





European Project Manager





LIFE SURFING: "FACILITIES, EQUIPMENT, CONSUMABLES, AND RESOURCES IN THE TEST EXECUTION"

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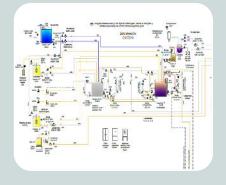
INTRODUCTION-



















PREPARATORY ACTIONS

A1 - Engineering Design Pilot Test A3 - Stakeholders Information and consultation

IMPLEMENTATION ACTIONS

- B1-Implementation of the field test
- B2 Full-Scale application design

FOLLOW-U P ACTIONS

• C1 -Environment al impact assessment and remediation achieved

COMMUNICATION ACTIONS

- D1 Outreach and awareness activities
- D3 –14th Int. HCH and Pesticides Forum

MANAGEMENT ACTIONS

 Collaboration with the Coordinating Partner (GA)





¿Why?

LIFE SURGING PILOT TEST

Elimination of residual DNAPL in a fractured aquifer SEAR+S-ISCO

¿How?

Organization has been integrated by an interdisciplinary work team with knowledge on the geomorphological and hydrological characteristics of the site.



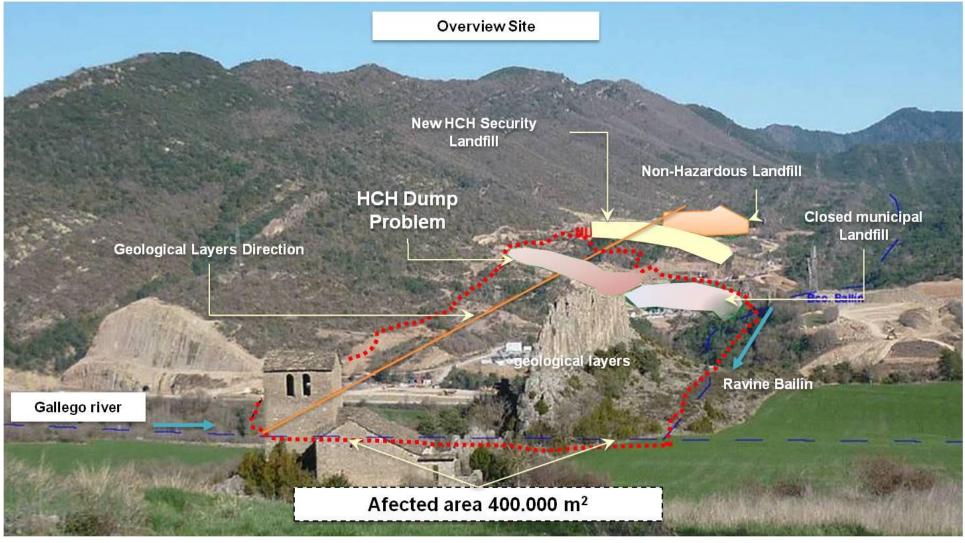


Based on it, they defined the scope of the test, the design of the installation, and the execution of the works.

Preventive and corrective measures have been applied to control the test performance in case of deviations in the development of the works.



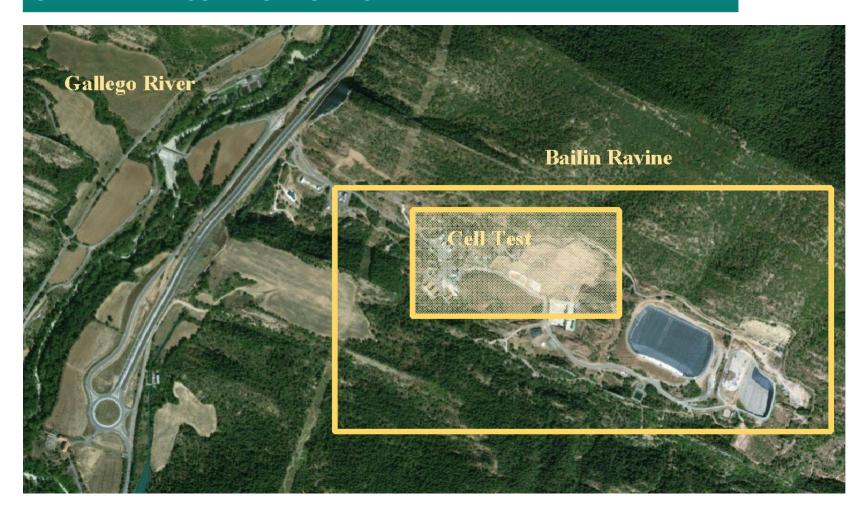








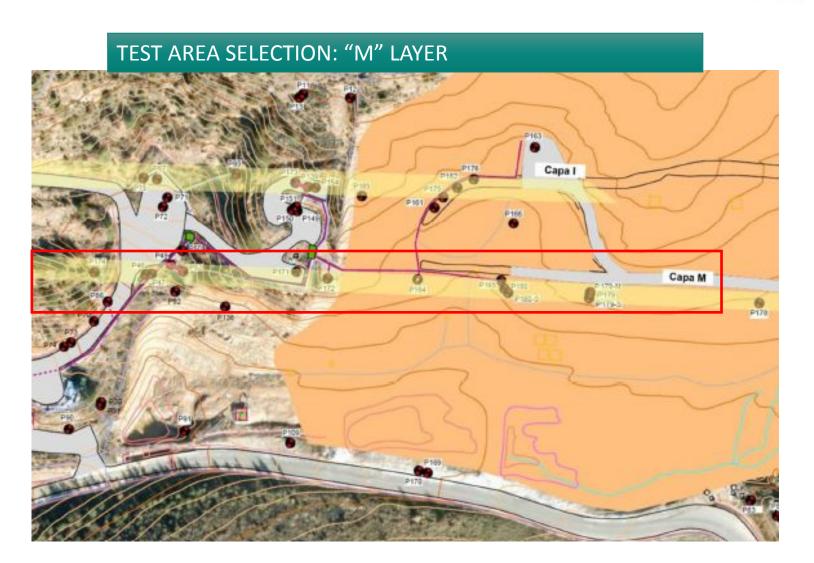
GENERAL AREA SURFING PILOT TEST





STAGE 1-PREVIOUS STUDIES & TEST DESIGN







STAGE 1-PREVIOUS STUDIES & TEST EXPERIMENTAL DESIGN



Experimental and technical DESIGN of the TEST:

- analyze hydrogeological studies
- the geochemical data of the selected test area
- reagent dosing
- laboratory tests with surfactants
- SEAR (Surfactant Enhanced Remediation) research review and analysis S-ISCO (Surfactant Enhanced In Situ Chemical Oxidation).

DEFINITION FIELD WORK:

- adequacy of accesses,
- drilling of new boreholes
- hydraulic tests (pumping, injection and tracer tests) and the design of the safety barrier.





STAGE 1- ENGINEERING TEST DESIGN & PROTOCOLS



ENGINEERING DESIGN

• technical requirements of the injection test and internal recirculation layer M.

PROTOCOLS AND PROCEDURES □

• Government of Aragon +UCM defined those for carrying out the preliminary tests, consisting of hydrogeological tests and thus establish the conditions of the hydrogeological flow and the connectivity of the fractured aquifer, the admissible injection and pumping flows, tracer tests to estimate recovery rates and adjust injection and pumping flow rates, and a barrier zone test to check its effectiveness.

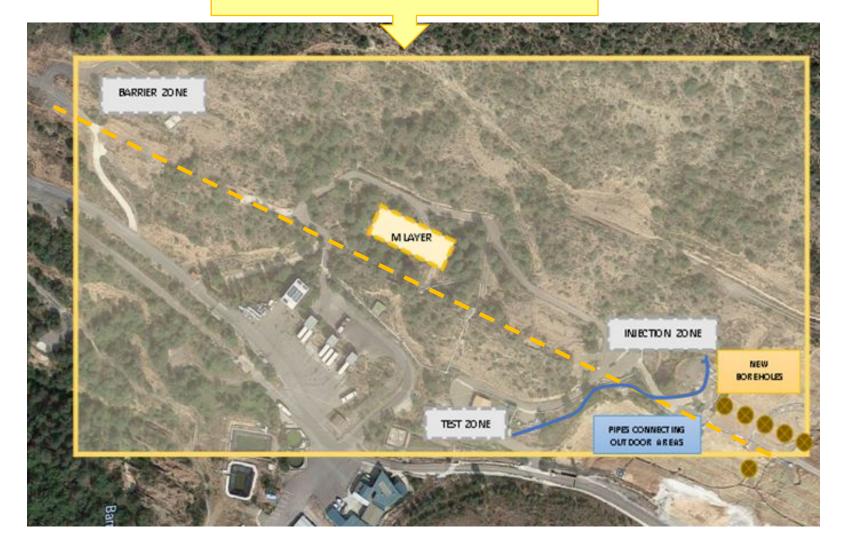
TEST EXECUTION PROTOCOL ☐ **TWO PHASES:**

- Phase 1: SEAR TEST, surfactant-enhanced extraction, consisting of 2 injection events.
- Phase 2: S-ISCO TEST, in situ chemical oxidation enhanced with surfactants, performed in 1 injection event. In these protocols, the control and follow-up methodology of the trial was defined, including data collection and analysis in situ and in the laboratory prior to, during and after carrying out each of the stages of the test.



STAGE 2-FACILITIES

LIFE SURFING TEST AREA



- -Inyection Area,
- -Test Area
- -Barrier Area





STAGE 2-FACILITIES- CIVIL WORKS



Construction of accesses and platforms for the execution of surveys **COMPLICATED OROGRAPHY**.

The concrete platforms allowed both the location of the drilling machinery during the construction phase and the installation of the tanks, equipment and reagents during the execution of the test.







Everything was planned with security guarantees so that the transfer of workers and necessary auxiliary materials will be carried out correctly in the execution.



STAGE 2-FACILITIES-CIVIL WORKS











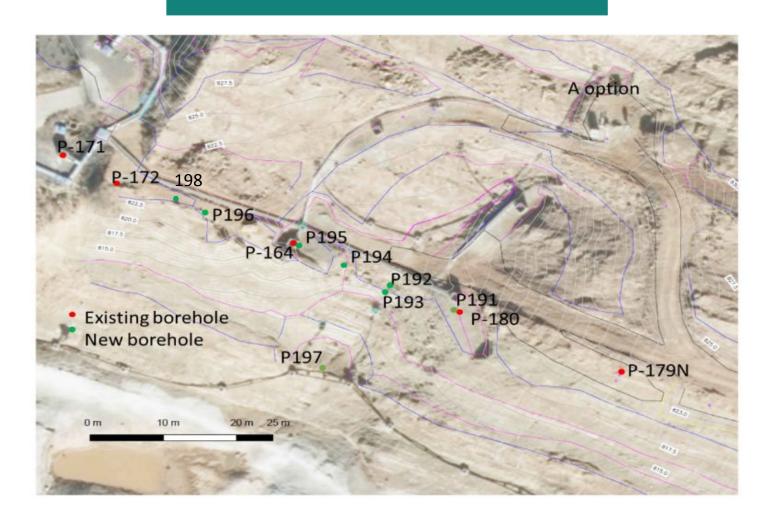




STAGE 2-FACILITIES-BOREHOLES

RESERVICES TEST 2016E PRINT OF 2016E PRINT ON 1945 PRINT ON 19

Boreholes in the "test cell"



Execution of **7 piezometers**(P190-P196) that were located on layer
M on the slope of the dismantled basin
of the Bailín landfill.
The length of the piezometers was
between 30 and 45 m deep.



Drilling machine at borehole P196



STAGE 2-FACILITIES-BOREHOLES



Drilling machine at borehole P193



Drilling machine at borehole P194

Boreholes in the "test cell"



Borehole core at borehole P194



Residual dense phase borehole P194

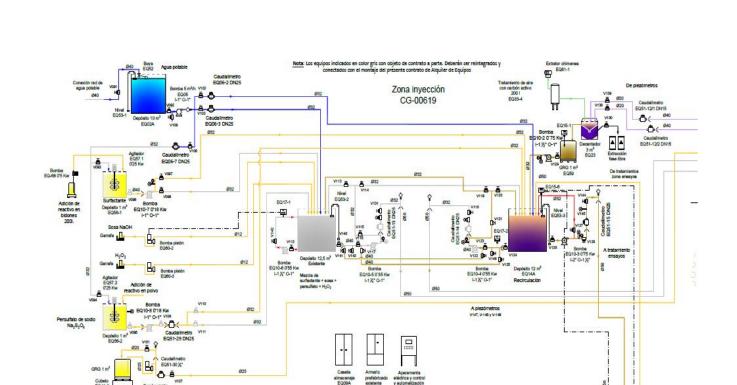


Residual dense phase borehole P194



ETAPA 2-FACILITIES- INJECTION AREA

INJECTION AREA





Injection equipment and the feeding line of the mixture of reagents to the piezometers to be treated.

The area was completed with a recirculation tank and a mixing tank, which were communicated to facilitate the injection and pumping maneuvers of the fluids and reagents to the two injection lines.

Also, in this area there was a 1m3 soda tank (25%).



ETAPA 2-FACILITIES-Injection Area

INJECTION AREA







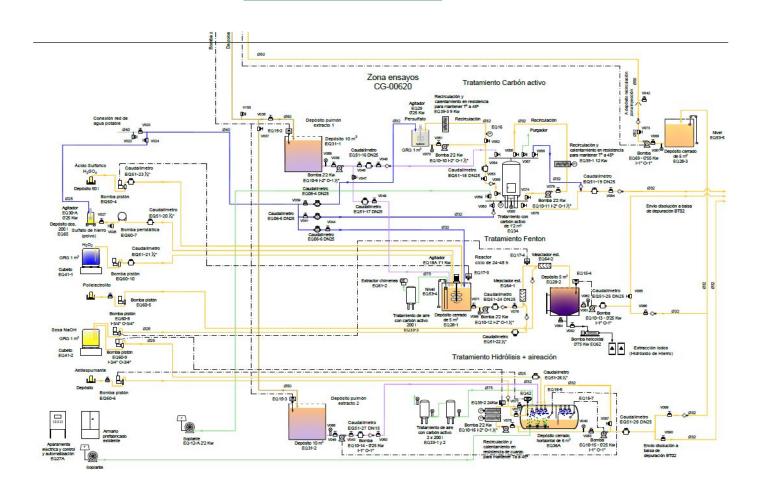






ETAPA 2-FACILITIES-Test Area

Test Area







Test Zone constituted a platform that collected the leachate from the injection zone, sent by pumping. Different equipment was arranged to carry out the leachate treatments, with different techniques: activated carbon, Fenton and Hydrolysis.



ETAPA 2-FACILITIES-Test Area



TEST AREA

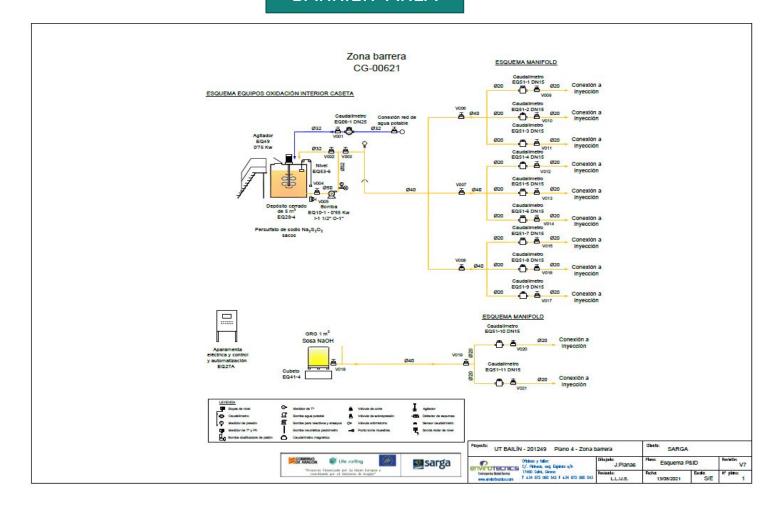






ETAPA 2-FACILITIES-Barrier Area

BARRIER AREA







The Barrier Area, constituted an area of more than 100m with wells for injection from a control point (with a safety bucket and injection manifolds) and for dosing of persulfate, soda.

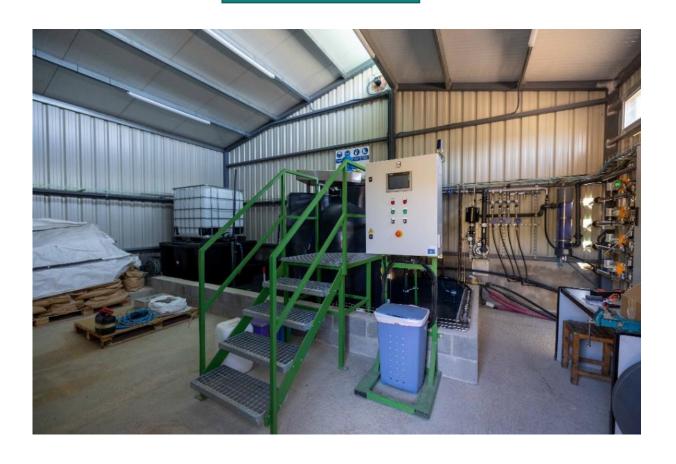
In addition, existing gas extraction equipment was set up in the area's survey network.



ETAPA 2-FACILITIES-Barrier Area

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BARRIER AREA







ETAPA 2-FACILITIES-Equipments



To complement and facilitate the handling, analysis, and monitoring of all test samples, a gas chromatograph with an electron capture detector (ECD) and flame ionization detector (FID) was purchased.





STAGE 3-TEST EXECUTION-QUEMICAL PRODUCTS & REAGENTS



QUEMICAL PRODUCTS & REAGENTS 10.200 kg y 7.600 L



Surfactant (EMULSE)



Salt



Persulfate





Carbon Active



Heptanol

| | 1 | | 4 | |
|-----|---|---|----|---|
| 16 | | | TI | W |
| | | - | | |
| -25 | | | | |

Soda 25%

| Product | Quantity(Kg) |
|---------------------------------|--------------|
| Activated carbon in pellets for | |
| gases | 500,0 |
| Activated carbon for water | 500,0 |
| Thickener | 5,6 |
| Ferrolin/ Kurita | 92,0 |
| Fluka | 1,0 |
| Iron(II) sulfate heptahydrate | 75,0 |
| sodium persulfate | 250,0 |
| Potassium Iodide PA-ISO 99.5% | 2,0 |
| Salt | 1.200,0 |
| Sodium bromide | 75,0 |
| Sodium persulfate | 6.500,0 |
| Caustic soda | 1.000,0 |
| SPAM-80 quality synthesis | 2,0 |
| TRITON X-100 synthesis quality | 2,0 |
| TWEEN-80 synthesis quality | 2,0 |
| Total | 10.206,6 |

| Product | Quantity (L) |
|------------------------------|--------------|
| 1-Heptanol | 25 |
| 20% sulfuric acid | 10 |
| silicone defoamer | 50 |
| Buffer | 3 |
| Hydrogen peroxide 50% | 1.400 |
| Polyelectrolyte / Flocculant | |
| A-30L | 25 |
| 25% soda | 4.000 |
| surfactant emulse | 2.082 |
| Total | 7.595 |



STAGE 3- TEST EXECUTION-CONSUMABLES

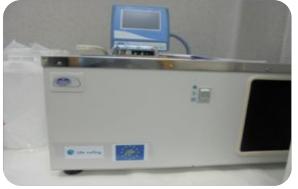


Consumables for the handling of chemical products and reagents auxiliary equipment and tools have been used (dosing and submersible pumps, packers, measurement probes, point samplers, interface and TLC measurement probes, containers sampling tubes, bladder pumps, electrodes, manometers, and small hardware and laboratory consumables), requiring continuous replacement, avoiding cross contamination and material wear.













Muestreador Discreto de Intervalos de 1.66" (42mm)





STAGE 3-TEST EXECUTION- CONSUMABLES















STAGE 3-TEST EXECUTION- HUMAN RESOURCES LABORATORY ANALYSIS ENVIRONMENTAL MONITORING SAFETY & HEALTH



Different entities (UCM,
Government of Aragon, SARGA),
companies (Eutop, AECOM,
Sondeos Jarem, Adiego
Hermanos, Hidroman,
Envirotecnics, etc.) have
collaborated











STAGE 3-TEST EXECUTION- HUMAN RESOURCES LABORATORY ANALYSIS ENVIRONMENTAL MONITORING SAFETY & HEALTH



SECUIMIENTO DISTRIBUCIÓN HORARIA

| hora | B-10 | 10-12 | 12-14 | 16-18 |
|----------|----------------------|------------------|--------------------|------------------|
| | 222-140-141-142-126- | 130-11-01-02-55- | 52-174-81-196-198- | 191-192-194-195- |
| nivel | 98-223-99-146-106 | 79-127-129 | 171-172 | 180-179N-186 |
| ERRA | 126-146-106 | 11-130-198 | 196-195-194 | 192-191 |
| muestreo | 126-146-106 | 11-130-198 | 196-195-194 | 192-191 |

P222-P140-P141-P142 los muestrea AECOM dentro de la campaña semestral

| 3 oct. Lunes | | | | |
|--------------|---------------|---------------|-------|-------|
| hora | 8-10 | 10-12 | 12-14 | 14-16 |
| nivel | 195-171 | | | |
| ERRA | | | | |
| muestrea | | | | |
| bombeo | ¿195-192-171? | ¿195-192-171? | | (5) |

El bombeo depende del nivel en estos sondeos y las cotas objetivo

| hora | 8-10 | 10-12 | 12-14 | 14-16 | 16-18 | 18-20 |
|------------|-----------------|------------------|---------------------|---------------------|------------------|--------------------|
| | | 192-195-198-172- | | | 192-195-198-172- | 192-195-198-172- |
| nivel | 195-198-172-171 | 171 | 192-195-198-172-171 | 192-195-198-172-171 | 171 | 171 |
| ERRA | | 52-174 | 186-179N-192-174-81 | 191-195-198-174-55 | 194-52-174-81-79 | 191-195-198-174-55 |
| muestrea | | 52-174 | 186-179N-192-174-81 | 191-195-198-174-55 | 194-52-174-81-79 | 191-195-198-174-55 |
| Caudal-gut | | 172 | 172 | 172 | 172 | 172 |
| | | | | | | |

| | surf-oxid. | | | | | | | |
|-------------|--|---|---|---|---|--|---|---|
| S | Airesción | | | | | | | |
| ĕ | espumes | | | - | | | | |
| Ě | SOSIE | | | | | | | |
| | baseline | Cono-muestra | Cond-muestra | cono-munitra | | 00/10e0 P29 2- P295 * | | |
| | Seguimiento | | | | | | | |
| | Jornada | Normal . | Normal | Normal | Namel | Normal | 1 1 | |
| | | * Si et nivet frei | time steets se | bombesré desc | ne F192 yF193 | | | |
| | | | | Semana 2 (5 | 5-9 oct.) | | | |
| | | Lunes | martes | titiéroples | Jueves | viernes | Sábado | Dontingo |
| | | | African pac | nar P122 animici | erei útimodía: | de Injección | | |
| | | - | | Be robe door. | | 77 | P 22 | |
| | instalación | | | | | | | _ |
| _ | Prep. reactives | | _ | Repone | ruces, entisept | ments, surfexio | [P\$79N] | _ |
| | surf-axid. | | _ | - | 1 | | | _ |
| Impactiones | Alreación | | | _ | 6 | -01 | _ | _ |
| | espumas | | F271 T | | man * | F171.7" | | |
| | 1018 | | #176-00-79 #180-196*1 | **P17485-79 4F180-156-957 | | * P174-88-79 LF180-198-9 51 | * PL74-85-79 2887 | ** P174-88-79 2981 |
| | | | | | | | | |
| | Seguimiento | | | | | | | |
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| | | * si es receser miérores, si le polifica curt or 2 *la generació | o bombeere i lu ibenere deespi lis case ole enfi in deespunas o | nes se bomb con umes funcione tr nescar re inyecci e mannentra mis | ia de P151-P151 ien pust fa inves ión en P182 y P1 entras de miente | Les d'es de iny terse due vie to se. | ección segunos : della semana f des urbosia | onmertes y to PS 75Wie |
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4 teams of 3 people each were needed, during the injection and control days, due to the continuous measurements performed.



Each TEST period lasted 5 weeks, with an initial week for preparation only, another for tracer testing, a third for TEST execution, and another two (minimum) subsequent follow-up weeks.



STAGE 3-TEST EXECUTION- HUMAN RESOURCES LABORATORY ANALYSIS ENVIRONMENTAL MONITORING SAFETY & HEALTH





The previous work began in **2020 and involved more than 500 samples**, among which the test in the Barrier Zone (August-Sep. 2021) with 361 samples stands out.

During the year 2022, all the tests scheduled for the Life Surfing project were carried out, with a number of samples indicated in the table below.

In addition, carrying out the tests implied an increase in the control of the river, which meant 40 more samples per month, compared to the control that is usually carried out, which is usually 150-170 samples per month.

| Samples | Base line | Old Cell | Barrier/Others | River Discharge | TOTAL | Gases |
|---------|-----------|----------|----------------|-----------------|-------|-------|
| Tracer | | | 89 | | 89 | - |
| SEAR 1 | 36 | 51 | 112 | 25 | 224 | - |
| SEAR 2 | 36 | 46 | 102 | 31 | 215 | 9 |
| SISCO | 33 | 74 | 97 | 25 | 229 | 79 |
| TOTAL | | | | | 757 | 88 |



The samples obtained in the field were analyzed in the Bailin laboratory and in the Pirenarium laboratory, comparing the results of all the samples with analyzes carried out at the UCM.





STAGE 4-ECONOMIC ANALYSIS & CONCLUSIONS



| Life test external cost | Total |
|---|-------------|
| Facilities | 233.969,69€ |
| Quemical products & Reagents | 64.715,81€ |
| Consumables | 65.873,20€ |
| | |
| Personal | 256.536,42€ |
| Others | 767,43€ |
| | |
| Total | 621.862,55€ |

LIFE SURFING
TEST
RESULTS

240 kg DNAPL =12.000 hm3= 48.000 OLIMPIC POOL Each kg of residual DNAPL extracted has cost €2,591



CONCLUSIONS



Remediation of contaminated soils

 Responsibility with the environment to avoid consequences on a larger scale.



Union of efforts public resources





1kg of DNAPL in surface water

• 50 hm3







CONCLUSIONS

It is necessary to reconsider the measures that prevent contamination and the importance of carrying out pilot tests that allow evaluating the feasibility of how to minimize the impact of those sites that are already contaminated, reducing the cost and incorporating the economic variable in the final decision.





THANK YOU FOR YOUR ATTENTION

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