverphy among different partners at local, regional, national and European level	Yes	Our dissemination, the contact with other projects, and the invitation to join our forum to different companies and associations helped the achievement of this result
Forum discussion	Yes	Created on the Riverphy website to exchange information, to communicate among participants and to have an easy and effective way to post information about the different projects. The number of contributions to the forum was 20 (regular success), but we made efforts to encourage people to use it to increase this figure. The number of stakeholders registered in the website had a regular success according to our initial indicators (9). We aimed to increase this number during the project by contacts with new projects and organizations.
Data base	Yes	We had a database with all projects and entities participating in the networking with contact details
Mailing lists	Yes	We had a mailing list with stakeholders, used to send updates, progresses, dissemination materials. This list was continuously updated.

#### Action E.3 Audit. May 2018 - September 2018.

With respect to the project audit, the auditors verified compliance with national legislation and accounting rules and certified that all costs incurred comply with the grant agreement. The auditor also checked the sources of the project financing, and in particular that cofinancing was not derived from other Community financial instruments. The work was in accordance with, and in the format of, the Guidelines provided by the Commission. The methodology used in this action was adequate because of the auditors verified the correct final statement of expenditure and income provided to the Commission, carrying out the final audit report.

#### Action E.4. After LIFE Communication Plan.

The after-LIFE dissemination and communication activities has been achieved through the involvement of the stakeholders, stimulated by the active dissemination carried out by the partners of the project. We must not forget that although the area of the project is located in a degraded area of southeast of Spain, the potential utilization of these technique includes national and international areas which allow dissemination and transfer activities for national and international audience through of courses for researcher o other scientific staff. In addition, local administration has supported the activities of maintenance of the rehabilitated areas due to reduce the risk of heavy metal mobility and increase the population welfare. The dissemination activities made at European level could help the process to be adopted in other countries. The environmental trial and its posters will be maintained periodically to avoid their deterioration. On the other hand, educational and field training courses will be carried out by the UPCT each year aimed to undergraduate students and general public; these courses or technical visits could be realized in association with the local administration and the owners of the tanning and farming areas. Finally, the waste producers (farmers and tanning companies) support the dissemination of the results in order to rehabilitate new degraded areas, which increase the potential use of their soils and could reclaim others degraded areas. The dissemination activities will be based on the continuation of the dissemination action (action D.1), continuing, always depending on the budget of each beneficiary, with the preparation of methodological and managing information, with different supports and approaches (leaflets, manuals, to detailed methodological and scientific guides and reports), technical visits, training courses to the riverbed area and workshops, focused to different stakeholders and using different approaches, from the classical ones to web-based resources and activities.

Other activities would be also the publication of several kinds of articles in written media (national and international journals, scientific and informative journals, electronic and paper journals), targeted to different stakeholders, showing also the evolution of soil properties and vegetation cover with time once the ecosystem is stabilized, although the project will be finished. The continuation of delivery of electronic newsletters highlighting the project's scientific progress will help to achieve this aim. The recording of radio and TV interviews and reports, the web page updating, and diffusion by environmental webpages from associations can continue after the end of the project.

See **annex 7.3.2.**

### **Visible results in a short period of time:**

Under these conditions of semiarid Mediterranean weather, the phytoextraction technique would be effective in a long period of time, although it would be advisable to carry out several recommendations to improve the efficiency of the technique such as irrigations, nutrient inputs and annual vegetation mowing.

One of the most important objectives in the Life project Riverphy has been the dissemination activities. The D actions have been widely accepted. This has been verified through the surveys carried out with the action C.2 and through the evaluation questionnaires of the events carried out (workshops and seminars). The people answered favorably to the surveys and to the questionnaires at the end of the training activities and they admit that the knowledge they have acquired can be applied to their municipality and can be put into practice.

### **Visible results in a long period of time:**

All the members of the Riverphy project have implemented, demonstrated and disseminated the technique of phytoextraction based on the controlled use of native species to promote its wide acceptance and to use it in big scale with shrub vegetation (depending on site) in conditions of Mediterranean semiarid climate, mainly characterized because of the scarcity of water and carbonated soils. All the work developed by the different partners has been demonstrated in actions B and D.

### **Efficiency of the diffusion and inconveniences arising:**

Regarding the dissemination activities, the following should be highlighted:

1. The request to participate in dissemination events through the website was viable when there was a long period of time.
2. The request to participate through questionnaires or similar ones through the website was not viable and very few or none questionnaires were received.
3. The realization of technical visits during the afternoon was unviable for educational centers. On the contrary, the realization of visits during the morning was unviable for companies and associations due to the complicated compatibility with the work schedule.
4. The completion of the summer course was unviable due to several reasons: the numerous courses offered, the short period of enrollment, the enrollment rate, the students' qualifications and the dates stipulated for the organization of the courses.
5. The place, schedule and duration of the workshops and seminars limited the number of attendees.

## 5.4 Analysis of long-term benefits

### 1. Environmental benefits

#### a. Direct / quantitative environmental benefits:

The main long-term benefit of the implementation of the project is the mitigation of environment contamination, since there has been a removal of contaminants from the soil that can migrate to water and other lands. There is also a decrease in human health risks, since the contaminated particles can reach cultivated lands, or can be respired by population when transported by wind. Lower contaminants in the riverbed reduce the risks of transfer of those contaminants to the environment and human. There could be also a recovery of the native riparian vegetation, which will attract native animals, with long-term recovery of a degraded ecosystem. Since the biomass has been transported to a concrete factory for its combustion, there has been an energetic saving in the factory since the combustion is associated to energy recovery. In addition, the ashes produced have been incorporated in the manufacturing of the concrete, with saving in raw materials.

The main quantitative environmental benefits have been the following:

- Total surface to recover by means of the phytoextraction technique: 96 550 m<sup>2</sup>.
- Number of plantations: 39 989.
- A decrease of Cr from 501 mg/kg to 153 mg/kg on the horizon of 0-20 cm.
- A decrease of Cr from 1170 mg/kg to 402 mg/kg on the horizon of 20-50 cm.
- A decrease of Cr from 701 mg/kg to 313 mg/kg on the horizon of 50-100 cm.
- A decrease of Cu from 21 mg/kg to 29 mg/kg on the horizon of 0-20 cm.
- A decrease of Cu from 23 mg/kg to 24 mg/kg on the horizon of 20-50 cm.
- A decrease of Cu from 23 mg/kg to 30 mg/kg on the horizon of 50-100 cm.
- A decrease of Zn from 84 mg/kg to 57 mg/kg on the horizon of 0-20 cm.
- A decrease of Zn from 78 mg/kg to 51 mg/kg on the horizon of 20-50 cm.
- A decrease of Zn from 47 mg/kg to 48 mg/kg on the horizon of 50-100 cm.
- Contaminated biomass harvested (kg): 15880 (estimating 4500 kg for the third transport).
- Generated energy (MW/hour): 8.85 (estimating 2.50 MW/hour for the third transport).
- Generated ashes (kg): 481.4 (estimating 140 kg for the third transport).

#### b. Relevance for environmentally significant issues or policy areas (e.g. industries/sectors with significant environmental impact, consistency with 6<sup>th</sup> or 7<sup>th</sup> (as applicable) EU Environment Action Programme and/or important environmental principles, relevance to the EU legislative framework (directives, policy development, etc.)

The results of this project provide results that should be incorporated in future policies to increase long-term sustainability of European ecosystems, promoting sustainable practices for soil reclamation, increasing the quality of life of all citizens, and aid in allocating environmental payments to the most promising measures. The Soil Thematic Strategy highlights the need for further research to fill the gaps in knowledge about soil and strengthen the foundation for policies. The outcomes of Riverphy could help to fill this gap, since we would look at how phytotechnologies contribute to soil decontamination and soil reclamation. These results can feed in updates of the Strategy to improve soil recovery and rehabilitation. These outcomes could be necessary if the Soil

Framework Directive proposal is resumed. The project outcomes can support future reforms of the Water Framework Directive (DIRECTIVE 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy). This Directive establishes the adoption of specific measures against pollution of water by individual pollutants or groups of pollutants presenting a significant risk to or via the aquatic environment, and to prevent environmental damage. Here we would provide data about how decontamination can be achieved by the use of phytoextraction, which could be proposed as an alternative to reduce soil contaminants which can migrate to waters, polluting them.

## 2. Long-term benefits and sustainability

### a. Long-term / qualitative environmental benefits

The implementation of the project can raise people awareness about the risks of soil contamination, the transfer pathways, and the need to find sustainable and feasible solutions. This will, in the end, make population increase efforts to decrease contamination to avoid environmental and human health risks. Thus, the visibility of the problem of pollution could avoid future risks in the future by awareness-raising.

### b. Long-term / qualitative economic benefits

The dissemination of the project results can encourage companies and entrepreneurs to adopt phytotechnologies to decontaminate soils and rehabilitate degraded areas, seeing it as an opportunity for business. This can favour regional development, with companies that can offer services in other regions or countries. The project could also encourage the use of extracted biomass to produce energy, and so it would encourage the adoption of renewable energy.

### c. Long-term / qualitative social benefits

The rehabilitation of a polluted and degraded area can increase the value and perceptual impression by population. So, the rehabilitation of the Guadalentín riverbed after the city of Lorca, with the creation of the interpretative itinerary has increased the value of the area, and has received more people from the city. This will increase changes in social networks and community integrity, by creation of links between centre and suburbs. The reduction in the content of contaminants in the environment could also reduce risks to human health by inhalation of contaminated particles. The decontamination and rehabilitation of further contaminated sediments in the region may also contribute to have positive effects on employment.

### d. Continuation of the project actions by the beneficiary or by other stakeholders.

Harvest of vegetation and planting/sowing could be periodically carried out by the public administrations to decrease the level of contaminants in hotspots were the concentrations are still a risk. The competent authority in the riverbed and the competent authority for the Environment in the Region of Murcia are partners of the project. So, there is an effort to continue to the procedure initiated in this project in those hotspots with higher content of contaminants which were not totally removed during the project implementation. As far as possible, the monitoring of the soil and vegetation present in the stretches of the riverbed area will be carried out. These samplings will be part of research activities of the different partners of the project, especially from the UPCT (final degree projects, master projects, etc.).

The dissemination tasks will be carried out by partners, mainly by the Regional Government of Murcia and the UPCT, by speeches, technical visits, training courses, presentations in conferences.

### 3. Replicability, demonstration, transferability, cooperation

The success of the phytoextraction technique remains in which the contaminated biomass contaminated (action B.2) can be used to generate energy and to produce concrete (results from action B.4) There are companies dealing with decontamination of soils and sediments, owing the industrial activities, mining activities or direct spills. The conventional methods are expensive and sometimes the high price makes them unfeasible. The demonstration that plants can efficiently remove the contaminants, even though the process is slow, can encourage private companies to include this strategy in the offer of services they provide. In addition, owner of contaminated lands and public administration will be encouraged to pay for the use of the phytoextraction technology, which is environmentally friendly, aesthetically positive, and more economical. Since the contaminated biomass can be used in combustion ovens to obtain energy, there is an added value that companies would also value or appreciate.

### 4. Best practice lessons

The plantation strategies implemented (through the use of native species) have allowed adjustment to local climate conditions, optimizing the use of water resources and minimizing their environmental impacts. Due to the soil heterogeneity of the riverbed area, these plantations are key when the phytoextraction technique is implemented, a key element in the programming of the technique. Both the samplings to determine the concentrations of plant metals and the sampling of soil sediments to carry out the metal balance and to define the changes in the quality of the soil have been carried out properly and have allowed to reach the objectives set in the project. However, with the implementation period we have verified that although the annual periodicity in the measurement of metals is adequate to obtain results and to monitor the concentrations of soluble and bioavailable metals in soil, soil samplings with biweekly periodicity are less necessary. We have observed that the changes in the soil are very slow when applying the phytoextraction technique and this effort is not necessary in the samplings. With an annual or semi-annual sampling it would be sufficient, with a monitoring for several years.

The removal degree of total Cu, Zn and Cr in soil sediments between the years 2013 and 2017 is favourable and evident for total Zn and total Cr and less evident for total Cu. The observed variations in the concentrations are remarkable, although the variations are not statistically significant. The implanted vegetation has been influenced by the periods of water scarcity and by the meteorological conditions, both facts could have conditioned the phytoextraction of metals by the vegetation present in the riverbed and therefore the concentrations of total metals registered in the samples of the soil sediments, especially in horizons of 0-20 cm and 20-50 cm.

On the study of the soil sediments affected by Cu, Zn and Cr in plots treated with 5 treatments (control, oxalic acid, amino acids and *Pseudomonas fluorescens* bacteria) with annual and biweekly samplings between June 2016 and September 2017, it can be deduced that in semiarid Mediterranean weather conditions the most notable treatment to increase the solubility and bioavailability of metals in soil is the treatment with citric acid, recommending to perform a biweekly monitoring of the rhizospheric soil (0-20 cm)

and an annual monitoring of the rhizospheric soil and the non-rhizospheric soil (0-100 cm). Thus, the addition of chelating agents (e.g. citric acid) in metal polluted and nutrient-poor soils of semiarid areas is recommended together irrigation and an annual reap of grown vegetation.

Finally, the application of the phytoextraction technique in semiarid Mediterranean conditions after the period 2013-2017 has shown that it is adequate but taking into account some recommendations such as the realization of emergency irrigation, the selection of the best native vegetation adapted to the conditions of climate and the accomplishment of agronomic practices that improve the development of the implanted vegetation like the nutritional applications that favour the development of the vegetation as well as an annual aerial biomass harvest.

## 5. Innovation and demonstration value

### Innovation:

The innovative aspects proposed in this project propose the application of the phytoextraction technique in degraded soils involving large-scale communities of owners responsible for their status. The use of techniques such as electrical tomography, soundings and biogeochemical studies to estimate the degraded surfaces to be rehabilitated have not been applied in an extended way so far and they represent an innovative aspect, giving an added value to the project.

### Demonstration value:

The actions and tasks of the project have been implemented in a real riverbed contaminated by heavy metals (by industrial activities of tanning companies and pig farms) to solve problems and needs and to restore the soil for environmental and landscape purposes. This fact guarantees the demonstrative value of the project, since the results obtained, and the strategy optimized in a real riverbed (with problems and real needs) would make it possible to publicize the environmental and economic benefits of the adoption of the controlled phytoextraction technique, favouring its replicability in other areas and its transfer to the European productive sector. This results will encourage managers, farmers, administration and legislators to promote the use of phytoextraction technique for environmental and landscape purposes

## 6. Long term indicators of the project success

Decrease of the concentrations of total metals Zn and Cr in the soil sediments:

### Total Cr (average values)

- $\leq 150$  mg/kg on the horizon of 0-20 cm.
- $\leq 400$  mg/kg on the horizon of 20-50 cm.
- $\leq 300$  mg/kg on the horizon of 50-100 cm.

### Total Cu (average values)

- $\leq 150$  From 21 mg/kg to 29 mg/kg on the horizon of 0-20 cm.
- $\leq 150$  From 23 mg/kg to 24 mg/kg on the horizon of 20-50 cm.
- $\leq 150$  From 23 mg/kg to 30 mg/kg on the horizon of 50-100 cm.

### Total Zn (average values)

- $\leq 50$  mg/kg on the horizon of 0-20 cm.
- $\leq 50$  mg/kg on the horizon of 20-50 cm.
- $\leq 50$  mg/kg on the horizon of 50-100 cm.

Increase of the contaminated surface without vegetation (39989 plantations).

Increase of the vegetation cover values  $\geq 45\%$ .

Increase of the vegetation density.

It would be convenient to highlight that the actual efficiency of phytoextraction or accumulation of metals by plants (and therefore the decontamination of metals from the soil) has been higher than the reflected in the reports and in the analysis of soil and vegetation. This is due to the fact that the tasks of harvesting of the contaminated biomass were carried out in July 2018 instead of autumn 2017 (as it was initially planned). So, the amount of harvested biomass has been higher (a greater amount) in July 2018 than if it had been done in autumn 2017 and also a higher amount of soil metals has been removed.

## 6. Annexes

### 6.1 Administrative annexes

ANNEX		Digital	Previous reports	Paper
7.1.1	Gantt-chart Riverphy		X	X
7.1.2	Control of attendance 2012-2018.	(E.1.)	X	
7.1.3	First meeting minutes. <b>Deliverable.</b>	(E.1.)	X	X
7.1.4	Second meeting minutes. <b>Deliverable.</b>	(E.1.)	X	X
7.1.5	Third meeting minutes. <b>Deliverable.</b>	(E.1.)	X	X
7.1.6	Fourth meeting minutes. <b>Deliverable.</b>	(E.1.)	X	X
7.1.7	Last meeting report. <b>Deliverable.</b>	(E.1.)	X	
7.1.8	Partnership agreement CARM and UPCT.		X	X
7.1.9	Partnership agreement CARM and Ayto Lorca.		X	X
7.1.10	Partnership agreement CARM and CHS.		X	X
7.1.11	DGCEA-CARM secondment.		X	X
7.1.12	UPCT secondment.		X	X
7.1.13	Inception report (30-6-2013).		X	X
7.1.14	Progress report (1-4-2014).		X	X
7.1.15	Mid-term report (30-9-2015).		X	X
7.1.16	Progress report (1-4-2017).		X	X
7.1.17	Final report networking	(E.2.)	X	

## 6.2. Technical annexes

ANNEX			Digital	Previous reports	Paper
7.2.1	Hydrological study.	(A.1.)	X	X	
7.2.2	Geophysical study.	(A.1.)	X	X	
7.2.3	Caracterización lecho en profundidad.	(A.1.)	X	X	
7.2.4	Justification of no creation of channel.	(A.1.)	X	X	
7.2.5	Initial characterization. <b>Deliverable.</b>	(B.1.)	X	X	
7.2.6	Phytoextraction project.	(B.2. B.3.)	X	X	
7.2.7	Documentation third biomass harvesting	(B.2.)	X		
7.2.8	Summary of field inspections 2016-2018	(B.2.)	X		
7.2.9	Report successful achievement.	(B.2.)	X		
7.2.10	Photographic summary		X		
7.2.11	Slopes protection project.	(B.3.)	X	X	
7.2.12	Holcim Carboneras letter of intent.	(B.4.)	X	X	
7.2.13	Report first transport of biomass.	(B.4.)	X	X	
7.2.14	Report second transport of biomass.	(B.4.)	X		
7.2.15	Documentation third transport of biomass	(B.4.)	X		
7.2.16	Monitoring methodology report. <b>Deliverable.</b>	(B.5.)	X	X	
7.2.17	Report on results on vegetation and biomass.	(B.5.)	X	X	
7.2.18	Report results metals plants.	(B.5.)	X	X	
7.2.19	Report soil results stretch 1.	(B.5.)	X	X	
7.2.20	Report results plots.	B.5.)	X	X	
7.2.21	Report soil removal efficiency.	(B.5.)	X	X	
7.2.22	Report (final) on results on vegetation and biomass.	(B.5.)	X		X
7.2.23	Report (final) results metals plants.	(B.5.)	X		X
7.2.24	Report (final) soil results in stretches.	(B.5.)	X		X
7.2.25	Report (final) results plots.	(B.5.)	X		X
7.2.26	Report (final) soil removal efficiency.	(B.5.)	X		X
7.2.27	Landscape design plan. <b>Deliverable.</b>	(B.6.)	X	X	
7.2.28	Environmental trial with photographs	(B.6.)	X	X	
7.2.29	Report aid decision model	(B.6.)	X		
7.2.30	Report on indicators.	(C.1.)	X	X	
7.2.31	Report (final) on indicators.	(C.1.)	X		X
7.2.32	Report on socioeconomic impact.	(C.2.)	X		

### 6.3. Dissemination annexes

ANNEX			Digital	Previous reports	Paper
7.3.1	Layman´s report. <b>Deliverable.</b>	(D.1.)	X		X
7.3.2	After LIFE Communication Plan. <b>Deliverable.</b>	(E.4.)	X		X
7.3.3	Corporative image manual.	(D.1.)	X	X	
7.3.4	Dissemination and Communication Plan. <b>Deliverable.</b>	(D.1.)	X	X	
7.3.5	Dissemination and Communication Plan (updated until 2018). <b>Deliverable.</b>	(D.1.)	X	X	
7.3.6	Report on website and social networks.	(D.2.)	X		
7.3.7	Notice boards.	(D.3.)	X	X	
7.3.8	Report on publicity material.	(D.4.)	X		
7.3.9	Leaflet.	(D.4.)	X	X	
7.3.10	Poster.	(D.4.)	X	X	
7.3.11	Initial video of the project.	(D.4.)	X	X	
7.3.12	Final video of the project.	(D.4.)	X		
7.3.13	2014-2018 Newsletters 1-12 (English).	(D.4.)	X		
7.3.14	2014-2018 Newsletters 1-12 (Spanish).	(D.4.)	X		
7.3.15	Report technical visits	(D.5.)	X		
7.3.16	Report training course.	(D.6.)	X		
7.3.17	Report on workshops and seminars. <b>Deliverable.</b>	(D.1. D.7.)	X		
7.3.18	Report on fairs and conferences.	(D.8.)	X		

## 6.4 Final table of indicators

See **annex 7.4**.

### Part 1 - Preparatory actions.

Table 6.4.1.

Types of preparatory actions	No.	Incurred cost (€)
Feasibility studies	-	-
Legislative reviews	-	-
Cost-benefit studies	-	-
Market analysis	-	-
Permit studies	-	-
Permit applications	-	-
Permits obtained	-	-
Environmental impact assessment studies	-	-
Scientific studies	-	-
Detailed engineering studies	3	61.926,81
Monitoring actions	-	-
Action plans	1	20.642,27
Management plans	1	20.642,27
Inventories & Studies	-	-
<i>Ex ante</i> environmental monitoring	-	-
<i>Ex post</i> environmental monitoring	-	-
Other (please specify)	-	-
<b>Total incurred cost (€)</b>		<b>103.211,35</b>

### Part 2 - Concrete actions.

Table 6.4.2. Main project deliverables (project implementation phase).

Deliverable	No.	Incurred cost (€)
Prototypes	-	-
Pilot plants	-	-
Techniques/Methodologies developed	1	330.970,54
Software	-	-
Successful implementation of demonstration actions	1	165.330,90
Monitoring techniques developed	1	64.694,32
Monitoring performed	2	94.776,75
Guidelines	-	-
Manuals	1	64.694,32
Others (implementation of demonstrative actions)	1	59.245,03
<b>Total incurred cost (€)</b>		<b>779.711,86</b>

Table 6.4.3. Training activities.

No. of training sessions	Total no.of persons trained	Incurred cost (€)
	-	0.00

### Part 3 - Awareness raising and communication.

Table 6.4.4. Workshops, seminars and conferences.

Target audience:	General public			Specialised audience (e.g. decision-makers)			Very specialised audience (e.g. experts, academics)		
	Local/ Regional	National	EU/ International	Local/ Regional	National	EU/ International	Local/ Regional	National	Local/ Regional
Number of participants:									
0-25 participants									
25-75 participants	2 seminars							1 workshop	
75-100 participants									
More than 100 participants								1 workshop	
<b>Total incurred cost (€)</b>	<b>24.525,13</b>								

Table 6.4.5. Media and other communication and dissemination work.

Type of media	No.
Project website: average number of visitors per month	1442
Press releases made by the project	113
General public article in national press	21
General public article in local press	92
Specialised press article	
Internet article	2
TV news/reportage	
Radio news/reportage	4
Film produced	
Film played on TV	
Film presented in events/festivals	
Exhibitions attended	12
Information centre/Information kiosk	
Project notice boards	2
Other (videos on youtube channel)	3
Other (documentary videos of the project)	2
Other (TV interview)	1

Other (calendar)	1
Other (documents of academic training)	4
Other (training course documentation)	1
<b>Total incurred cost (€)</b>	<b>119.522,47</b>

Table 6.4.6. Publications.

Type of publication	No. published	No. of copies	Languages (*)
Layman's report	1	0 (only digital)	EN/ES
Manuals	1	325	ES
Leaflets	1	2000	EN/ES
Brochures	-	-	-
Posters	1	1000	EN/ES
Books	-	-	-
Technical publications	2	0 (only digital)	EN
Other (merchandising: notebooks, folders, stickers, pens, caps and Usb's 4Gb)	6	2450	EN/ES
Other (newsletters)	12	0 (only digital)	EN/ES
<b>Total incurred cost (€)</b>	<b>82.867,01</b>		

Table 6.4.7. Educational activities.

Establishment involved	No. of students
Kindergartens/Primary schools	0
Secondary schools	103
Higher education establishments	88
Others	17
<b>Total incurred cost (€)</b>	<b>6.767,97</b>

## 7. Financial report and annexes

ANNEX			Digital	Paper
8.1	Standard payment request and beneficiary certificate of CARM-DGMA.		X	
8.2	Consolidated cost statement of the project.		X	
8.3	Financial statement of CARM-DGMA.		X	
8.4	Financial statement of UPCT		X	
8.5	Financial statement of AYTO LORCA.		X	
8.6	Financial statement of CHS.		X	
8.7	Answers to the letter from the EC (13/05/2015) Ref. Ares (2015)2034397 - 13/05/2015.		X	
8.7.1	Errata document (CARM)		X	
8.8	Report answers to the letter from the EC (18/07/2016) Ref. Ares (2016)3569172 - 18/07/2016.		X	
8.8.1	CHS VAT certificate		X	
8.8.2	Elements annual gross salaries		X	
8.8.3	Time dedications		X	
8.8.4	José Mora documentation		X	
8.8.5	Raúl Zornoza documentation		X	
8.8.6	Point 17 documentation		X	
8.8.7	Point 18 documentation		X	
8.8.8	Point 20 documentation		X	
8.9	Report answers to the letter from the EC (24/02/2017) Ref. Ares (2017)1007215 - 24/02/2017.		X	
8.10	Report answers to the letter from the EC (17/07/2017) Ref. Ares (2017)3592839 - 17/07/2017.		X	
8.11	Auditor's report. <b>Deliverable.</b>	(E.3.)	X	X