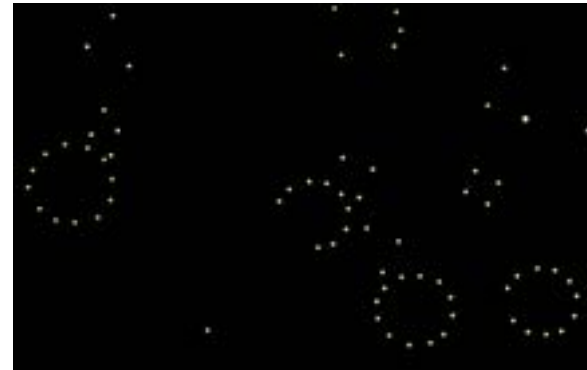




Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Département fédéral de l'intérieur DFI
Office fédéral de la santé publique OFSP
Unité de direction Protection des consommateurs

Ra-226 in waste disposal sites and radium action plan in Switzerland





Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Département fédéral de l'intérieur DFI
Office fédéral de la santé publique OFSP
Unité de direction Protection des consommateurs

Radium

Discovered 1898 by
Marie & Pierre Curie

Uran



Radium



Radon



Blei



Radium enjoyed an excellent reputation
soon after its discovery



Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Département fédéral de l'intérieur DFI
Office fédéral de la santé publique OFSP
Unité de direction Protection des consommateurs

Products containing radium





Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Département fédéral de l'intérieur DFI
Office fédéral de la santé publique OFSP
Unité de direction Protection des consommateurs





Use of radioactive luminescent paint in the watch industry in Switzerland

~ 1910 - 1965

Luminescent paint with radium

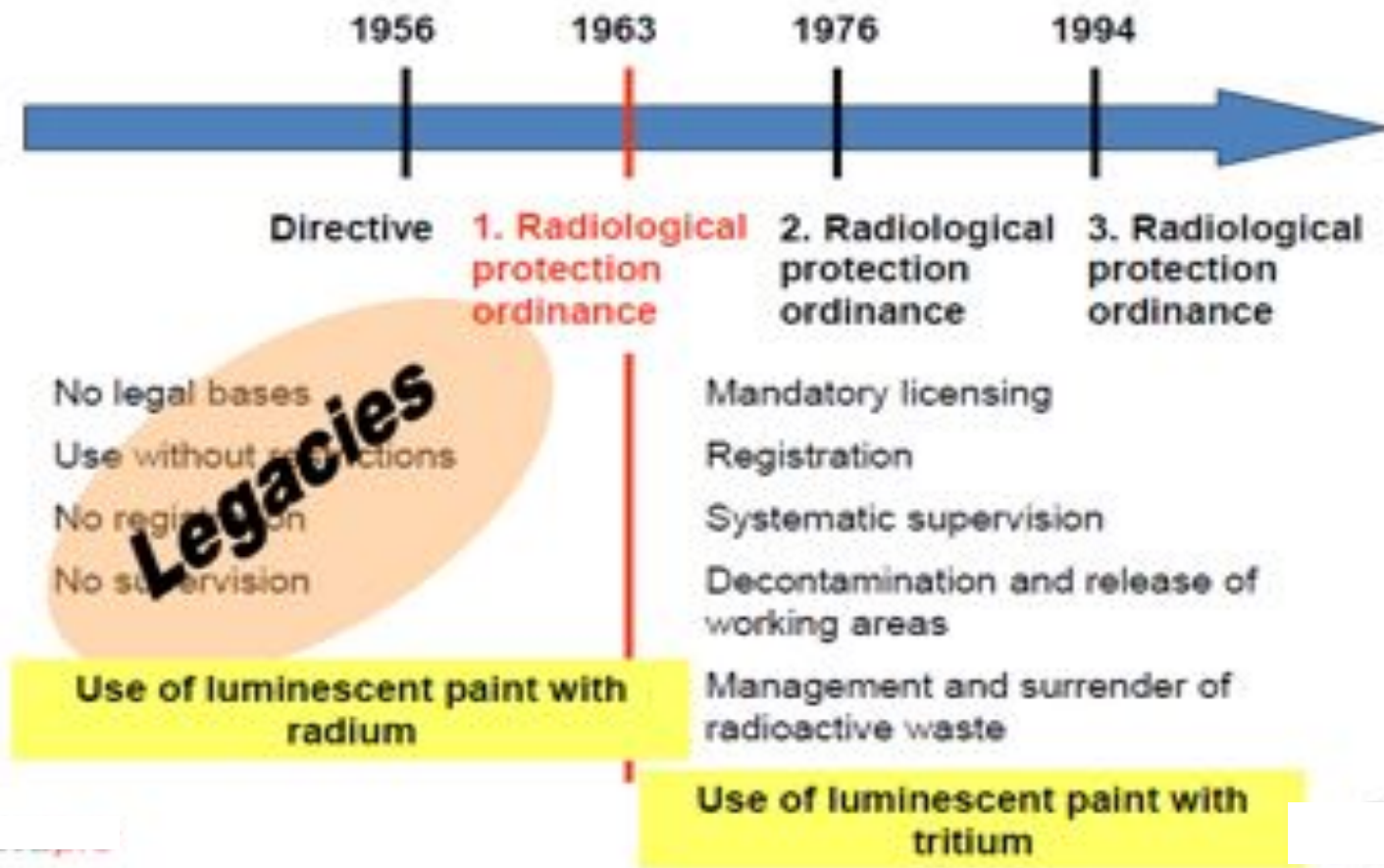
- 2 Manufacturers of luminescent paint
- 25-... Workshops for the application of luminescent paint
- 50-... Manufacturers of dials with workplaces where luminescent paint was applied
- 50-... "small" clients (manufacturer of instruments, watchmaker, homework, military)

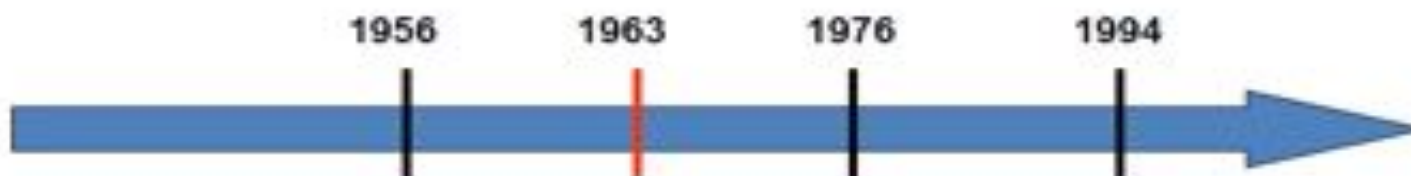
Estimated use of luminescent paint with radium: about 4 TBq

⇒ Local contamination of buildings and environment



Regulations in radiological protection





Enterprises which stopped activities before 1963:

- ⇒ Missing documents, no final measurement for release of working areas
- ⇒ Contaminations of radium still partially existing

Discharge of radium-containing waste in landfill sites

Enterprises which stopped activities after 1963:

- ⇒ Decontamination and release of working areas by the authority

Legacies



Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Département fédéral de l'intérieur DFI
Office fédéral de la santé publique OFSP
Unité de direction Protection des consommateurs

Use of luminescent paint with radium





Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Département fédéral de l'intérieur DFI
Office fédéral de la santé publique OFSP
Unité de direction Protection des consommateurs





Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Département fédéral de l'intérieur DFI
Office fédéral de la santé publique OFSP
Unité de direction Protection des consommateurs





Measure from 1963 until 2014

- ☐ Measure on sites after suspicion or indication by public, remediation if necessary
- ☐ Organisation of campaign to collect contaminated samples
(watch, lightning conductors, etc.)
- ☐ Installation of detectors at the entrance of incineration facilities and steel mills
- ☐ Measurement in several scrap dealers
- ☐ Several pilot remediation were performed

- ☐ No systematic investigation to find polluted sites where luminescent paint with radium was used before 1963 because:
 - ☐ small risk for the people concerned
 - ☐ great effort needed and not on the priority list



Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Département fédéral de l'intérieur DFI
Office fédéral de la santé publique OFSP
Unité de direction Protection des consommateurs

But in 2014

Discovery of radium-contaminated waste on the highway A5 construction site in a city named Bienne



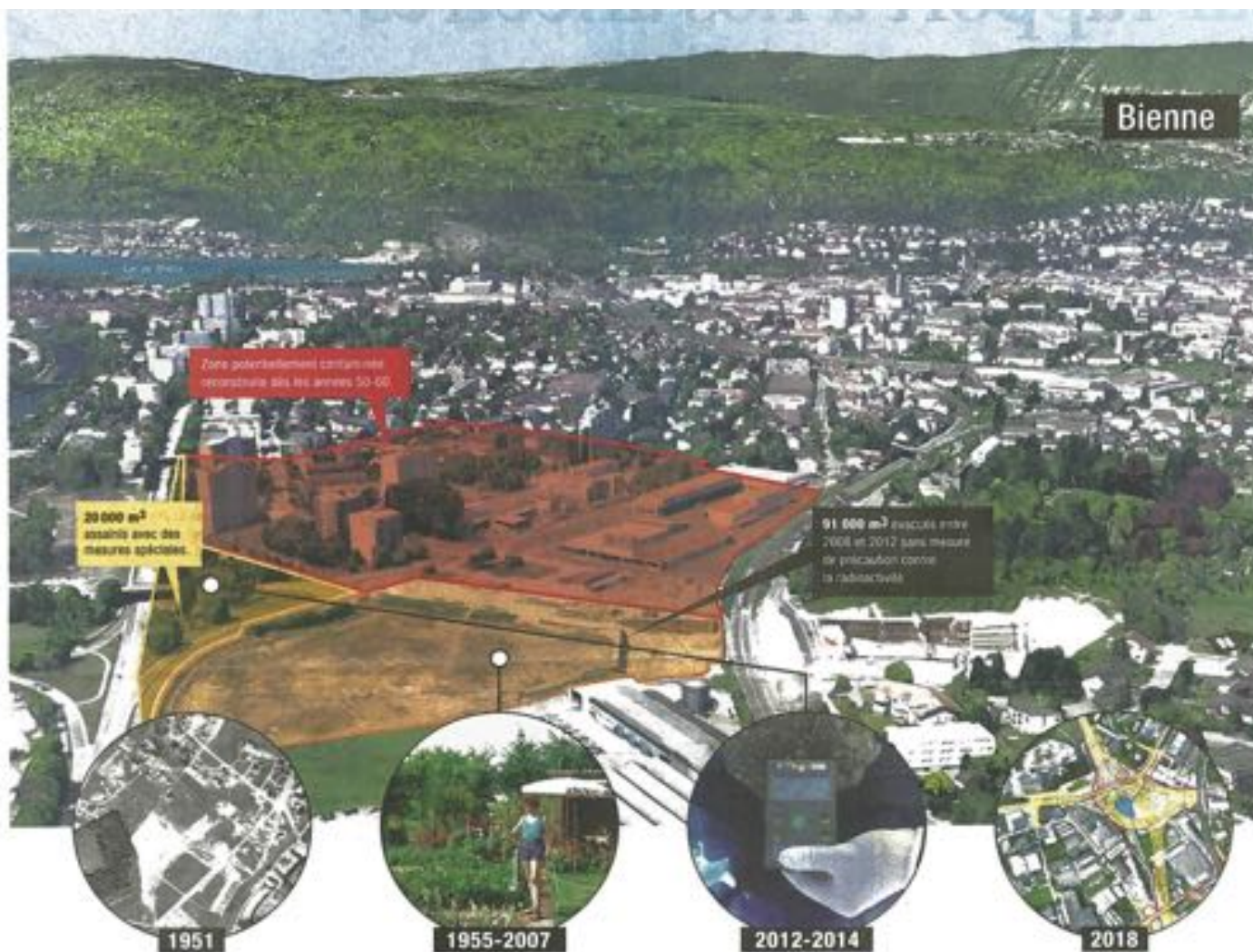
The course of events

- The route of highway A5 leads over a former waste disposal site
 - the site had been in use until the 1950s and has subsequently been covered by debris and soil
 - on a part of the site a residential area has been built
- The city of Bienne has carried out toxicological measurements prior to the highway construction activity
- A part of the waste – which could not be disposed of conventionally – has been transferred to a disposal site
- In **November 2012** a radioactivity alarm has been triggered at the reception control. A hotspot with 250 kBq/kg of Ra-226 has been identified (exemption limit = 40 Bq/kg).



Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Département fédéral de l'intérieur DFI
Office fédéral de la santé publique OFSP
Unité de direction Protection des consommateurs





The course of events (2)

- According to standard procedures, SUVA (supervising authority) has been informed about the incident
 - The radioactive material has been separated from inactive material and has been disposed of appropriately as radioactive waste
 - A systematic measurement procedure has been established in order to check all the material after extraction of the former waste disposal site
 - The workers have been briefed concerning correct behaviour in case of exceeding of a threshold value and have been equipped with personal dosimeters.
- A second threshold exceeding has been reported in August 2013
- A third threshold exceeding has been reported in January 2014 when an intact bottle containing radium luminous paint has been found.



Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

13.08.2013

Département fédéral de l'intérieur DFI
Office fédéral de la santé publique OFSP
Unité de direction Protection des consommateurs





Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Département fédéral de l'intérieur DFI
Office fédéral de la santé publique OFSP
Unité de direction Protection des consommateurs



20.01.2014



A communication problem

- **residents have been informed by the media instead of the authorities (city)**



big public issue despite the following facts :

- procedure to identify, extract and dispose of radioactive material
- measures to protect workers on site
- very small sanitary risk for the general public



Measurement campaign

- Regarding the available data concerning the radium contamination of the disposal site, the FOPH concludes that the sanitary risk for the population as well as the hazard for the environment has been marginal.
 - Punctual contaminations
 - In undisturbed parts of the site, the debris and soil cover leads to an additional protection
 - Conservative scenarios for the most exposed part of the population lead to cumulative dose estimations of well below 1 mSv per year
- In order to exclude any sanitary risk, the FOPH has decided to carry out additional measurements in the constructed parts of the former deposal site
 - Measurements of radionuclide concentrations and dose rate
 - Radium-measurements in percolation water

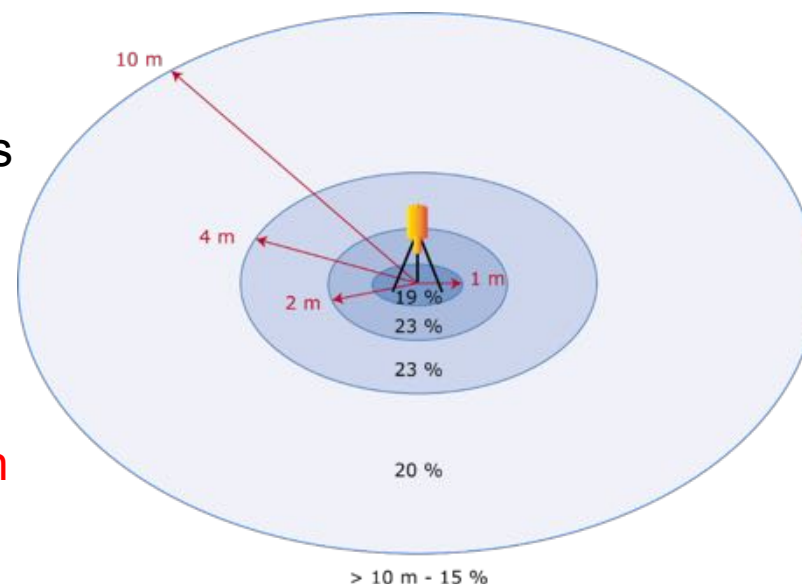
In situ Gamma-Spectrometry

Why this method?

- Qualitative information about the radionuclides present on site.
- One measurement covers an area of approximately 20m in diameter.
- The results give a more global idea of the site than the analysis of individual samples (unless a very large number of samples is taken and analysed).
- Realistic estimation of dose rate contribution of different radionuclides
- Differentiation of natural versus artificial Ra-226

Disadvantage:

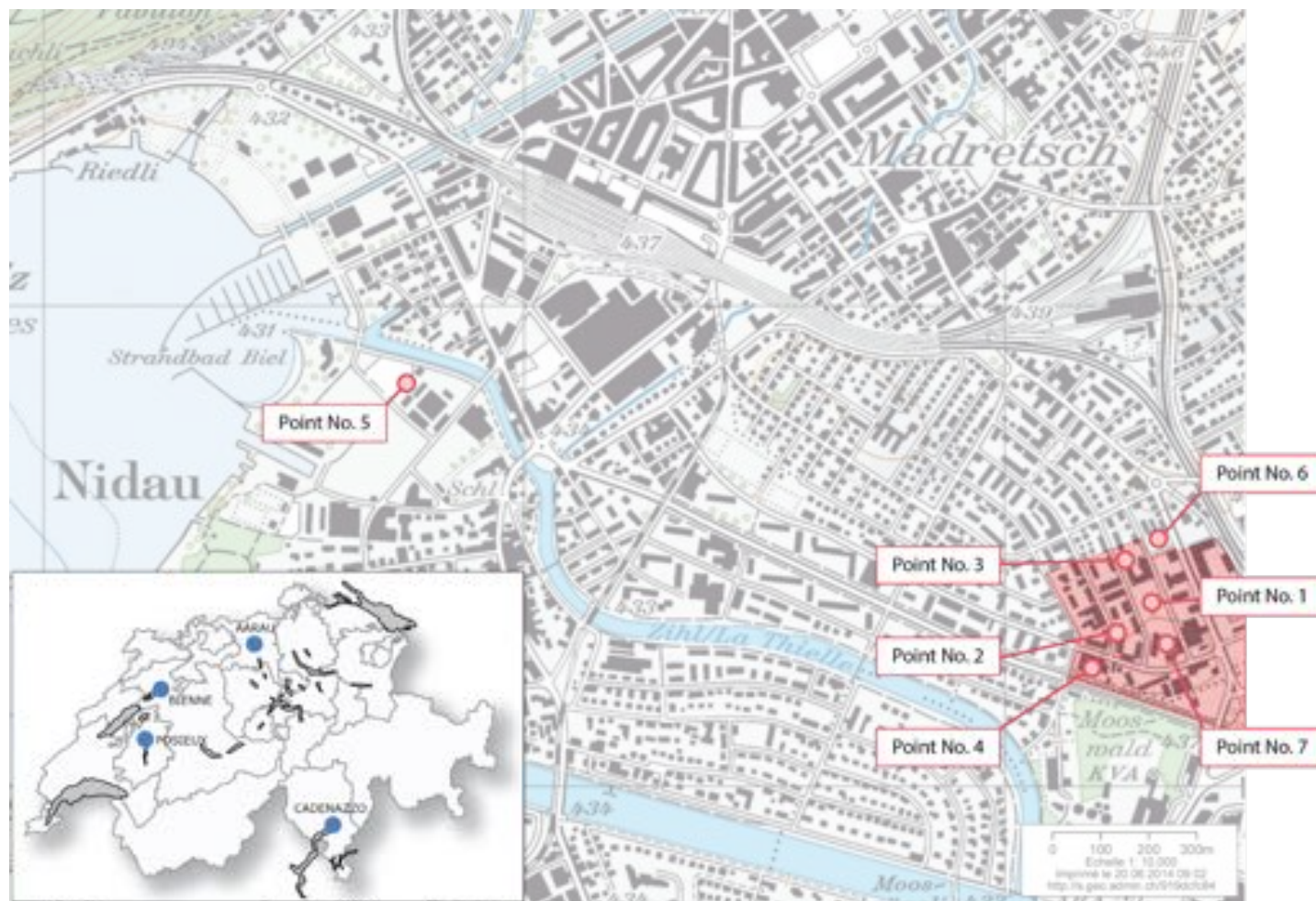
No reliable quantification, due to unknown radionuclide distribution in the ground.





Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Département fédéral de l'intérieur DFI
Office fédéral de la santé publique OFSP
Unité de direction Protection des consommateurs





Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Département fédéral de l'intérieur DFI
Office fédéral de la santé publique OFSP
Unité de direction Protection des consommateurs

Site No. 3



Site No. 2



Site No. 6



Site No. 1



Site No. 4

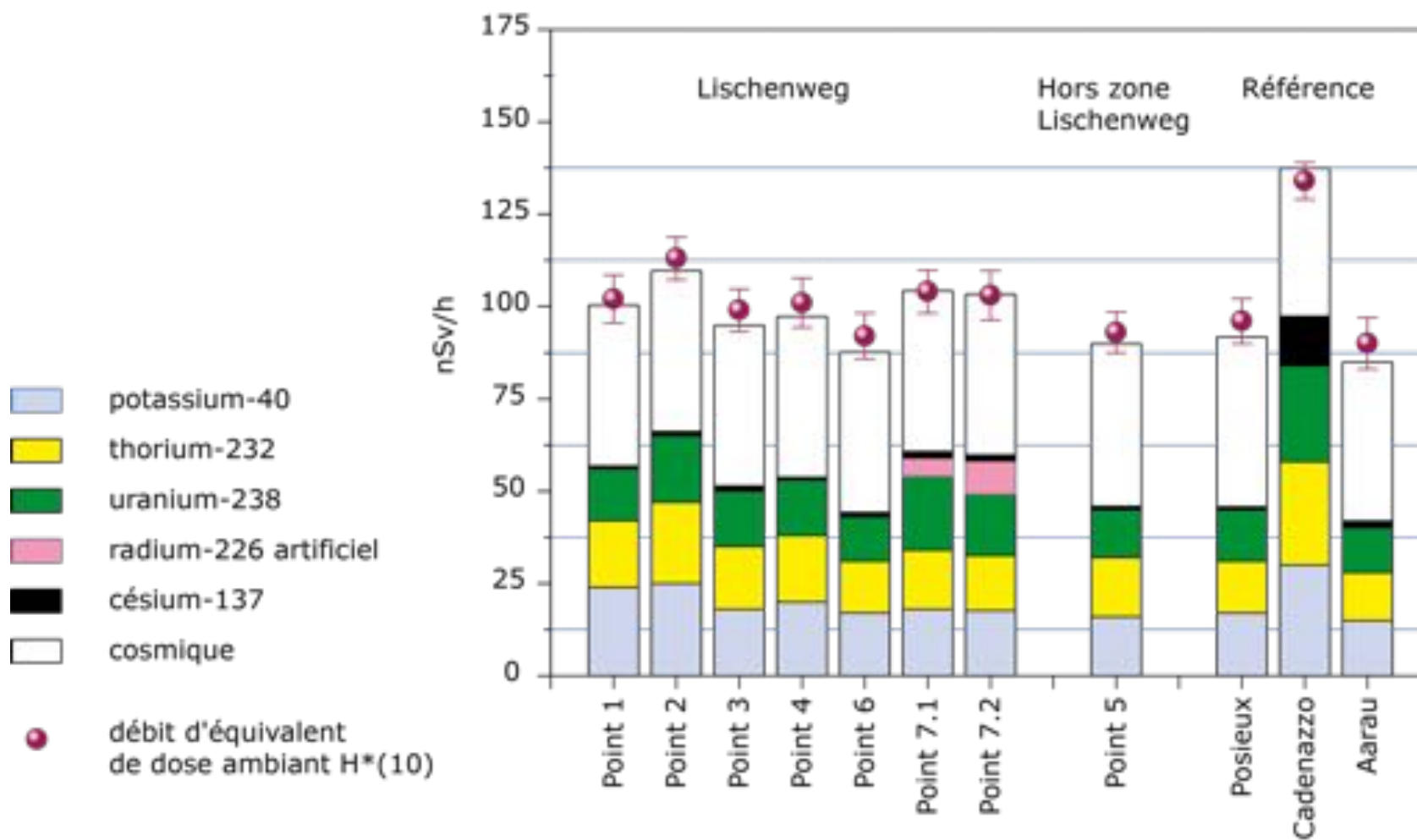


Site No. 7





Results





Results

■ In situ gamma spectrometry measurements have confirmed, that the sanitary risk for the public is insignificant.

- On 5 measurement sites the values correspond to the naturally occurring radium in the ground.
- On 1 site the presence of artificial radium could be determined.

The resulting additional dose rate of 5 to 9 nSv/h is less than 10% of the dose rate due to naturally occurring radioactivity.



Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Département fédéral de l'intérieur DFI
Office fédéral de la santé publique OFSP
Unité de direction Protection des consommateurs

Sampling sites for percolation water





Results of seepage water measurements

Probe	Ra-226	pH	Conductibility	redox	Rn-222	Tritium
	mBq/l		uS/cm	mV	Bq/l	Bq/l
Pm 1	8.5 ± 1.2	8.1	501	-234	n.g.	<10
Pm 2	9.3 ± 1.1	n.g.	676.0	n.g.	n.g.	<10
Pm 3	7.4 ± 1.0	n.g.	502.0	n.g.	n.g.	<10
Pm 4	36.9 ± 3.7	n.g.	n.g.	n.g.	n.g.	<10
Pm 5	41.6 ± 4.2	7.3	1315	n.g.	13 ± 1.3	<10
Pm 6	173 ± 18	7.5	1473	n.g.	50.7 ± 4.1	<10
Pm 7	9.1 ± 1.3	7.0	3220	-173	9.6 ± 1.1	<10
KB 08/4	9.9 ± 1.4	7.1	740	-30	13 ± 1.2	<10
KB 09/8	42.9 ± 4.3	7.0	901	-136	26.4 ± 2.3	<10
KB 10/12	16.7 ± 2.1	7.0	1747	-147	<3	<10

Results of percolation water measurements

- Ra-226 concentrations in percolation water have been measured on 10 sites (depth: 2 to 5 m, measurements IRA Lausanne)
 - On 6 sites the radium values are identical to those known for natural groundwater.
 - On 3 sites the values were between 37 and 43 mBq/L
 - On 1 site 173 mBq/L have been measured → clear indicator for the presence of artificial Ra-226
 - All values are below the EU limit value of 500 mBq/L Ra-226 in drinking water. The city of Bienne does not extract groundwater for human consumption in the area of the former disposal site.

- The measured values are not alarming and confirm prior evaluations of the low sanitary risks.



Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Département fédéral de l'intérieur DFI
Office fédéral de la santé publique OFSP
Unité de direction Protection des consommateurs

Media publication after the Bienne finding

- ♦ 8.6.2014: The Sunday press publishes a list of 91 addresses, where luminescent paint with radium was applied.
- ♦ Most of these addresses are buildings where the work with radium was terminated before 1963.
⇒ No measurements of contamination
- ♦ The involved population is worried



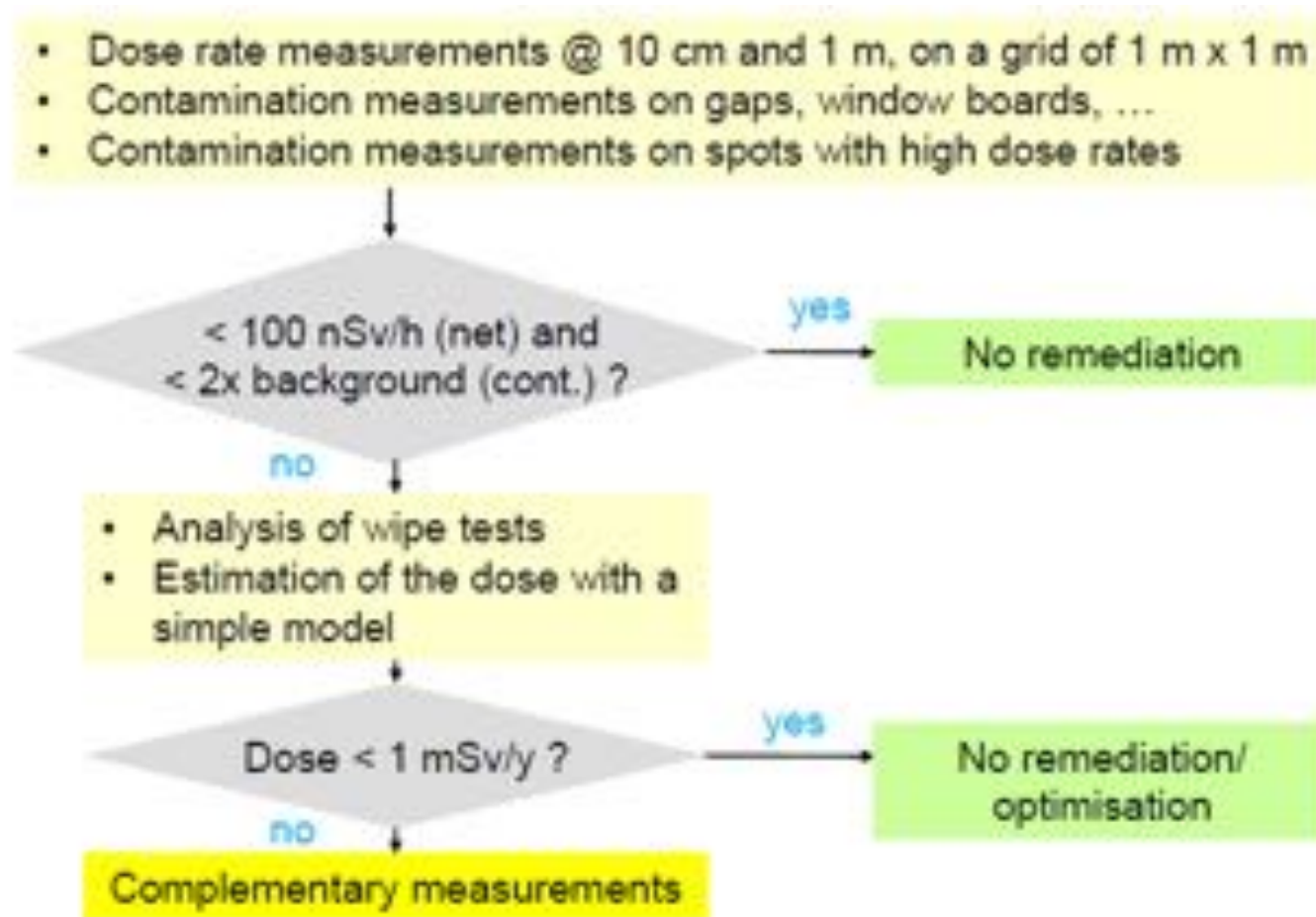


Consequences for the regulatory bodies

- ◆ Press conferences in La Chaux-de-Fonds and Biel, information event in Biel
 - all published sites will be measured (BAG: apartments, Suva: enterprises)
 - Investigations in archives
 - Call for indication of suspicious sites
- ◆ Establishing contacts to the municipality, owner and occupant
- ◆ Exchange of information with the french authorities (ASN and ANDRA)
- ◆ Development of a diagnostic measurement procedure approved by the Federal Commission for Radiological Protection 11.9.2014
 - Remediation if the dose is higher than 1 mSv per year
- ◆ Additional 47 suspicious sites indicated by the population
- ◆ Investigations in archives (different lists of suppliers, cantons, union of watches,...)
 - ⇒ **about 500 buildings may be concerned**



Procedure of measurement inside a building

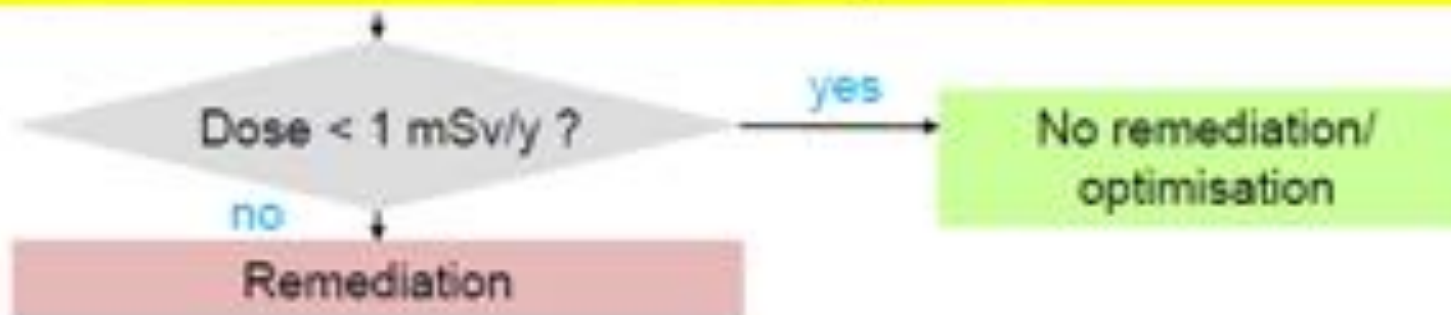




Complementary measurements

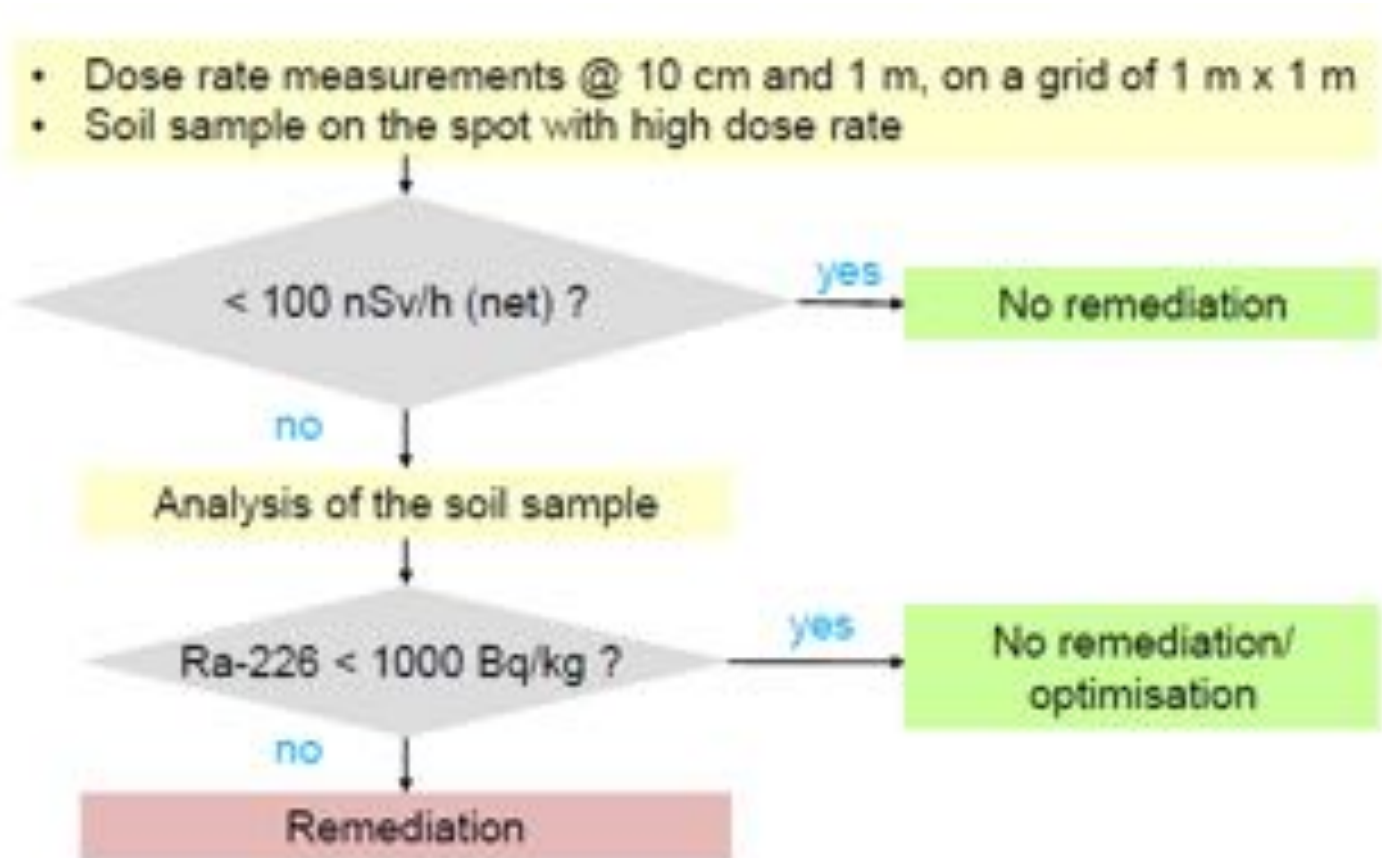
- Dose rate measurements on the identified spots @ 10 cm and 1 m, on a grid of 0.2 m x 0.5 m, some measurements @ 50 cm
- More detailed contamination measurements
- Detailed description of the room

- Estimation of the dose with a more complex model





Procedure of measurements outside building





Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

First results



- ◆ 18 "tranquillisation mesasurements"
 - 3 buildings with small contaminations locally limited, no remediation necessary
 - Remediation necessary in 1 building
- ◆ 28 radium-diagnostic measurements, among of them 26 in Biel
 - No traces of radium in 16 buildings
 - 5 buildings with small contaminations locally limited, no remediation necessary
 - 7 sites where a remediation will be necessary:
 - 4 inside buildings (one of them was a nursery from 2007 to 2011),
 - 3 outside buildings



Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Département fédéral de l'intérieur DFI
Office fédéral de la santé publique OFSP
Unité de direction Protection des consommateurs

First remediation of a dwelling





Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Département fédéral de l'intérieur DFI
Office fédéral de la santé publique OFSP
Unité de direction Protection des consommateurs

Remediation of a outdoor area





Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Département fédéral de l'intérieur DFI
Office fédéral de la santé publique OFSP
Unité de direction Protection des consommateurs

Next action

Implementation

Action Plan Radium 2015 to 2019



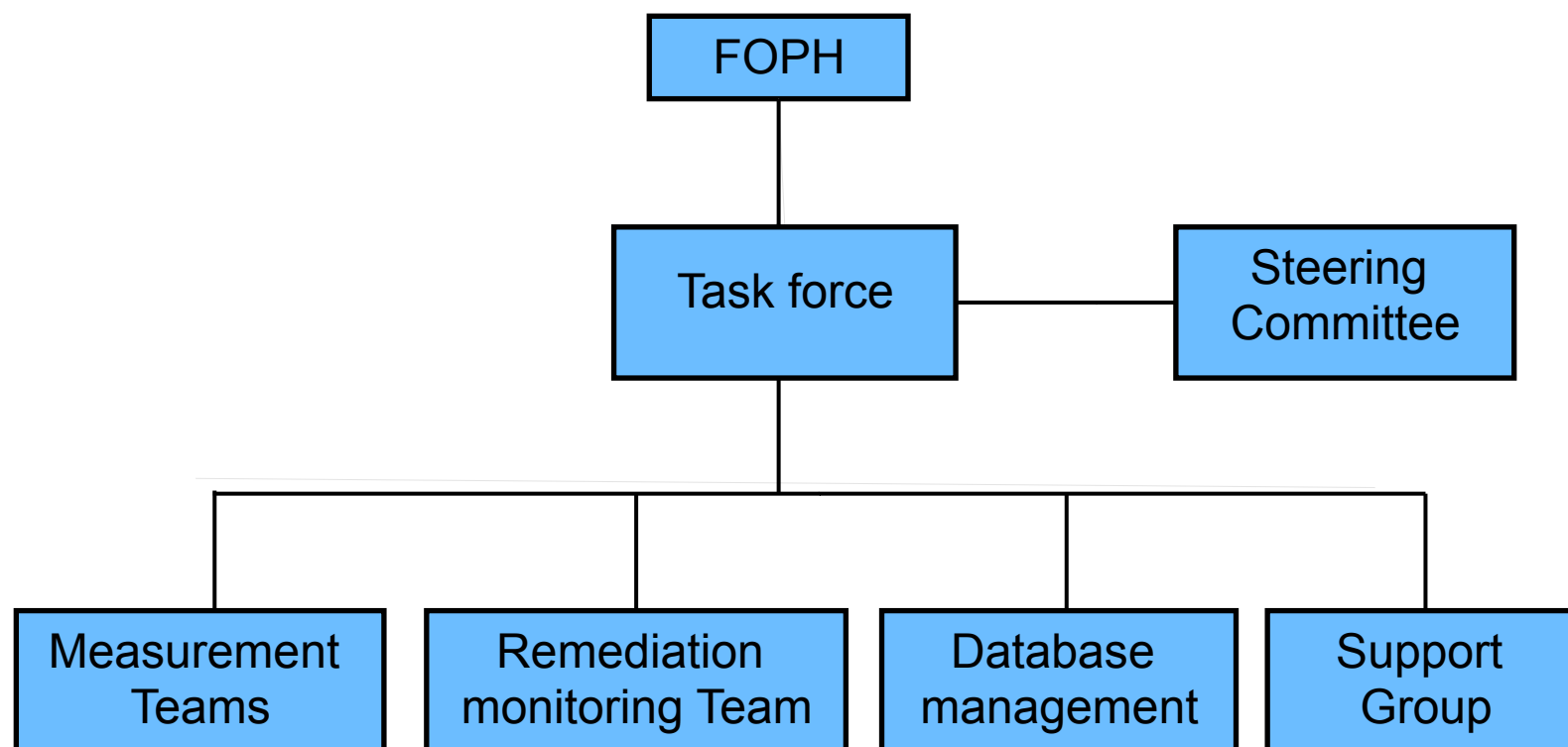


The different steps of the action plan

- **Inventory phase** : Search for potentially contaminated sites (information sources : historical informations and contact with the professionals concerned)
- **Diagnostic phase** : Carry out the radium diagnostic in buildings and surrounding land according to the established procedure; assessment of the resulting annual exposure for the residents (graded approach)
- **Remediation phase** : (in case that the exposure exceeds the annual limit of 1 mSv) : this phase involves decontamination and waste management, as well as the rehabilitation of the concerned premises and lands
- **Monitoring of potentially contaminated landfill sites** : $H^*(10)$, in situ gamma spectrometry if needed; Ra-226 in seepage water



Organisation of the action plan



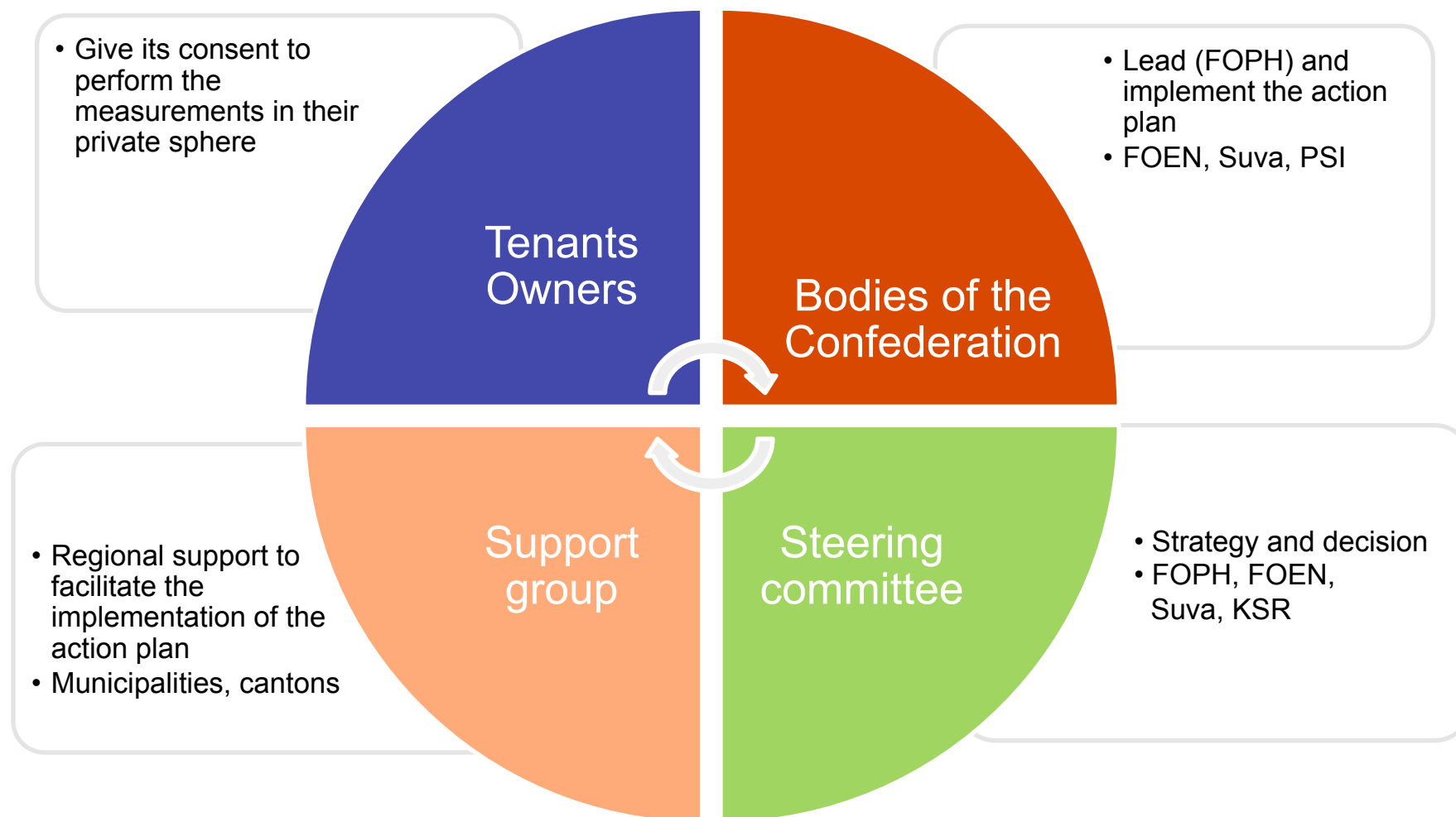


Content of the action plan

Actions	Measures	Impact
1. Search for potentially contaminated buildings and landfills	Search and list the buildings concerned and identify other possibly impacted sites (landfill sites) Inform the owners and/or the public authorities	Protection of the health of the population ($< 1 \text{ mSv/yr}$)
2. Diagnostic of potentially contaminated buildings	Initiate contact with the owners Carry out the diagnostic measurements Evaluate the need for remediation or optimisation	
3. Remediation of contaminated buildings	Plan and carry out the remediation Ensure the work is carried out Separate and remove the radium waste	
4. Monitor the potentially contaminated landfills	Implement site monitoring (seepage water) Supervise the workers and guarantee the correct management of the waste	Protection of the environment



Actors in the action plan and their role





Time schedule / Execution of the action plan

2015 - 2017	2017 - 2018	2018 - 2019	2019
Pilot phase			
Search for sites			
Diagnostic of potentially contaminated buildings			
Remediation of contaminated buildings when the reference value (1 mSv/yr) is exceeded			
Surveillance of potentially contaminated landfills			



Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Département fédéral de l'intérieur DFI
Office fédéral de la santé publique OFSP
Unité de direction Protection des consommateurs

Thank you for your attention

