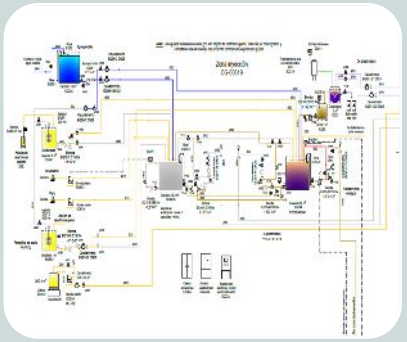
SÁNCHEZ-VALVERDE MORENO ALICIA

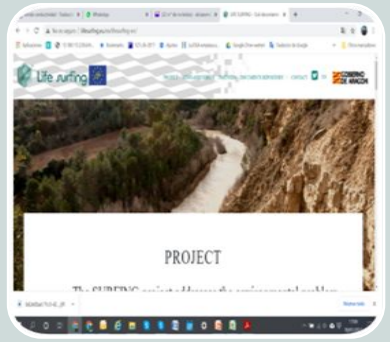
European Project Manager

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

Sánchez-Valverde A.[1], Romero P.[1], Peiro A.[1], Arjol M.A.[1], Herranz C.[1], Cano, E.[2], Fernández J.[2]

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-UP ACTIONS

- C1 - Environmental 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)

INTRODUCTION-LIFE SURFING PILOT TEST

¿Why?

LIFE SURGING PILOT TEST

Elimination of residual DNAPL in a fractured aquifer

SEAR+S-ISCO

¿How?

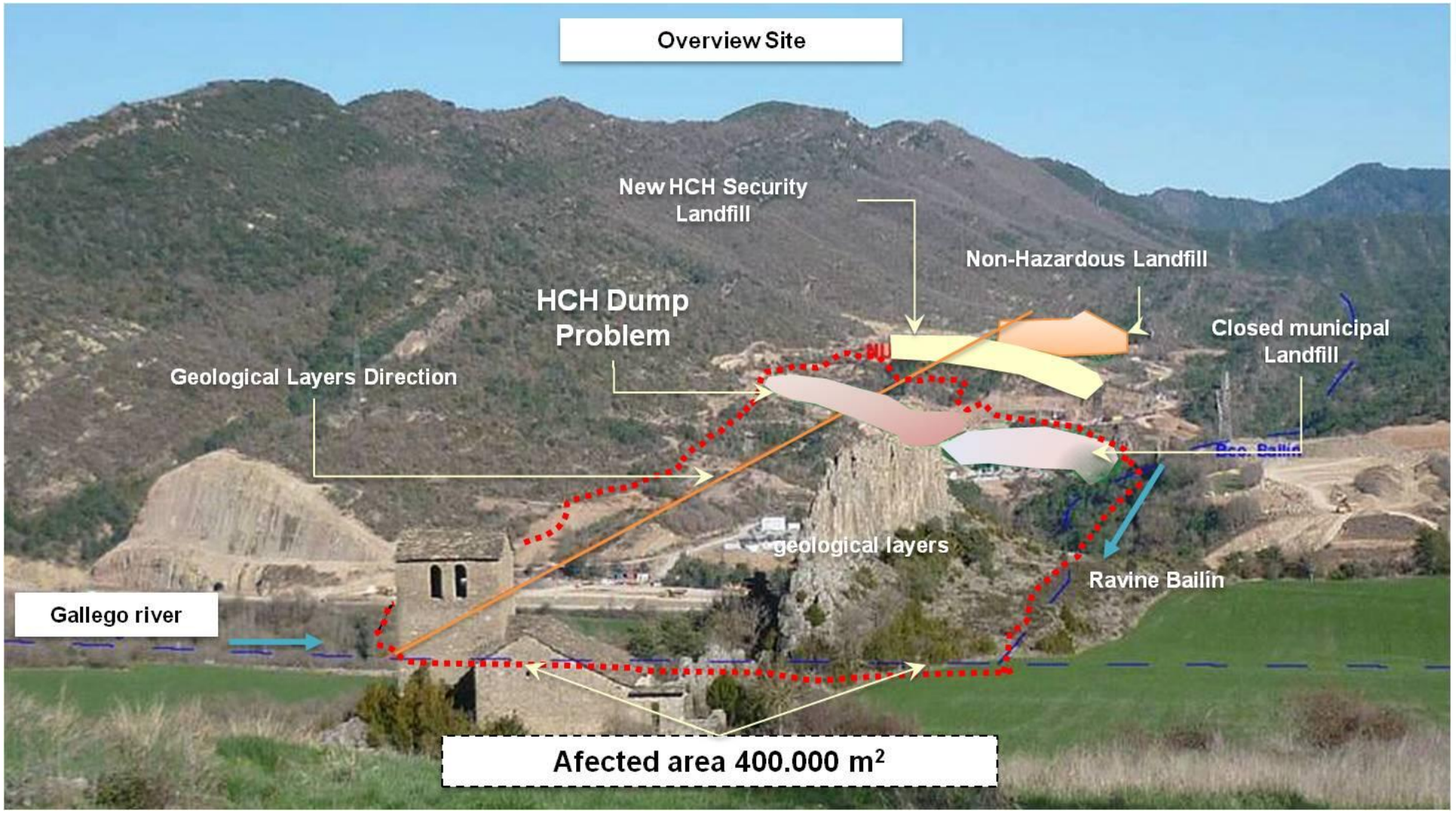
Organization has been integrated by an interdisciplinary work team with knowledge on the geomorphological and hydrological characteristics of the site.

INTRODUCTION-LIFE SURFING PILOT TEST

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.

INTRODUCTION-LIFE SURFING PILOT TEST

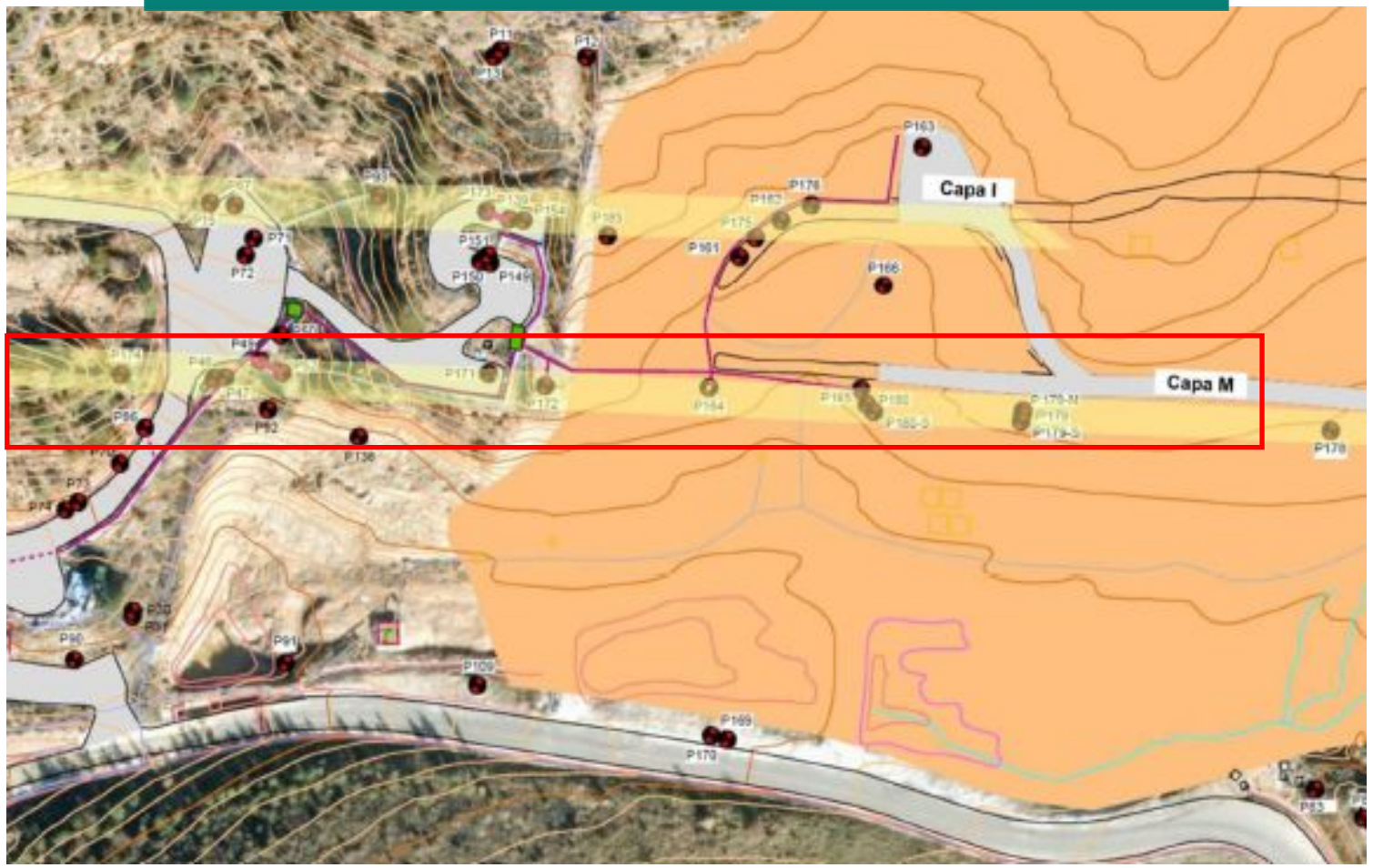


INTRODUCTION-LIFE SURFING PILOT TEST

GENERAL AREA SURFING PILOT TEST

STAGE 1-PREVIOUS STUDIES & TEST DESIGN

TEST AREA SELECTION: “M” LAYER



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.

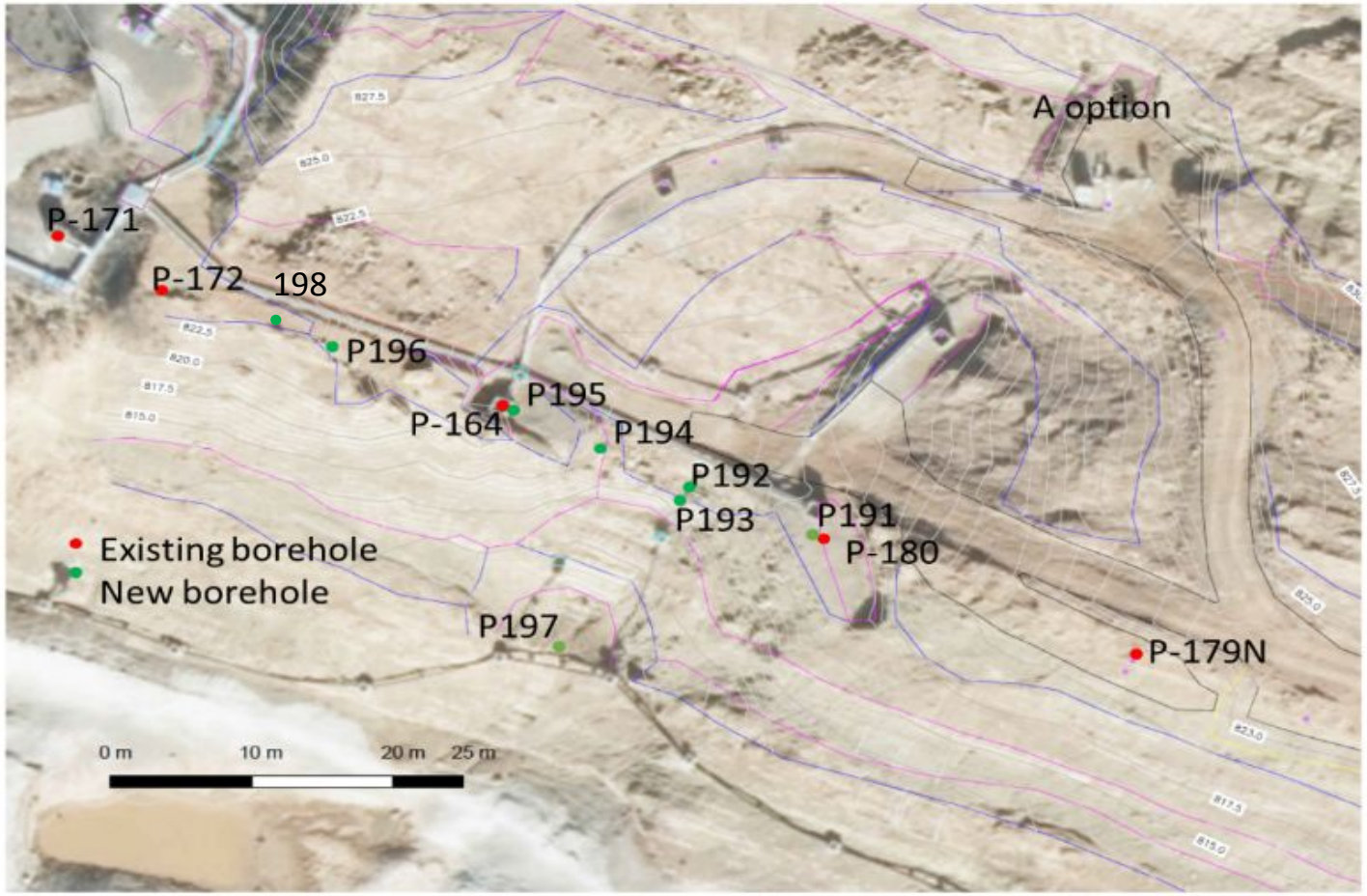
Everything was planned with security guarantees so that the transfer of workers and necessary auxiliary materials will be carried out correctly in the execution.

14th International HCH and Pesticides Forum

STAGE 2-FACILITIES-CIVIL WORKS

STAGE 2-FACILITIES-BOREHOLES

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

Boreholes in the "test cell"

Drilling machine at borehole P193

Drilling machine at borehole P194

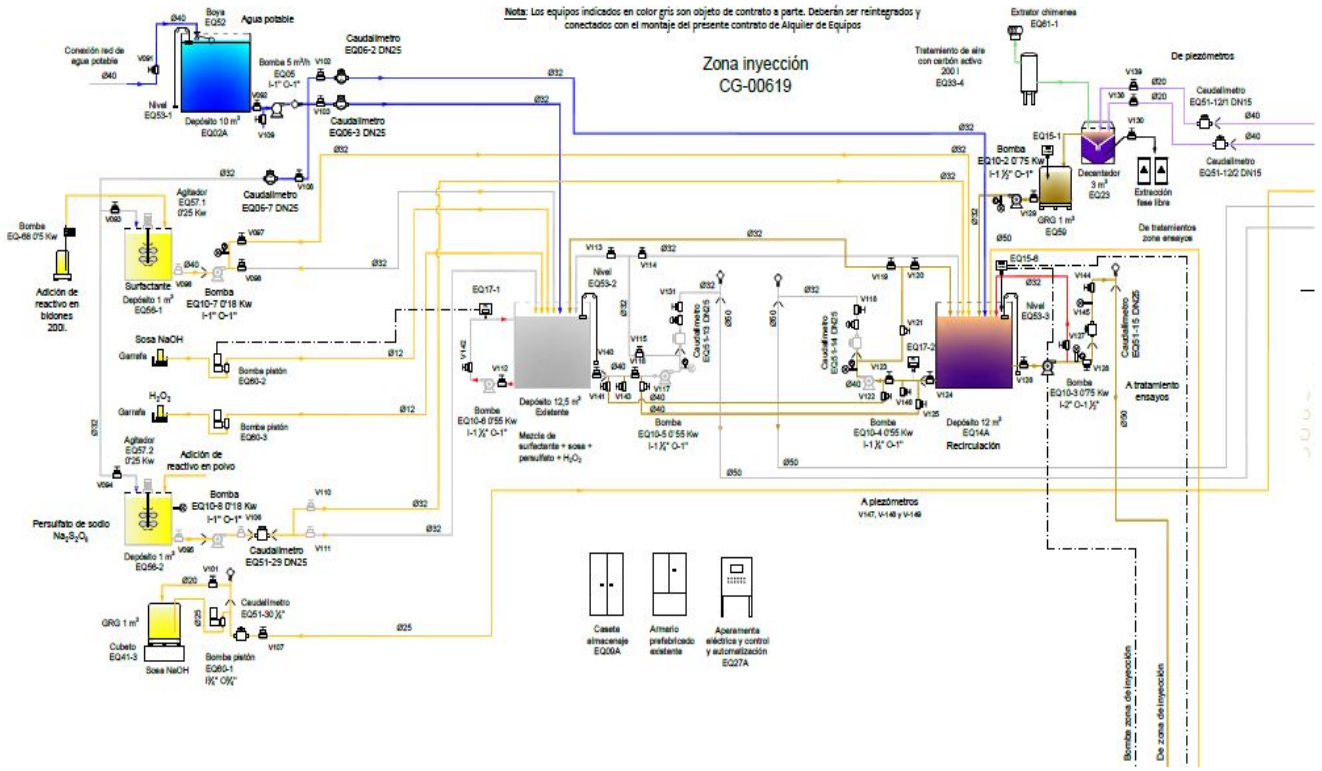
Borehole core at borehole P194

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.

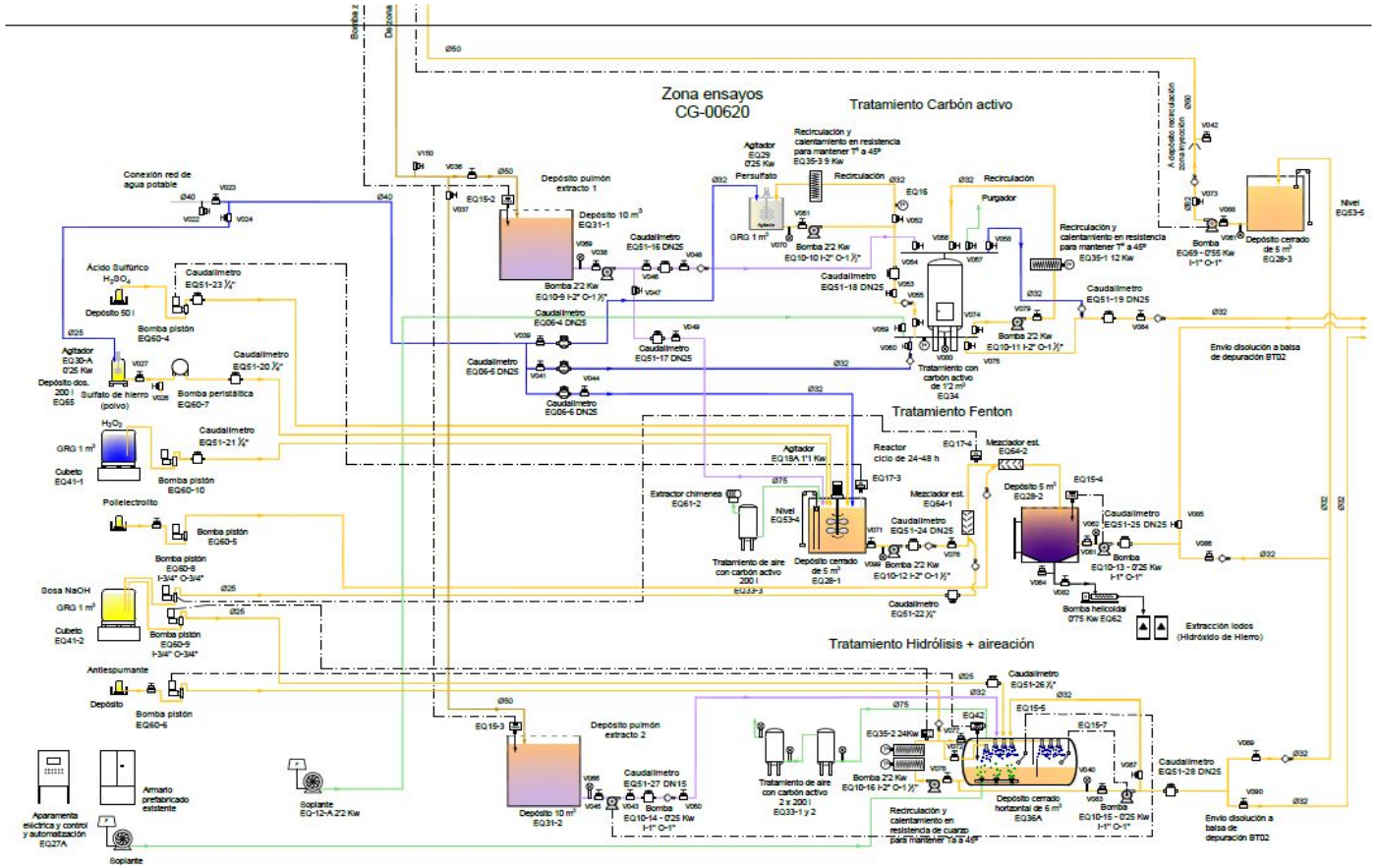
The area was completed with a recirculation tank and a mixing tank, which were communicated to facilitate the injection and pumping maneuvers of the fluids and reagents to the two injection lines.
Also, in this area there was a 1m3 soda tank (25%).

ETAPA 2-FACILITIES-Injection Area

INJECTION AREA

ETAPA 2-FACILITIES-Test Area

Test Area



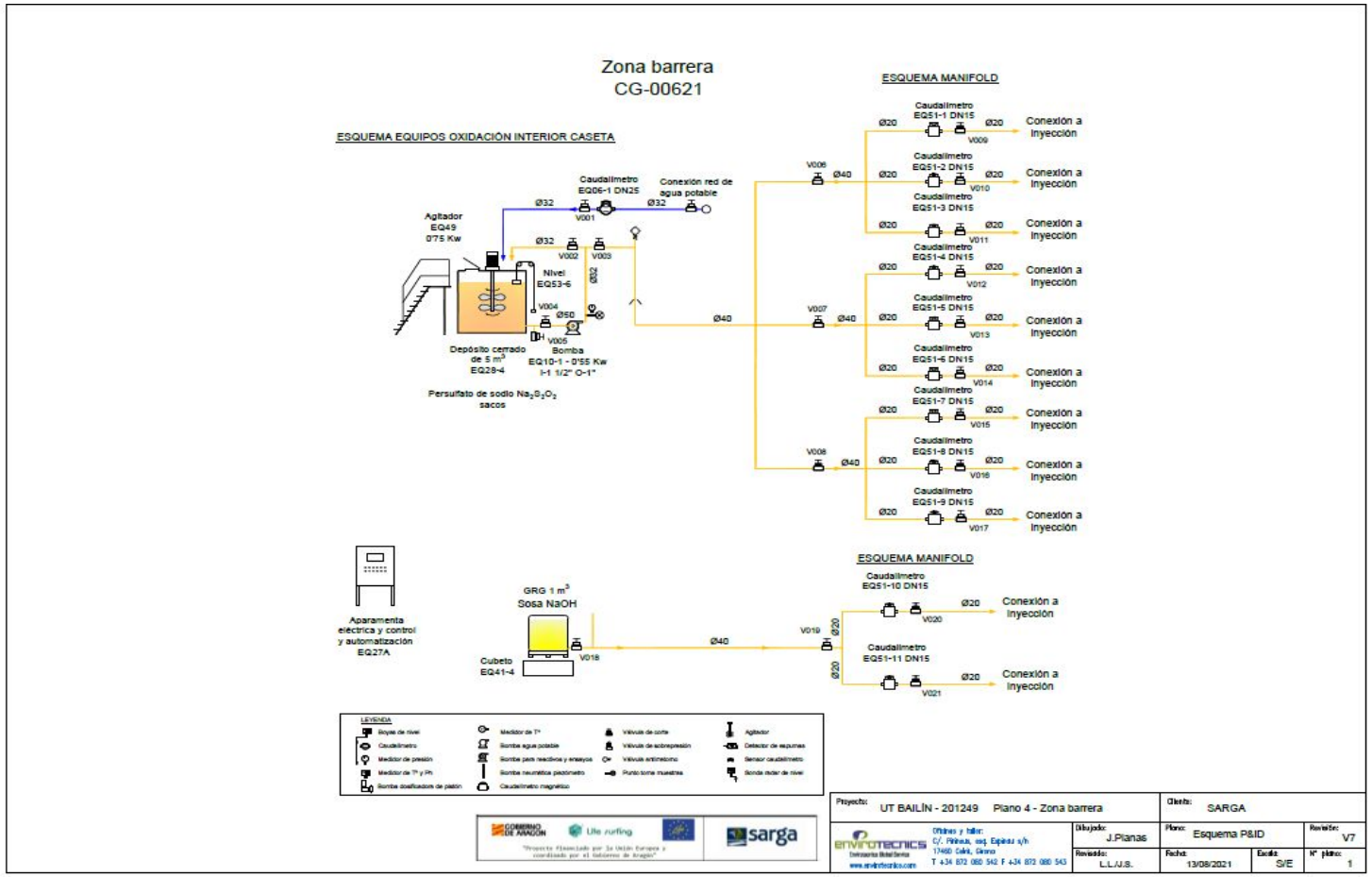
Test Zone constituted a platform that collected the leachate from the injection zone, sent by pumping. Different equipment was arranged to carry out the leachate treatments, with different techniques: activated carbon, Fenton and Hydrolysis.

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

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

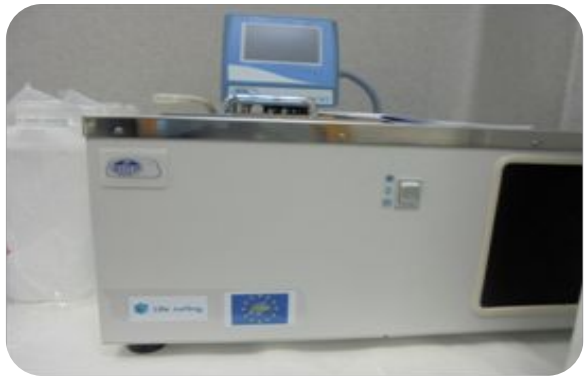
Soda 25%

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) con bomba manual de alta presión.

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

SEGUIMIENTO DISTRIBUCIÓN HORARIA

27, sep. Martes

hora	8-10	10-12	12-14	16-18
nivel	222-140-141-142-126-98-223-99-146-106	130-I1-O1-O2-55-79-127-129	52-174-81-196-198-171-172	191-192-194-195-180-179N-186
ppad.	126-146-106	I1-130-198	196-195-194	192-191
muestreo	126-146-106	I1-130-198	196-195-194	192-191

Los sondeos P186-P179N-P180-P172-P171-P52-P49-P174-P81-P55-P79-P127-P129-O1-O2-P223-P98-P99-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			
ppad.				
muestreo				
bombeo	¿195-192-171?	¿195-192-171?		

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

4 oct. Martes

hora	8-10	10-12	12-14	14-16	16-18	18-20
nivel	195-198-172-171	192-195-198-172-171	192-195-198-172-171	192-195-198-172-171	192-195-198-172-171	192-195-198-172-171
ppad.		52-174	186-179N-192-174-81	191-195-198-174-55	194-52-174-81-79	191-195-198-174-55
muestreo		52-174	186-179N-192-174-81	191-195-198-174-55	194-52-174-81-79	191-195-198-174-55
Caudal-out		172	172	172	172	172
muestreo-out		172-INI	172	172-INI	172	172-INI

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.

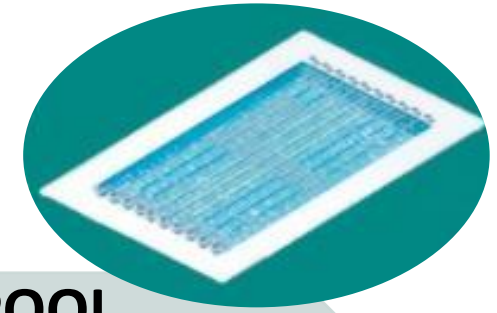
In addition, carrying out the tests implied an increase in the control of the river, which meant **40 more samples per month, compared to the control that is usually carried out, which is usually 150-170 samples per month**.

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

GOBIERNO DE ARAGON + Life

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

asanchez@sarga.es / www.sarga.es