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HUMAN HEALTH RISK ASSESSMENT GUIDANCE FOR DREDGING AND DISPOSAL AT SEA OF MARINE AND ESTUARINE SEDIMENTS

Background and Objectives

Human health risk assessment

Chemical Risk

Biological Risk



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Background

- **Regulation :**

- For projects subject to an Environmental Impact assessment, a human health risk assessment has to be done ;

- For projects submitted to the Water Act, the analysis of health impacts is recommended.

- **General :**

Differences in the consideration of the human health risk assessment.



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Objectives

The working Group on dredging and environment (GEODE) decided to produce this guide in order to :

- ***provide a common frame of reference to :***
 - *Administrations,*
 - *Port authorities,*
 - *Consultancy companies.*
- ***Harmonize practices.***



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Human health risk assessment

Keys concepts

Methodology





HHRA : Keys Concepts

Hazard : corresponds to inherent properties of a physical, chemical or biological factor which can affect human health.

Exposure : refers to the contact between a physical, chemical or biological factor which can affect human health ;

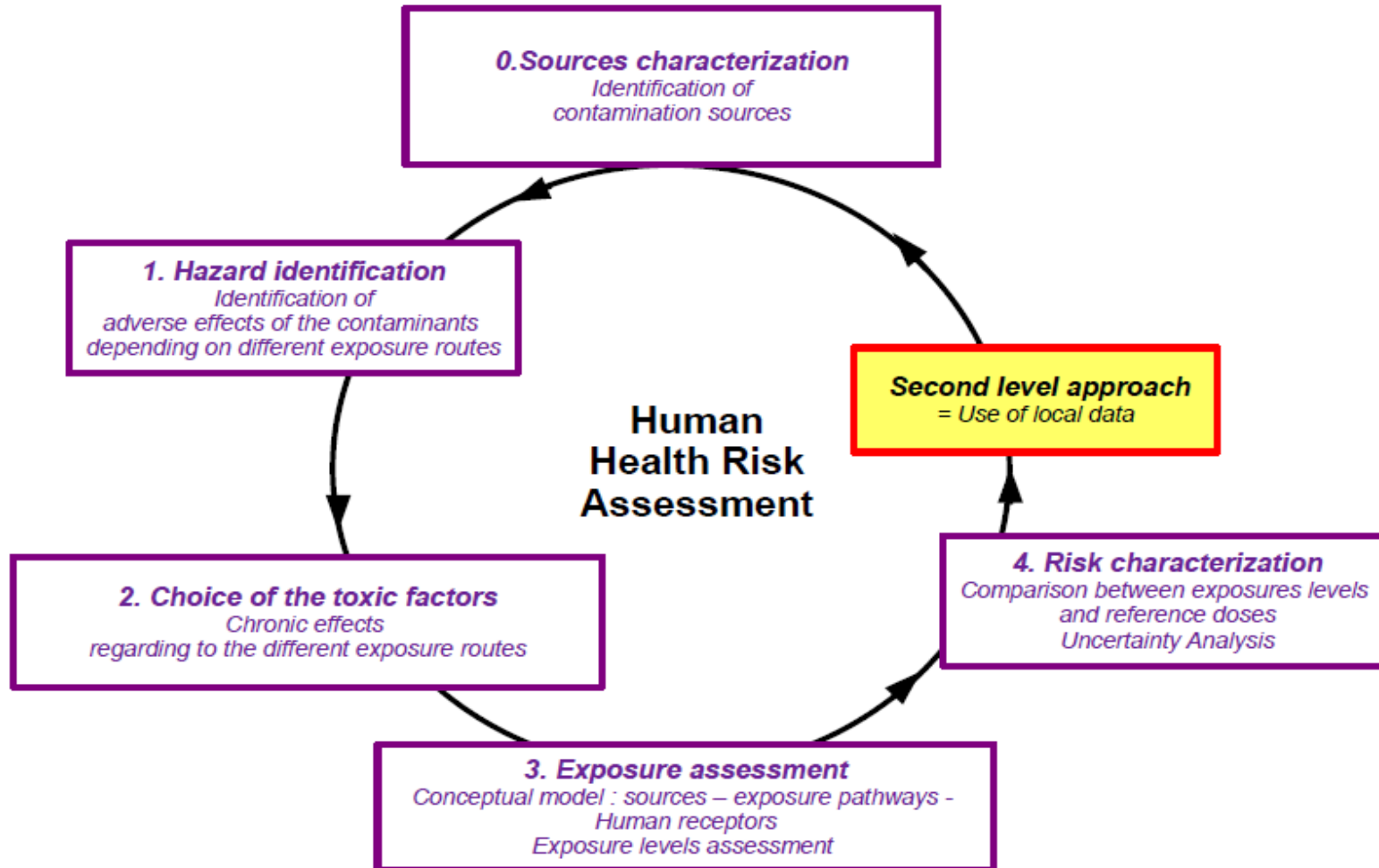
Toxicity factors (TF): these values define exposure level that is likely to be without an appreciable risk of adverse effects.

Health risk corresponds to the probability of a disease occurrence for a person or a population in a defined period.

$$\text{Risk}_{\text{Hazard}} = f_{\text{Hazard}}(\text{Exposure}, \text{TF})$$



HHRA : Methodology





Chemical Risk

Site initial state data

Conceptual model

Contaminants of concern

Decision criteria

Quantitative risk assessment



Chemical Risk : site initial state data

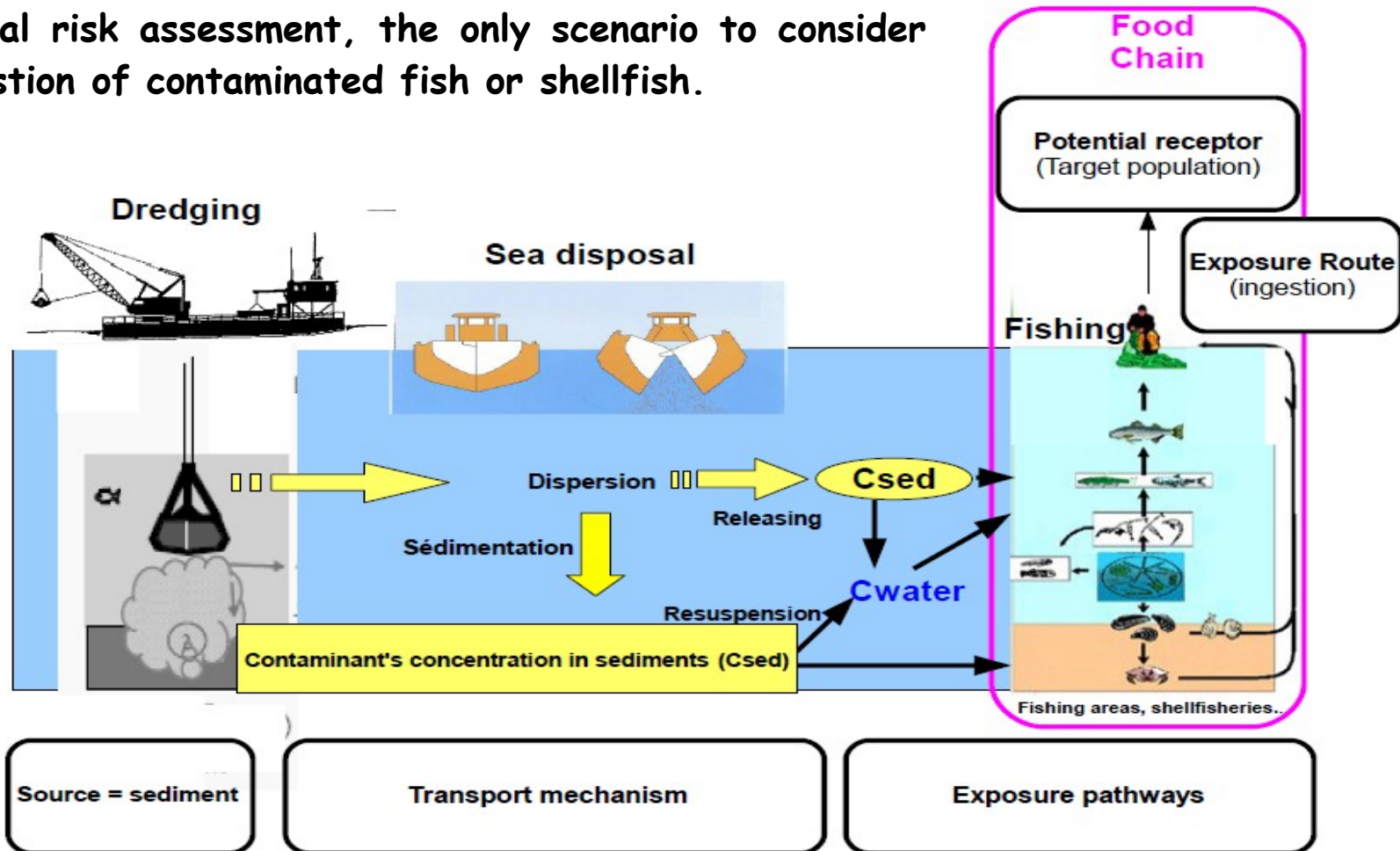
In the context of dredging and sea relocation of harbour sediments, many data from the site initial state can be use for HHRA :

- **Potential targets** : shellfishery and fishing areas, aquatic and nautical recreational activities...;
- **Contaminants of concern** : chemical characterization of dredged sediments and presence of specific emissions ;
- **Exposed area** : Characteristics of dredging techniques, physical properties of sediments and local hydrodynamic conditions allow to evaluate the dispersal of particles (turbidity plume).



Chemical Risk : conceptual model

The conceptual model defines individual risk scenarios.
For chemical risk assessment, the only scenario to consider
is the ingestion of contaminated fish or shellfish.



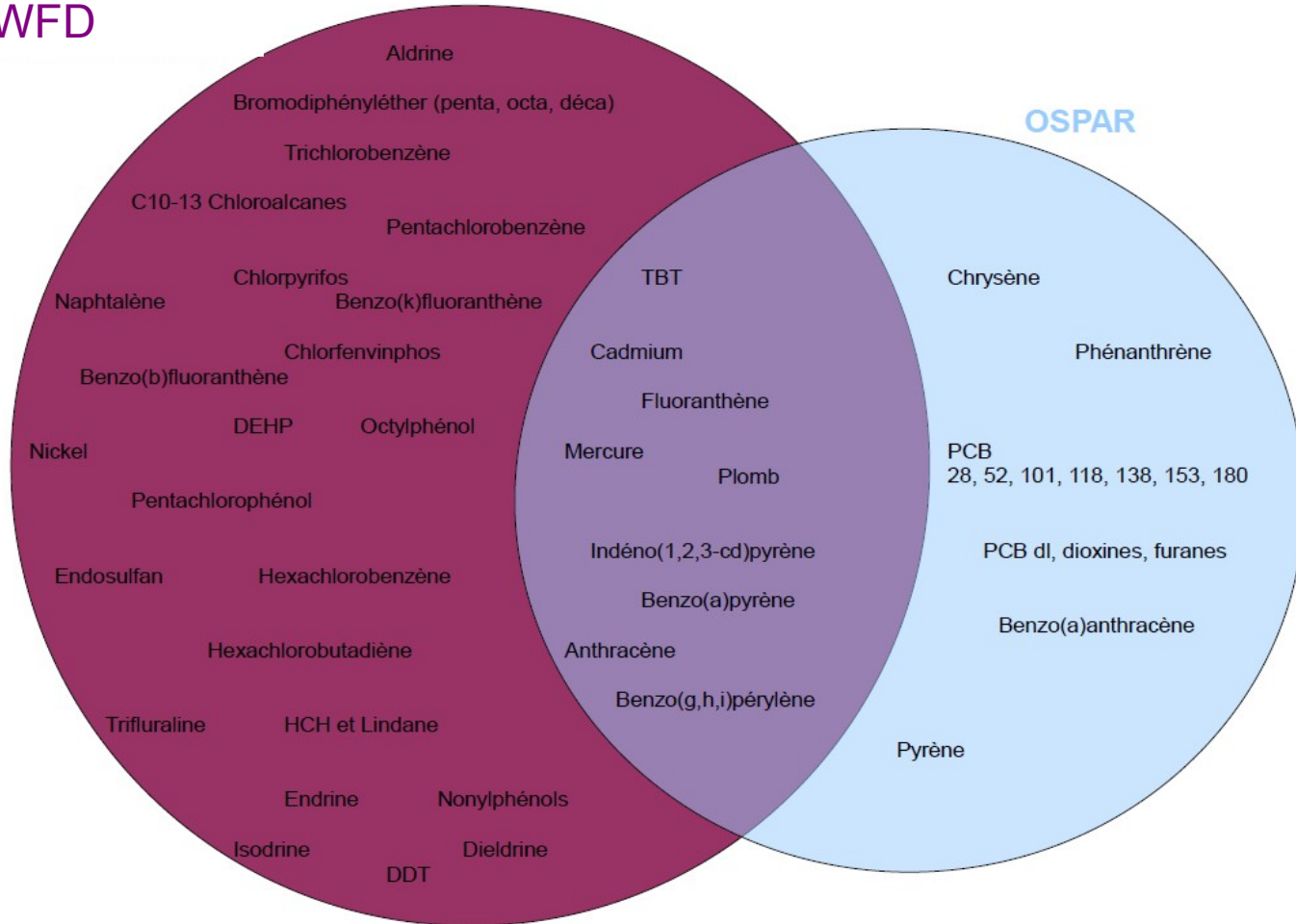


Chemical Risk : contaminants of concern

Chemical compounds with human health concern have been determined among contaminants listed by OSPAR convention and UE Water Framework Directive, focusing on compounds that preferentially bound to sediment and biota (hydrophobic, persistent, bioaccumulable substances).

WFD

OSPAR





Chemical Risk : contaminants of concern

The chemical compounds identified for having human health effects have been classified with decreasing importance in four categories. :

List 1 : Contaminants with regulations about their concentration in seafood	List 2 : Contaminants with recommendations about their concentration in seafood	List 3 : Priority chemical substances in marine environment with toxic factors	List 4 : Contaminants that may be found in marine environment connected to agricultural river basins with toxic factors
Arsenic Cadmium Lead Mercury Benzo(a)pyrene PCB i (CB 28, 52, 101, 118, 138, 153, 180) PCB-DL, dioxins, et furans Hexachlorobenzene	Anthracene Fluoranthene Naphtalene Benzo(b)fluoranthene Benzo(ghi)pérylene Benzo(k)fluoranthene Indéno(1,2,3-cd)pyrène Chrysene Benzo(a)anthracene	Pyrene Phénanthrene Nickel Lindane Tributyltin (TBT)	Dieldrin

Among these chemicals, metallic compounds, PCB, TBT and PAHs are routinely analysed on sediments in dredging projects.



Chemical Risk : decision criteria

Benchmark values of contaminant's concentrations in sediments have been calculated using the equilibrium partitioning method of the European Technical Guidance Document (TGD) for :

- ▶ *substances of list 1 and 2, from concentration thresholds in seafood ;*
- ▶ *substances of list 3 and 4 that are priority substances of the European Water Framework Directive, from quality standards in biota calculated by the European Commission in 2005 considering human health criteria ;*
- ▶ *other compounds, from toxicity factors.*



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Chemical Risk : decision criteria

It was not possible to determine threshold values using the TGD for mercury and arsenic due to a lack of data.

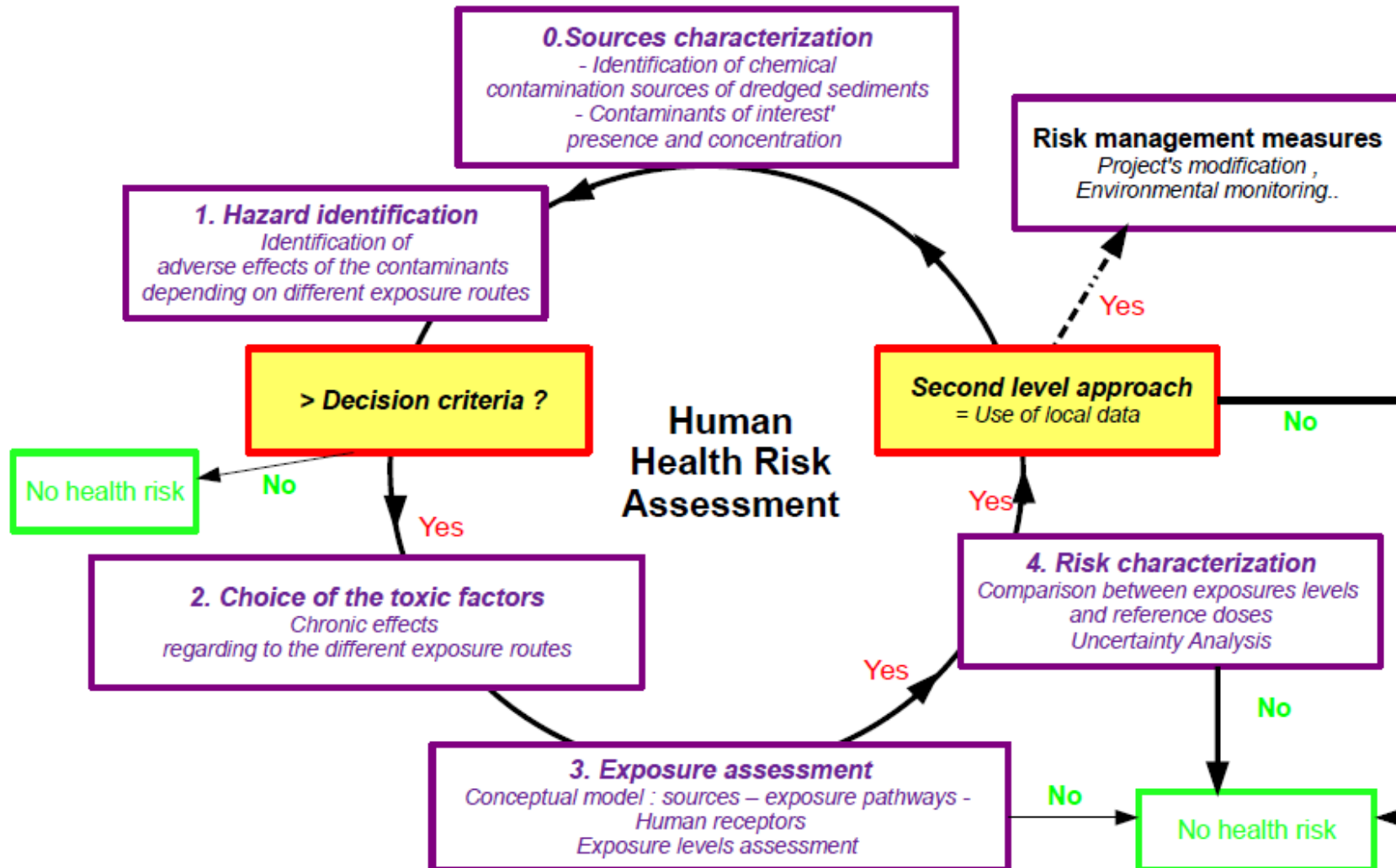
If contaminants concentrations in sediments are under the decision criterias, there is no need for further investigations.

So, it is no necessary to conduct a human health risk assesment.

If one contaminant at least exceed the decision criteria, a human health risk assesment has to be conduct on concerned substances.



Chemical Risk : quantitative risk assessment





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Biological Risk

Qualitative assessment

Microbiological contamination

Toxic phytoplankton contamination



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Biological Risk : Qualitative Risk Assessment

The assessment of biological risk is different from the chemical risk assessment:

- ▶ *the lack of data and methods of environmental concentration assessment only allows to realize a **qualitative assessment** ;*
- ▶ *effects to consider are principally acute.*



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Biological Risk : microbiological contamination

Risk assessment

- ▶ *It is necessary to consider **bacteria, virus and pathogenic protozoa**;*
- ▶ *The possible exposure routes are **ingestion, inhalation, and skin contact**.*
- ▶ *The effects induce by microbiological organisms could be **acute, chronic, carcinogenic or allergic**.*



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Biological Risk : microbiological contamination

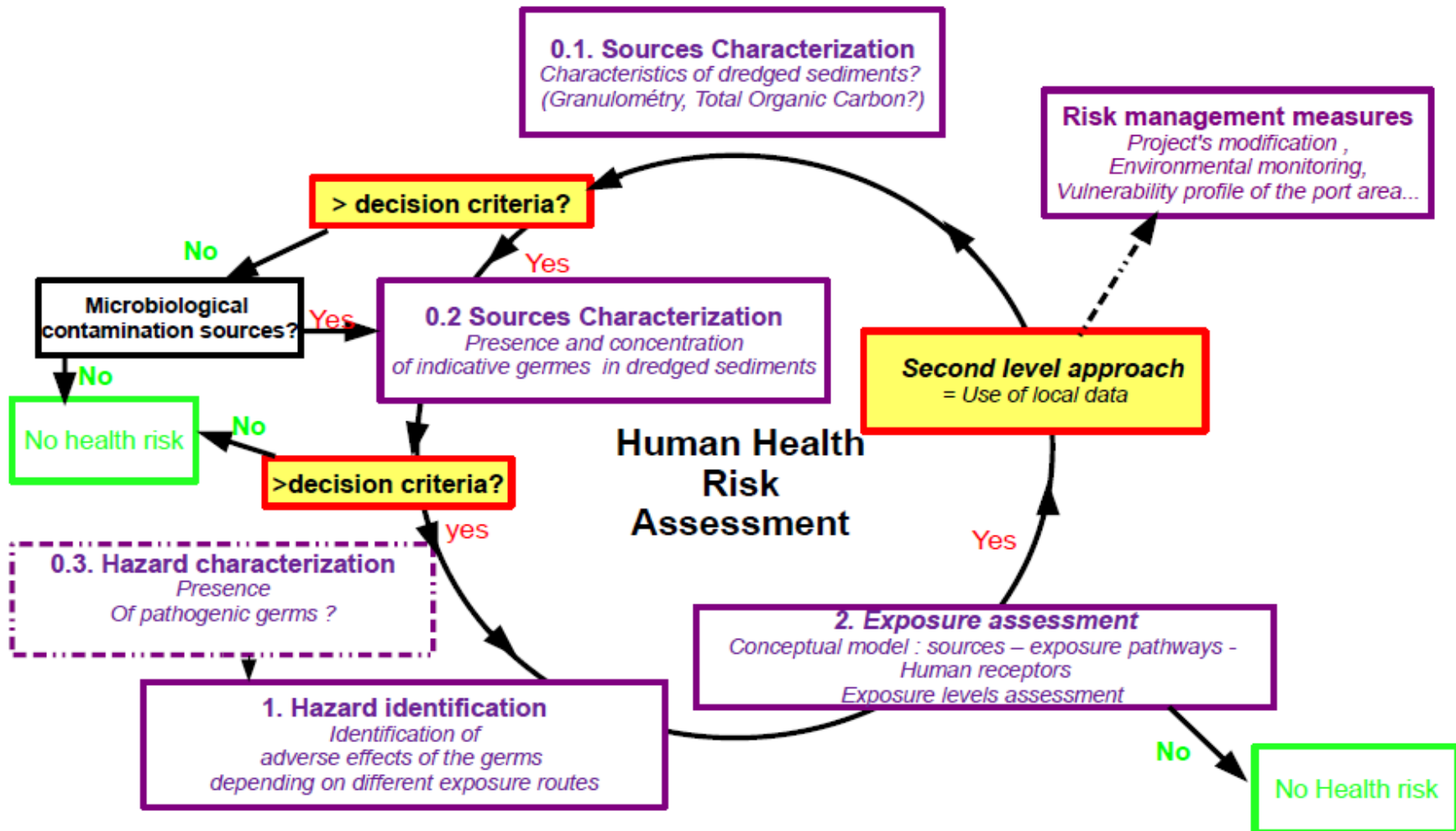
Decision criteria

- ▶ *The first decision criteria is the fecal indicator germs concentration (E.coli and enterococci) ;*
- ▶ *In addition, several **physical and chemical characteristics of sediments** could give an indication on a possible microbiological contamination (grain size distribution of sediment, organic matter content).*

*In some cases, a direct analysis of **pathogenic germs** like salmonella, for example, could be necessary.*



Biological Risk : microbiological contamination





Biological Risk : toxic phytoplankton contamination

Risk assessment

- ▶ *In France, three species of toxic phytoplankton are a matter of concern for human health : **Dinophysis**, **Alexandrium** and **Pseudo-nitschia**.*
- ▶ *The transport mechanism is the dispersion of phytoplankton cysts potentially present in sediments. Then, only the phytoplankton capable of producing cysts like **Dinophysis** and **Alexandrium** should be considered.*
- ▶ *The principal exposure route is the ingestion of contaminated seashell or fish.*
- ▶ *The main effects of phycotoxins are acute.*



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Biological Risk : toxic phytoplankton contamination

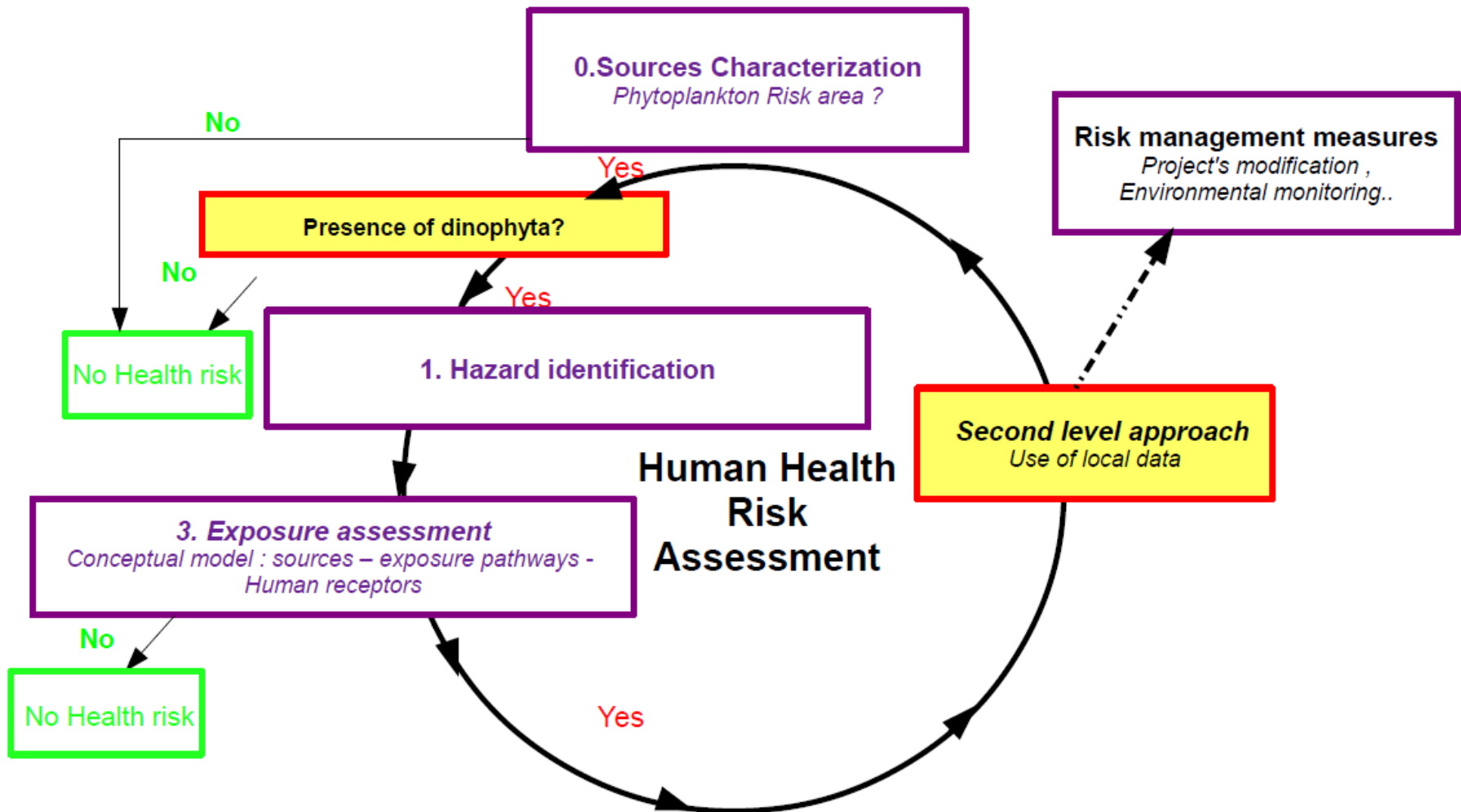
Decision criteria

- ▶ *The decision criteria is based on the classification of the area in "risk area" through the program of monitoring "REPHY". (Ifremer)*

- ▶ *If **Dinophysis** and **Alexandrium** are responsible of the classification of the area in « risk area », a HHRA has to be done.*



Biological Risk : toxic phytoplankton contamination





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Conclusions



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Conclusions

To confer to decision criteria a protective character, **inflating hypotheses** have been considered.

Those values constitute decision criteria which conduce port authorities to assess or not the human health risk. **They have not to be considered as management thresholds.**

For HHRA, **local parameters** have to be preferred to theoretical values in order to reduce uncertainties.

Mitigation measures that can follow the highlighting of a health risk must be proportioned with identified stakes and some result's uncertainty.



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Thanks
for your attention.

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