



“Sediments to be dredged from ports: a resource to exploit and a growth opportunity in a rapidly evolving environmental context”

“I sedimenti da dragare nei porti: una risorsa necessariamente da valorizzare ed una occasione di crescita in un contesto ambientale in rapida evoluzione”

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ISPRA - Italian Institute for Environmental Protection and Research

ISPRA is a Governmental Institute carrying out research and experimentation, monitoring and control, technical-scientific support to the Ministry of Environment and other Administrations, environmental inspections, collection and dissemination of environmental data



L.132/16 established «Il Sistema Nazionale a rete per la protezione dell'ambiente» – SNPA composed by the Regional Environmental Agencies coordinated by ISPRA



- ✓ Roma
- ✓ Castelromano
- ✓ Livorno
- ✓ Ozzano
- ✓ Palermo
- ✓ Milazzo
- ✓ Venezia
- ✓ Chioggia



Livorno: carries out research and experimentation activities regarding the distribution and effects on the biota of traditional and emerging pollutants and develops procedures, innovative methodologies and assessment criteria for the monitoring and management of marine-coastal waters and sediments, based on multidisciplinary approaches.

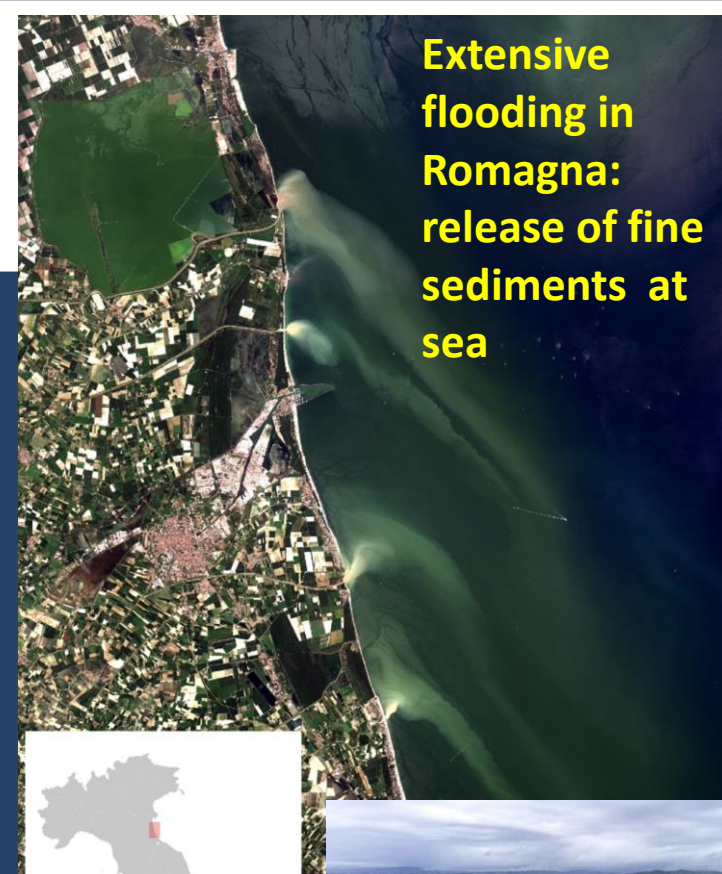
Outline

- The **different dredging needs** in a changing environment
- New chemicals in constant increase: **the role of integrated analysis** that includes the effect of complex matrices (water and sediments) beyond measuring the concentration of single contaminants
- Dredging **sediment as a resource** that has not to be considered as a waste
- Importance of **characterization and classification of materials** through an integrated approach, aimed at promoting the reuse at sea and on land
- Use of **WOE approach in different applications**, including **monitoring**
- Some ongoing ideas for **implementation of the legislation**
- **Milestones**

Different types of dredging:

- **Maintenance dredging**, to restore the depth after natural silting from sea or from land (port canals), and after extreme meteorological events (highly recurring in the last years) such as flooding and landslides (in Emilia-Romagna coastline and in Casamicciola – Ischia, respectively);
- **Capital dredging** to build new terminal of facilities to allow the entrance of larger vessels or ships
- **Remediation dredging** removal of highly contaminated sediments.

Those pictures highlight the thin line between land and sea, that has to necessarily reflect their management of a common matrix, despite in two different environments.



How many chemicals in the environment?

More than 100,000 commercial chemical substances in 1981 (European Inventory)

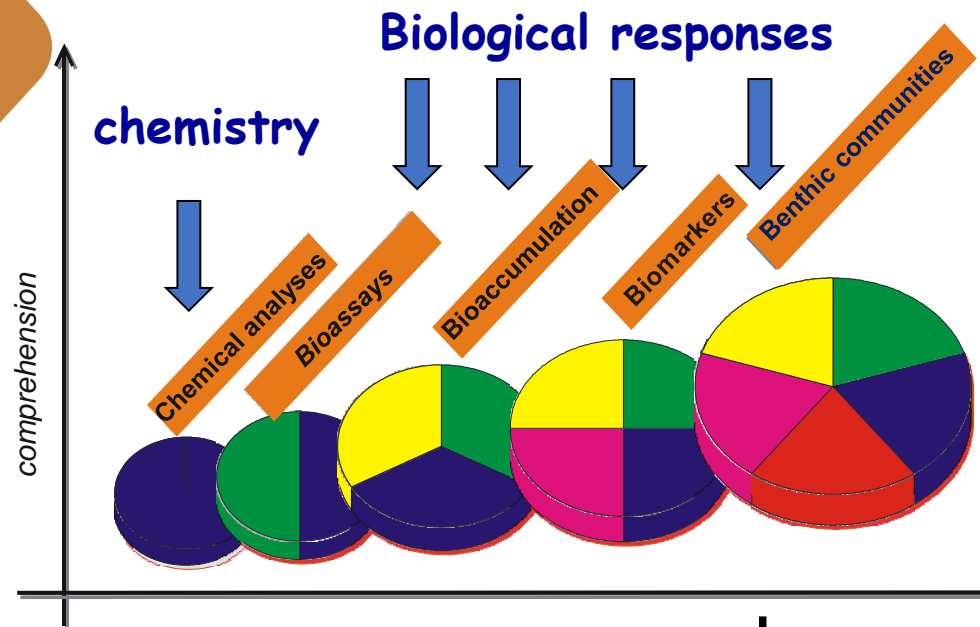
More than 1,500 new chemicals added every year

500 chemicals with extensive characterization for exposure and toxicological hazard

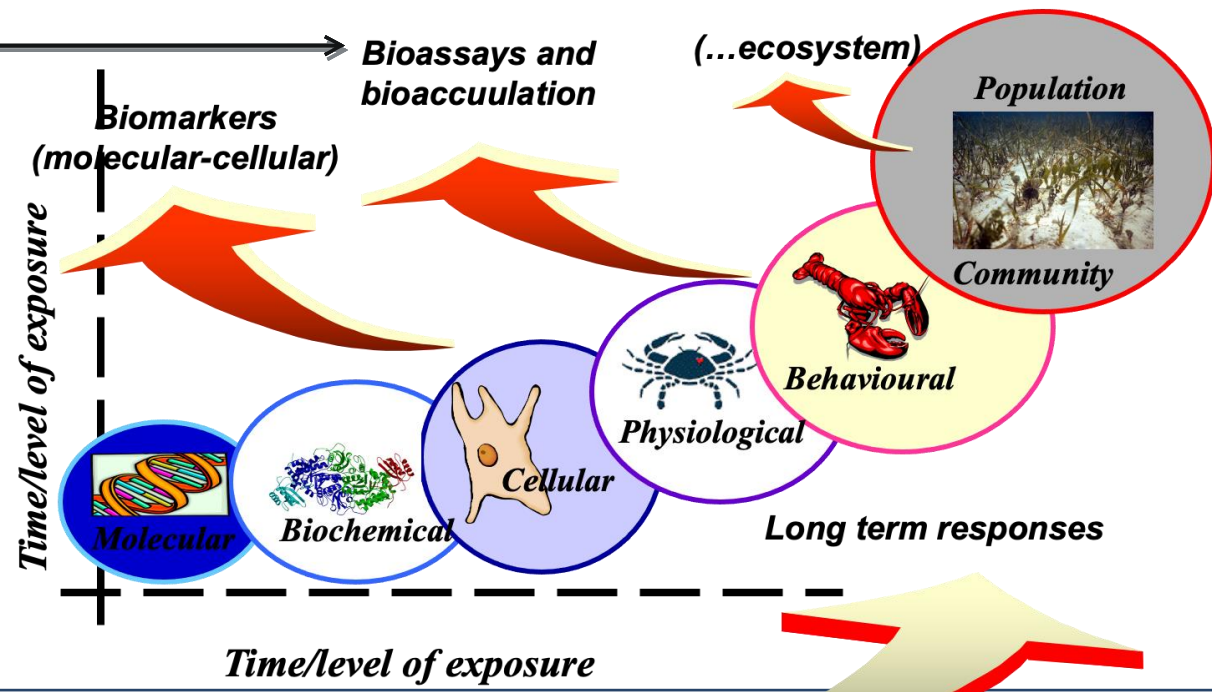
10,000 chemicals with sufficient characterization for exposure and toxicological hazard

20,000 chemicals with limited characterization for exposure and toxicological hazard

70,000 chemicals with poor/absent characterization for exposure and toxicological hazard



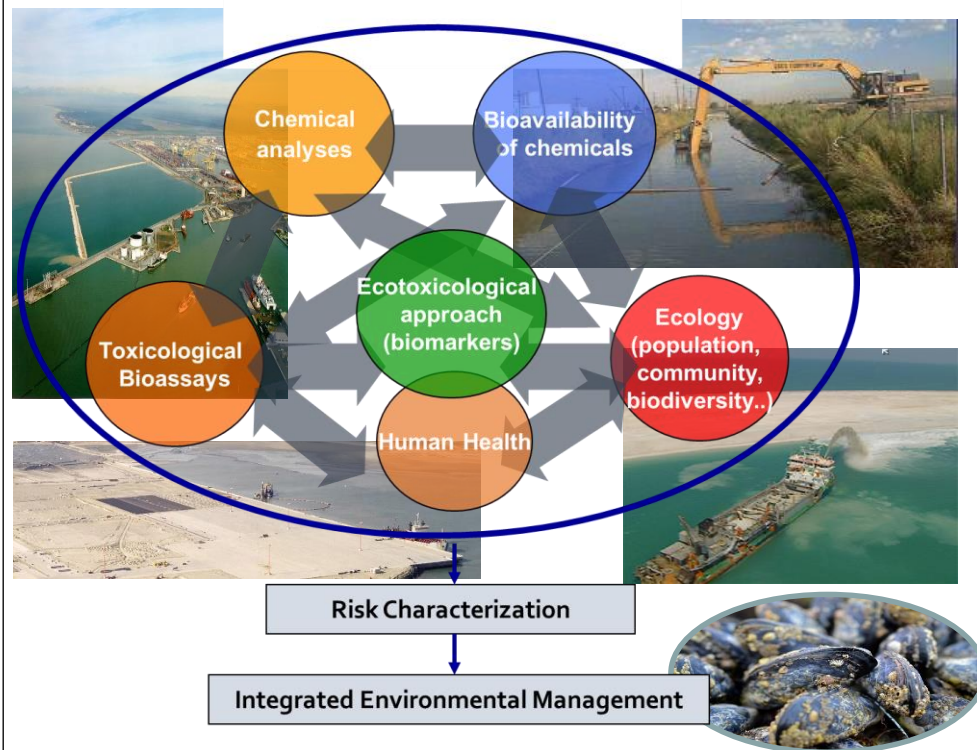
Biological responses



Short term responses

Weight Of Evidence (WOE) approaches for risk assessment in the marine environment: definition of weighted criteria for elaboration of individual Lines Of Evidence (LOEs)

INTEGRATED MODELS FOR RISK ASSESSMENT



CRITICAL ISSUES IN RISK ASSESSMENT

- Interpretation and significance of complex datasets of heterogeneous results
- Qualitative and quantitative evaluations: indices and scales development
- Integration of different typologies of data
- Synthetic risk characterization/communication



Fixed point: «Sediment is a resource to be RE-USED as an alternative to disposal at sea»

The start: (LC) London Protocol '96 -

Dredged material assessment framework

- Dredged Material Characterization
- Beneficial uses



The Italian regulation in force on the management of dredged material

- Weight Of Evidence (WOE) approach for sediment classification
- Management options according to quality (hierarchy)

EU Experimental projects on sediment reuse (on land and in coastal environment);

monitoring and environmental quality assessment:

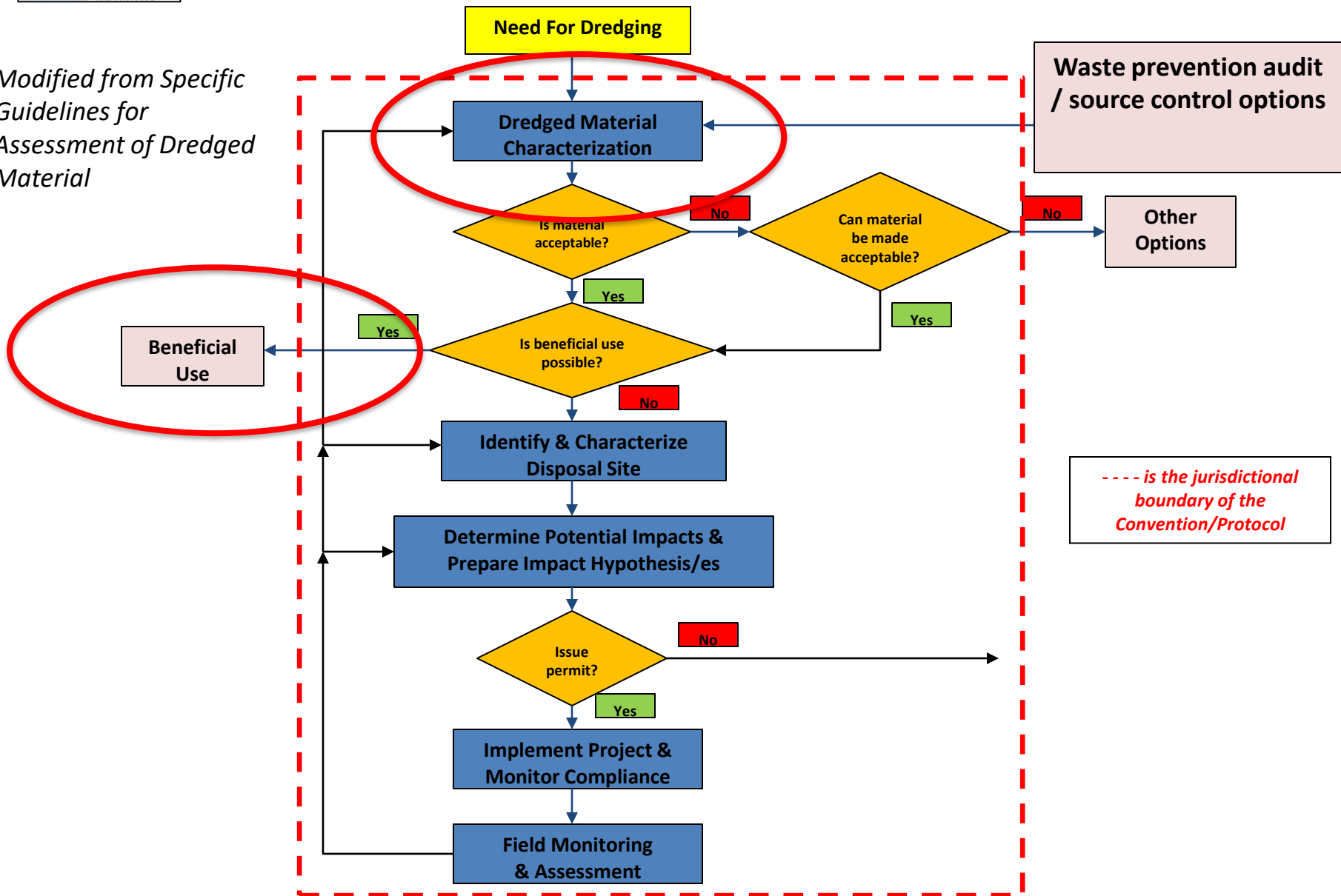
SEDITERRA, SEDRIPORT, GEREMIA, GRRinPORT





DREDGED MATERIAL ASSESSMENT FRAMEWORK (LP)

Modified from Specific Guidelines for Assessment of Dredged Material

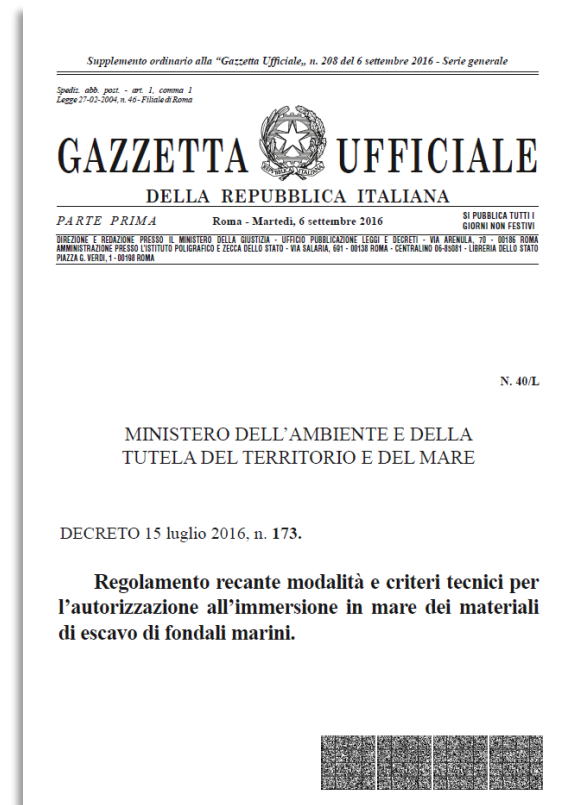


Environment Ministry Decree n. 173/2016

The Decree of Italian Ministry of Environment n. 173/2016 entered into force on 21 September 2016:

- updates technical procedures on how to apply for a dumping permit for dredging sediments originating from marine and brackish waters or from reclaimed coastal lands;
- the technical Annex **establishes criteria and methodological procedures for dredging sediment characterization, their classification and identification of appropriate management options and monitoring.**

A group of expert (osservatorio) composed by member of ISPRA, ISS, CNR, Environmental Protection Agencies and coastal regions, has concluded a process of analysis of the critical issue of the Decree within the first 5 years of application and has elaborated a series of proposals for its revision and implementation



Technical annex

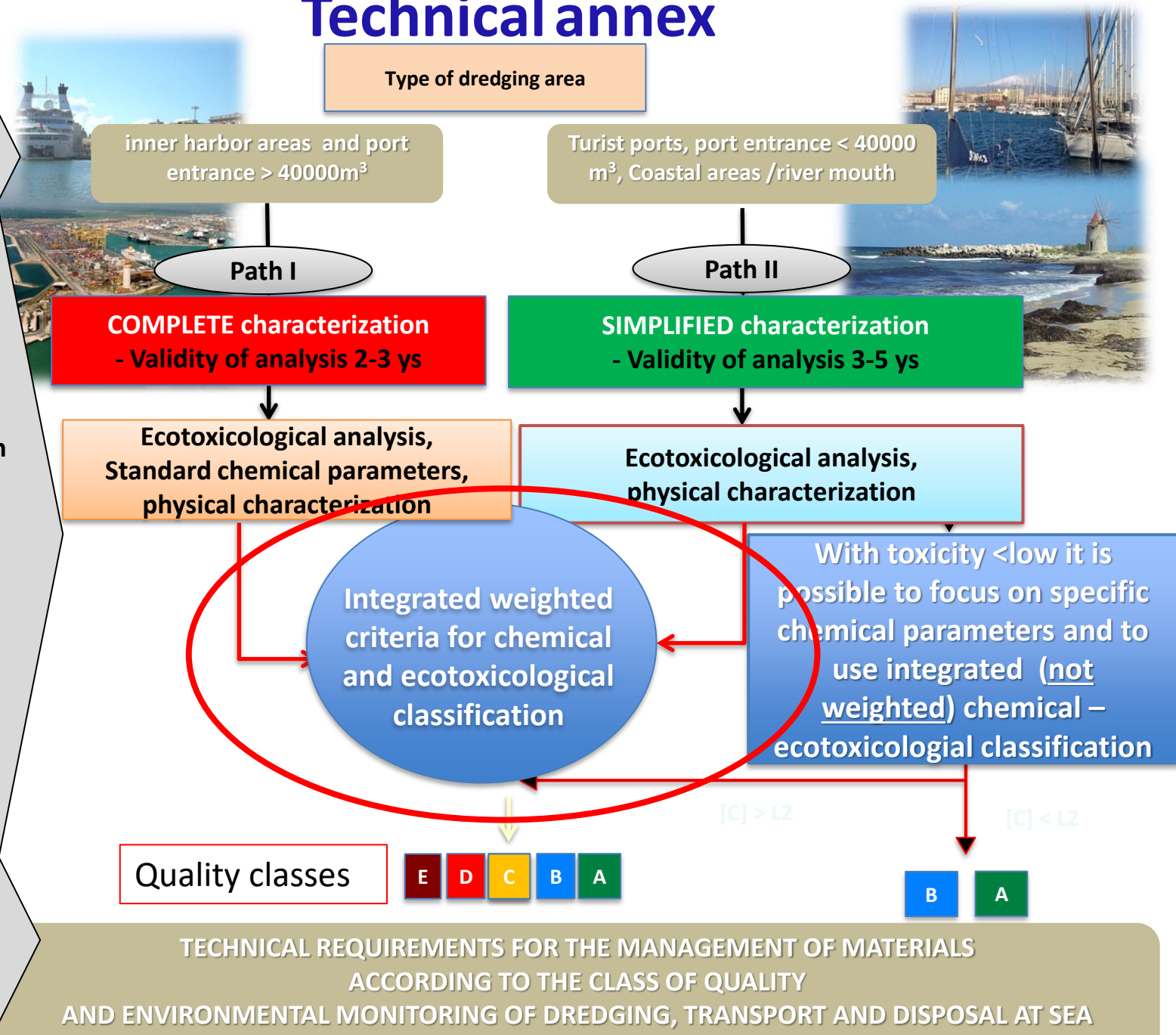
Area information
Chapter 1

Characterization and classification
Chapter 2

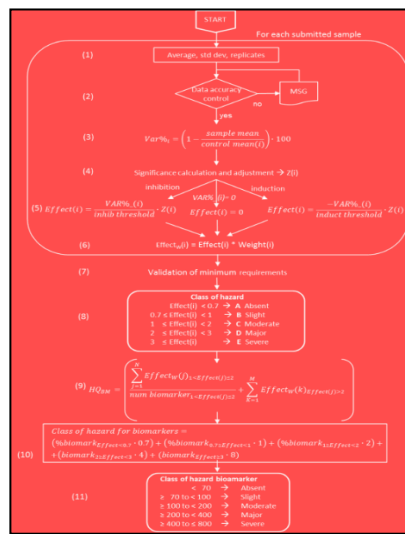
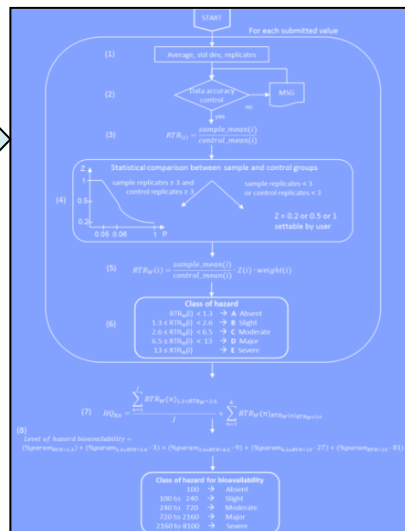
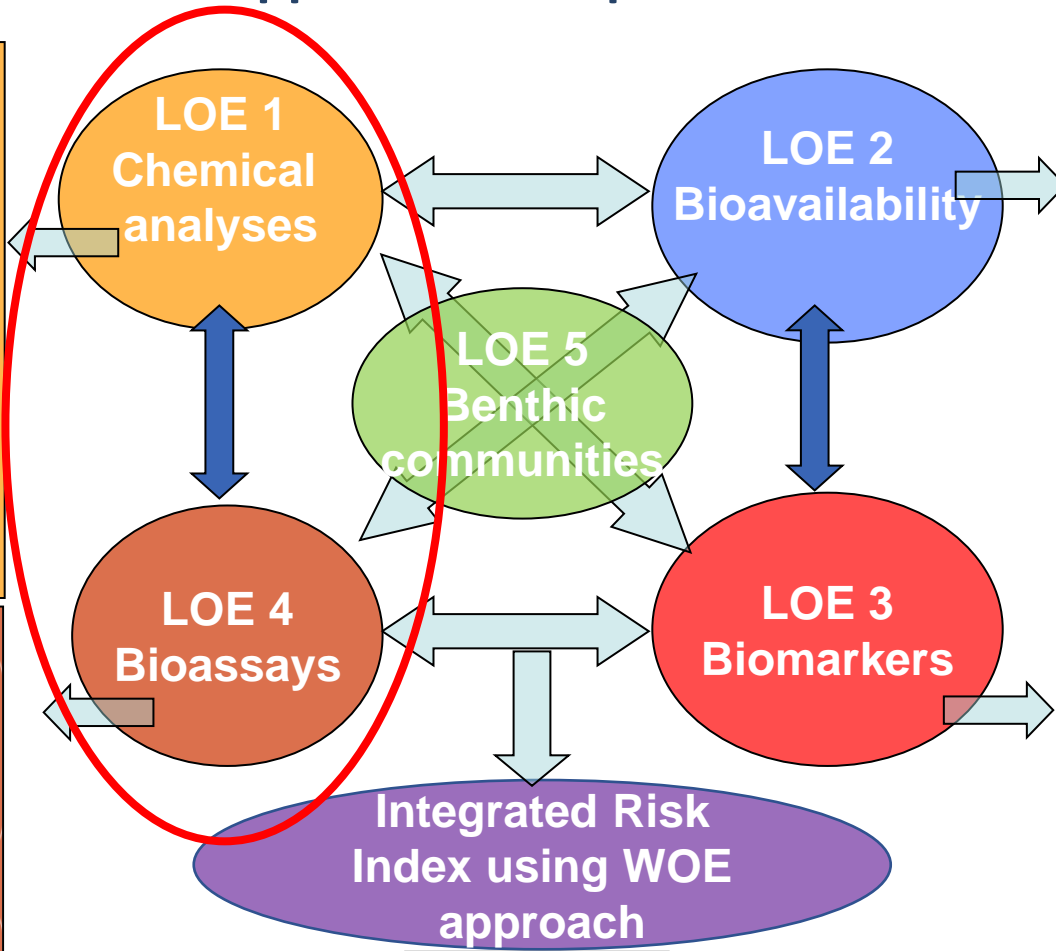
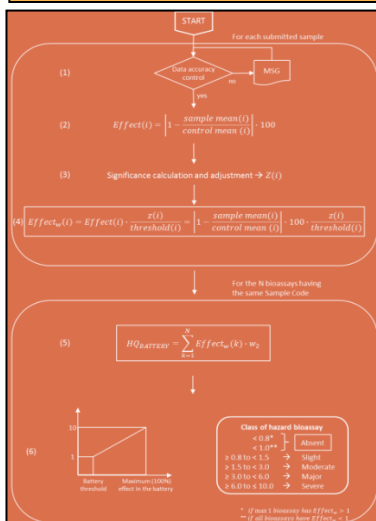
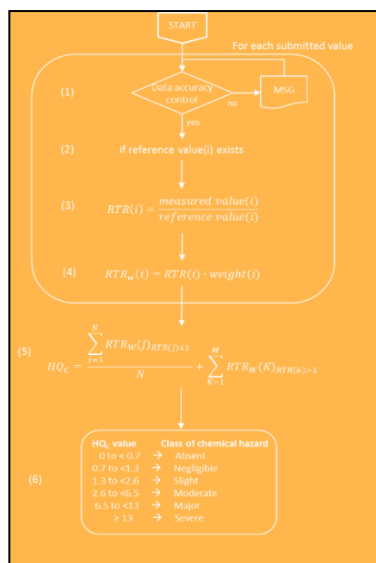
Chapter 2

(Path I)
(Path II)

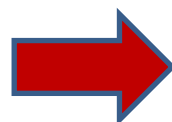
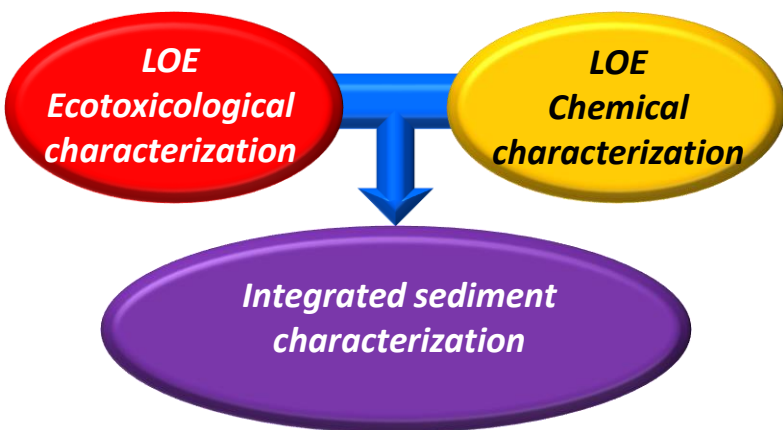
Management and monitoring
Chapter 3



Quantitative risk assessment model on Weight of Evidence (WOE) approach: Sediqualsoft®



Integrated characterization and weighted approach for sediment quality assessment



High development of private laboratories and standardized procedures (accredited methods), promoting new expertises

Ecotoxicological hazard	Chemical hazard	Quality classes
Absent	$HQ_C (L2) \leq \text{Negligible}$	A
	$\text{Slight} \leq HQ_C (L2) \leq \text{Moderate}$	B
	$HQ_C (L2) = \text{High}$	C
	$HQ_C (L2) > \text{High}$	D
Slight	$HQ_C (L1) \leq \text{Slight}$	A
	$HQ_C (L1) \geq \text{Moderate}$ and $HQ_C (L2) \leq \text{Slight}$	B
	$\text{Moderate} \leq HQ_C (L2) \leq \text{High}$	C
	$HQ_C (L2) > \text{High}$	D
Moderate	$HQ_C (L2) \leq \text{Slight}$	C
	$HQ_C (L2) \geq \text{Moderate}$	D
$\geq \text{High}$	$HQ_C (L2) \leq \text{Slight}$	D
	$HQ_C (L2) \geq \text{Moderate}$	E

Italian Environment Ministry Decree n. 173/2016

Class	Management Options (in the marine environment/close to...)
A	<p>Sands (fines < 10%) to be used or re-located in the following hierarchy:</p> <ul style="list-style-type: none"> • Beach nourishment; • Reconstruction of natural structures in marine coastal environments including use for the restoration of shorelines; • Filling of breakwater and embankments in port areas; • Disposal at sea (> 3 NM); • Disposal in aquatic confined facilities
B	<p>Material to be used or re-located in the following hierarchy:</p> <ul style="list-style-type: none"> • Disposal at sea (> 3 NM) with recomm. environmental monitoring; • Disposal in confined facilities within port, or capping, with environmental monitoring.
C	<ul style="list-style-type: none"> • Disposal in confined facilities able to retain all the grain size fraction of sediment; • Capping, with environmental monitoring.
D	<ul style="list-style-type: none"> • Disposal in completely sealed confines facilities, with environmental monitoring.
E	<ul style="list-style-type: none"> • Material to be managed with special environmental safety procedures, whose removal and handling must be assessed with Environmental Risk Assessment

The weighted approach is used not only for sediment characterization, but also for integrated monitoring of port areas: **Environmental Quality index for ports**

GEREMIA PROJECT

Chemical analyses




Sediments

LOE 1



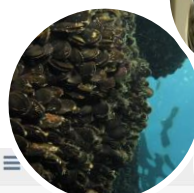
Water column

LOE 2



Bioaccumulation of chemicals

LOE 3



Biomarkers analyses

LOE 4



Ecotoxicological tests

LOE 5

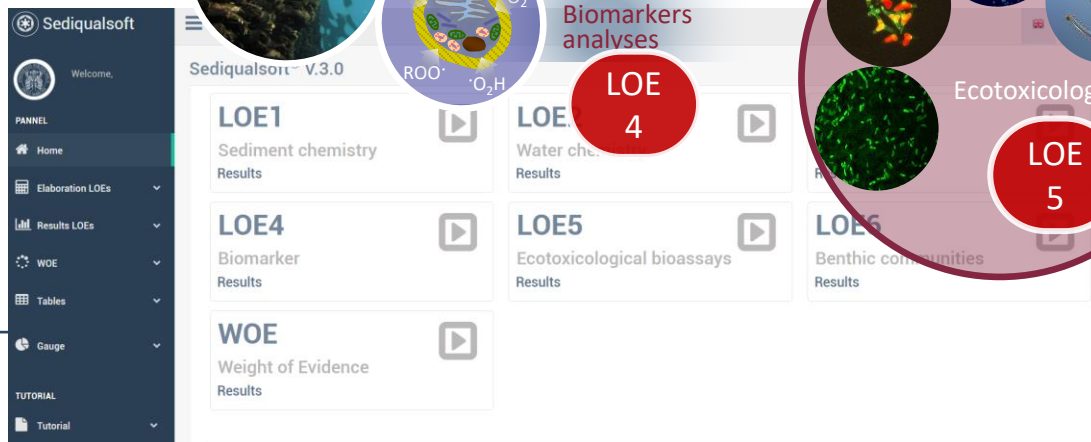


Analyses of benthic communities

LOE 6

LINES OF EVIDENCE

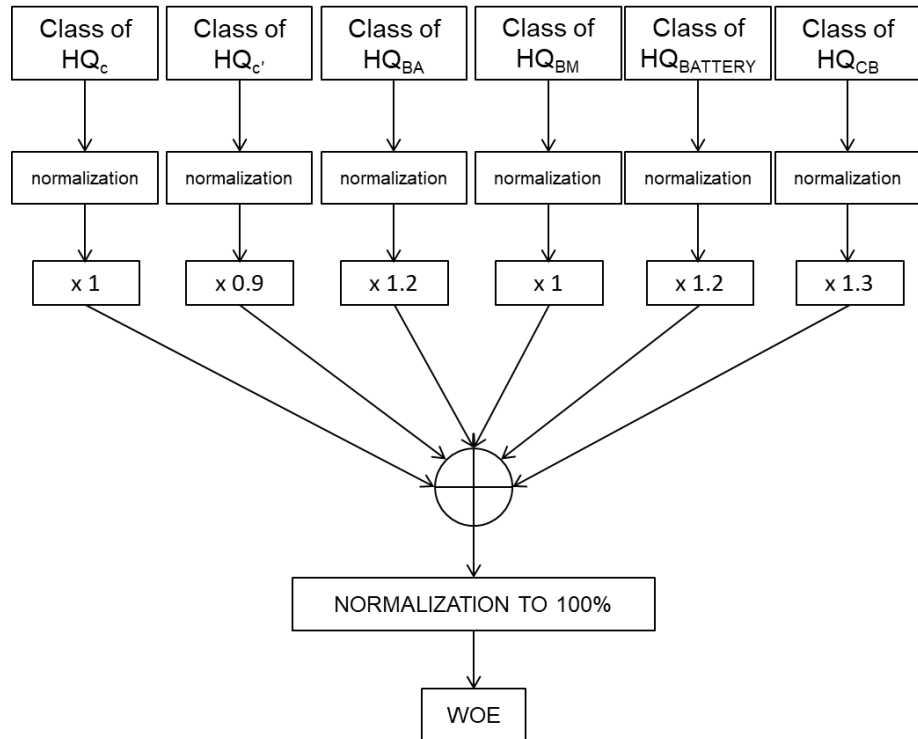
- LOE 1: Sediments chemistry
- LOE 2: Column Water chemistry (passive samplers)
- LOE 3: Bioavailability on sentinel organisms
- LOE 4: Biomarkers on sentinel organisms
- LOE 5: Bioassays
- LOE 6: Analyses of benthic communities



Sediqualsort V.3.0

LOE1 Sediment chemistry Results	LOE2 Water chemistry Results
LOE4 Biomarker Results	LOE5 Ecotoxicological bioassays Results
WOE Weight of Evidence Results	LOE6 Benthic communities Results

Integration of various LOEs into WOE and class of Risk



integrated environmental quality index

environmental 'hazard' maps

Integration code: A
 Sampling code: GR-OL-II-SE-01
 Area: Olbia
 Site: Banchina Isola Bianca
 Date: 21/05/2019

Weight of Evidence integration: SLIGHT

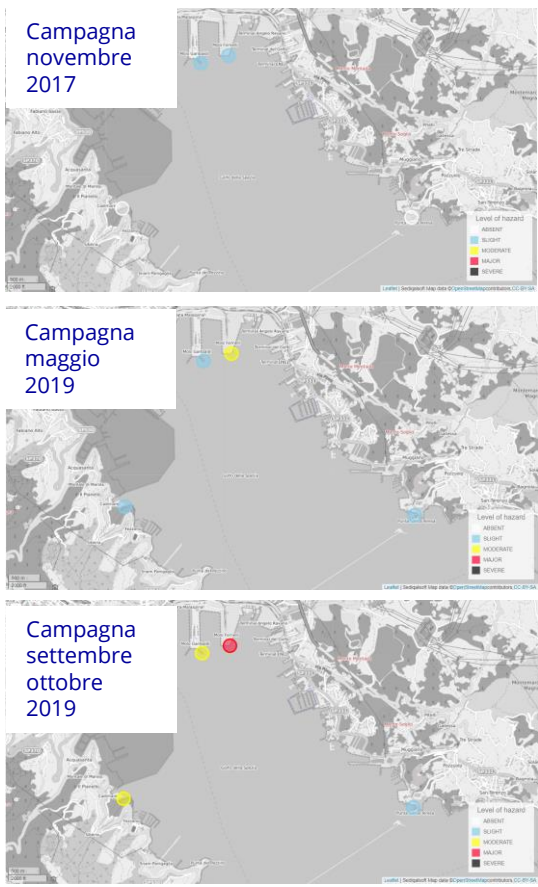
LOE	Description	Weight
LOE 1	Chemical characterization of sediments	4.2%
LOE 2	Chemical characterization of water column	24%
LOE 3	Bioavailability of chemicals	11.1%
LOE 4	Sublethal effects Biomarkers	10.9%
LOE 5	Toxicological Bioassays	30%
LOE 6	Benthic Communities	19.8%

Radar Chart: Shows the relative contribution of each LOE to the overall WOE.

Map: Shows the location of Banchina Isola Bianca in Olbia, Sardinia, Italy.

Port of La Spezia: 5 lines of evidence

Sito	Campagna	LIVELLO DI PERICOLO					WOE	
		chimico sedimenti LOE 1	chimico colonna d'acqua LOE 2	bioaccumulo LOE 3	biomarker LOE 4	saggi ecotossicologici LOE 5		
Molo Fornelli	I novembre 2017	ASSENTE		ALTO		ASSENTE	BASSO	
Cadimare molo aeronautica militare		ASSENTE		ALTO		ASSENTE	BASSO	
Centro Rada		ASSENTE				ASSENTE	ASSENTE	
Imboccatura di levante		ASSENTE				ASSENTE	ASSENTE	
Molo Fornelli	II maggio 2019	ALTO	ASSENTE	BASSO	ASSENTE	MOLTO ALTO	MEDIO	
Cadimare molo aeronautica militare		MOLTO ALTO	BASSO	BASSO	BASSO	ASSENTE	BASSO	
Centro Rada		MEDIO	ASSENTE		ASSENTE	ASSENTE	BASSO	
Imboccatura di levante		MEDIO	ASSENTE	ASSENTE	ASSENTE	ASSENTE	BASSO	
Molo Fornelli	III settembre 2019	ALTO		ALTO		MEDIO	ALTO	
Cadimare molo aeronautica militare	III ottobre 2019	ALTO		MEDIO	BASSO	BASSO	MEDIO	
Centro Rada		MEDIO			BASSO	BASSO	MEDIO	
Imboccatura di levante		MEDIO		ASSENTE	ASSENTE	ALTO	BASSO	



Monitoring suveys carried out within Interreg Se.D.Ri.Port. project

Port of La Spezia: 5 lines of evidence

Survey May 2019



Leaflet | Sediqisoft Map data ©OpenStreetMap contributors, CC-BY-SA

Port of La Spezia: 5 lines of evidence

Survey September-October 2019



Other application of WOE approach:

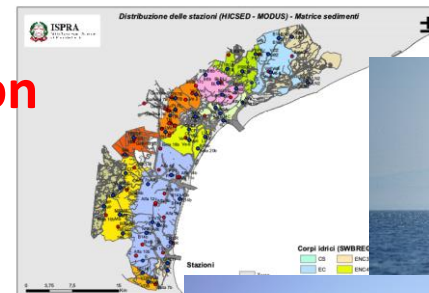
- HP14 (ecotoxic) for **wastes**
- **fields** and **paddies** (use of pesticides in agriculture)
- reuse of **sewage sludges** in agriculture
- reuse of **coal ashes** or **C&D** (construction and demolition materials) for road foundations
- **rivers** (ex. Cecina river with 9 LOEs)
- **new special legislation for Venice Lagoon**
- **offshore oil and gas platforms**
- monitoring of complex marine environments (**Costa Concordia** shipwreck)

Research article

An innovative methodological path to attribute the hazard property HP14 "ecotoxic" to waste using a weight of evidence approach

Onorati Fulvio^a, Bellucci Micol^a, Tornambè Andrea^a, Paina Andrea^a, Maggi Chiara^a

^aInstitute for Environmental



Some remarks on WOE approach...

- *WOE models represent a fundamental tool for summarizing and interpreting large datasets of heterogeneous data, singularly or in an integrated environmental quality index*
- *They do not use “pass-to-fail” approach, enhancing the capability to discriminate different environmental conditions*
- *The developed model is versatile, easy to update or adapt to local or national specificities*
- *Scientifically sound but user-friendly format, to support a more comprehensive process of risk assessment and “site-oriented” management decisions*
- *The integrated environmental quality index generated by the model can be used for generating of environmental 'hazard' maps.*

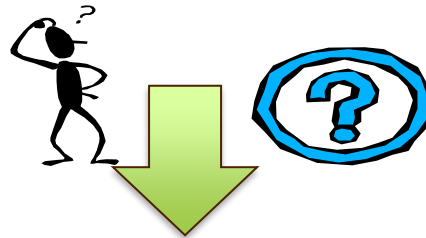
New legislation

(amendment of art 184 quater Dlgs 152/06)

END OF WASTE

In order to promote investments in **circular economy projects**, to foster technological innovation and to guarantee the safety of maritime transport, the competent administrations may authorize, subject to characterization,also for **single particle size fractions, of the materials deriving from the dredging of port and marine-coastal areas** in agreement with the regulations in force, [...], **the reuse of the aforementioned** materials on land and in marine-coastal environments also for single particle-size fraction obtained after mechanical separation.

[.....] the **technical decree** establishing the options for reuse of dredging sediments and every single particle size fraction according to the best available technologies, **still to be issued**



Under discussion on 'for single particle-size fraction obtained after mechanical separation':

- application of the discipline of by-products for the reuse on land of «excavated earth and rocks» (Decreto «terre e rocce da scavo»)
- application of the «new annex to DM173» for the reuse in marine-coastal environment



Reuse after sediment treatment

- ❖ comparative study of **current legislation and best practices** adopted in the field of land management of contaminated dredged sediments implemented in Italy and France. Comparison between the different management options and methodologies adopted in the two countries
- ❖ Recognition of the **treatment processed** applied to contaminated sediments, innovative and already of consolidated use in the countries involved, capitalization of the knowledge acquired in previous projects
- ❖ **Experimental activities** through pilot plants for the treatment and valorization of sediments, through the application of soil-washing, bio-remediation and energy recovery techniques - **Drafting of guidelines.**

<https://www.sediterra.net/it/>

<http://interreg-maritime.eu/web/sediterra>



Milestones and needs:

- Solid technical-scientific assumptions are common in various marine and terrestrial environments
- **Solidi presupposti tecnico-scientifici comuni ai vari ambienti marini e terrestri**
- Effective and environmental friendly management solutions are available
- **Soluzioni gestionali fattive ed ambientalmente compatibili**
- Importance of a large-scale national (international) vision
- **Importanza di una visione nazionale (internazionale) di ampia scala**
- Need for defined roles between the different stakeholders (authorities, SNPA, regional administrations, AdSP) to facilitate collaboration and resolution of critical issues
- **Necessità di ruoli definiti tra i differenti soggetti (capitanerie, SNPA, amministrazioni regionali, AdSP) per agevolare la collaborazione e la risoluzione delle criticità**
- A less fragmented legislation (sometimes inspired by legitimate but specific interests) and aimed at defining "framework" laws is desirable
- **Una attività legislativa meno parcellizzata (talvolta ispirata a interessi legittimi ma di parte) e finalizzata a provvedimenti «quadro»**



THANKS FOR YOUR ATTENTION!

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