

Marine assessment using the ERICA Tool

In this practical you will progress from a simple Tier 1 assessment, through Tier 2 where you will make use of differing input data and create organisms, to Tier 3 where you will conduct a probabilistic assessment and, interpret and discuss your results.

Purpose of the assessment

You have to conduct an assessment for wildlife in the vicinity of a nuclear site which discharges directly into the marine environment.

Discharges occur via a pipeline extending 200 m into the sea from the coastline.

Part A: Tier 1 assessment

Begin your assessment at Tier 1 and use the ERICA screening dose rate.

You have the results of a monitoring programme providing activity concentrations in water and sediment (Table 1) at four sampling sites (Figure 1).

Table 1. Water (Bq/l) and sediment (Bq/kg dw) activity concentrations at four sampling sites (see Figure 1).

	Site 1		Site 2		Site 3		Site 4	
	Water	Sediment	Water	Sediment	Water	Sediment	Water	Sediment
H-3	5.3E-1	5.3E-1	2.0E+1	2.0E+1	1.6E+0	Not available	4.7E-1	Not available
Co-60	2.7E-4	8.0E+1	9.9E-3	3.0E+3	8.2E-4		2.4E-4	
Sr-90	1.3E-1	5.0E+1	1.2E-1	4.0E+1	4.1E-1		5.0E+0	
Tc-99	2.7E-2	2.7E+0	9.9E-1	9.9E+1	8.2E-2		2.4E-2	
Ru-106	1.3E-1	5.3E+2	5.0E+0	2.0E+4	4.1E-1		1.2E-1	
Cs-134	1.3E-1	5.3E+2	5.0E+0	2.0E+4	4.1E-1		1.2E-1	
Cs-137	5.0E+1	5.3E+3	1.3E+0	2.0E+5	4.1E+0		1.2E+0	
Pu-238	2.7E-4	2.7E-1	9.9E-3	9.9E+0	1.0E-3		2.4E-4	
Pu-239	1.3E-2	1.3E+1	5.0E-1	5.0E+2	4.1E-2		2.0E-2	
Am-241	2.7E-3	5.3E+1	9.9E-2	2.0E+3	8.2E-3		2.4E-3	

Note: the ratios between most radionuclides in this scenario are reflective of real discharges however the data have been modified and additional radionuclides added to help us to demonstrate different aspects of the assessment

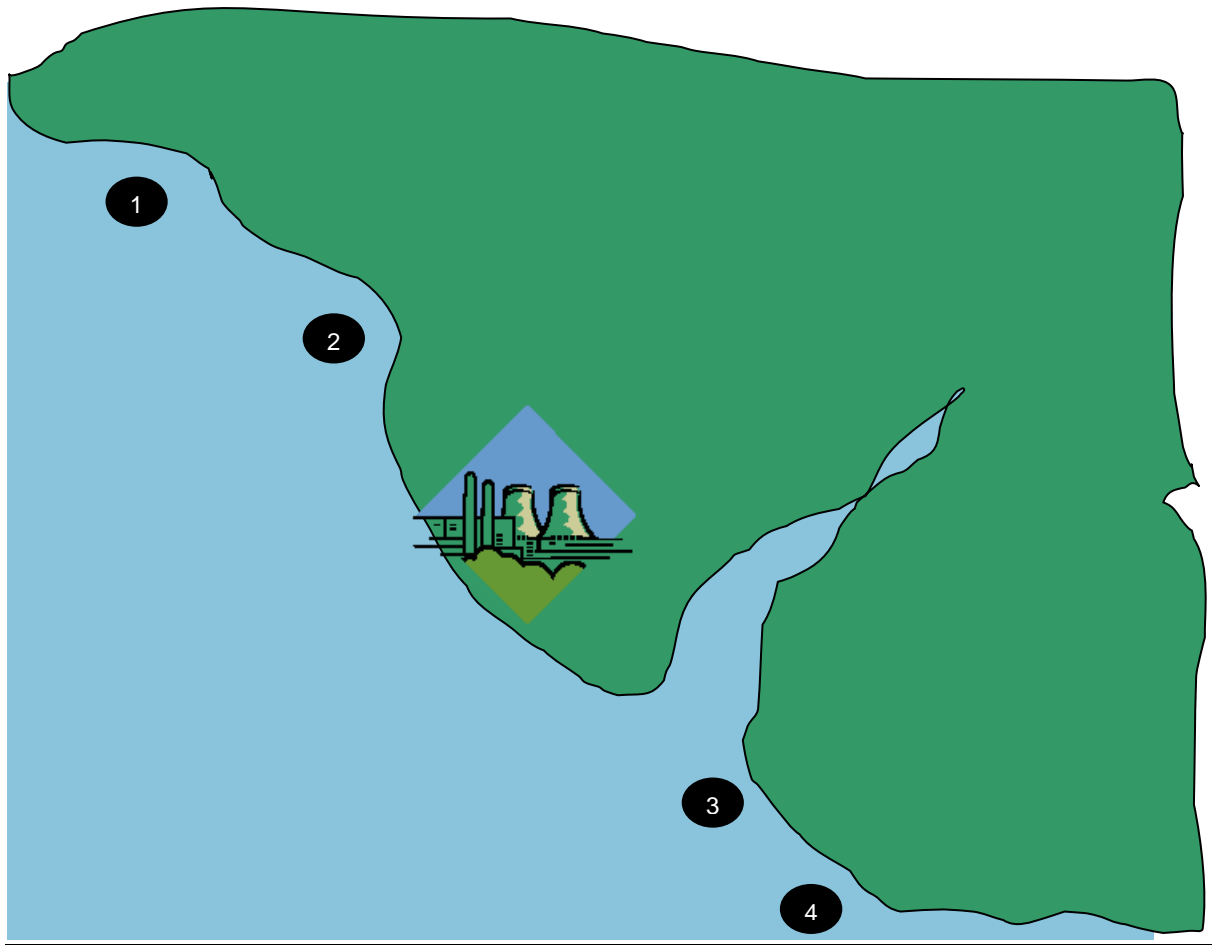


Figure 1 The co-located water and sampling sites

Record:

- your decisions regarding input activity concentrations (i.e. what did you use);
- the estimated RQ values and limiting reference organisms;
- your decision on the assessment outcome.

Use the space below to record your decisions; there is a results table on the next page for reporting RQ values and limiting organisms.

Tier 1 results table

	Risk quotient	Limiting reference organism
H-3		
Co-60		
Sr-90		
Tc-99		
Ru-106		
Cs-134		
Cs-137		
Pu-238		
Pu-239		
Am-241		
Sum of RQs		

Part B: Move to a Tier 2 assessment

There is a Natura 2000 site located 10 km distant from the nuclear site (Figure 2). Two of the sampling locations (Sites 3 and 4) are within the Nature 2000 site.

Protected species at the site and their relevant characteristics are:

Atlantic salmon

Diet –fish and zooplankton
 Size 60x10x8 cm (length x height x width)
 Mass 1.4 kg
 Spends 100% of its time in the water column



Common seal

Diet –fish
 Size 150x40x40 cm (length x height x width)
 Mass 150 kg
 Assume it spends 100% of its time in the water column



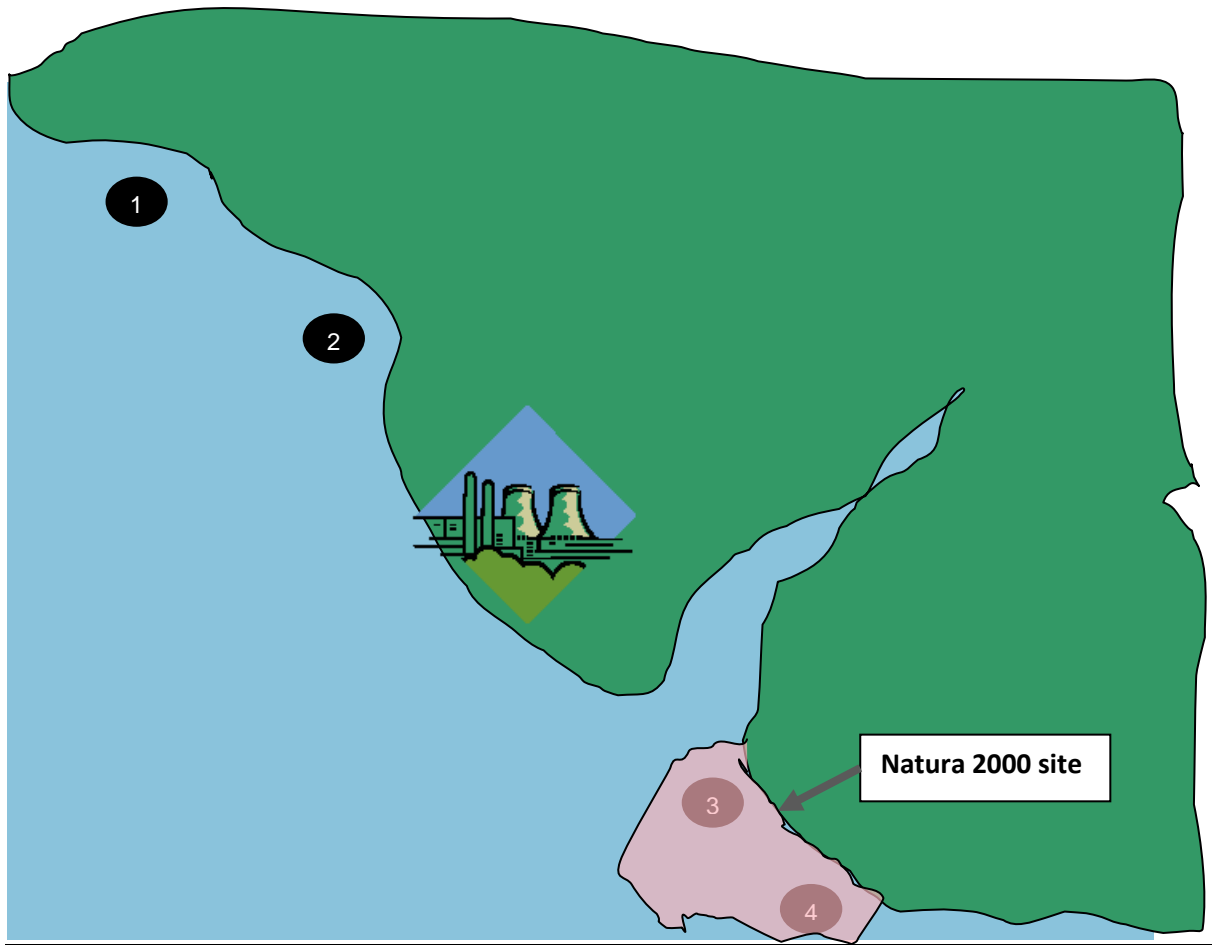


Figure 2 Sampling points in relation to Natura 2000 site

Conduct an assessment for the Natura 2000 site using Tier 2 of the ERICA Tool.

- i) Firstly, select all the reference organism geometries but identify the most appropriate reference organism geometry to represent the protected species. You will need to consult the help file to help you decide which reference organism to use (click 'Add Organism Wizard' link from Help file menu). Use the defaults for all the other parameters.
- ii) Repeat the Tier 2 assessment creating your own organisms to represent the protected species. Use the CR values for an appropriate reference organism to allow you to complete the assessment. As previously, run the assessment with all the reference organism geometries selected.

Use the following page to record your findings and describe any differences in the results for your created organism and the default reference organism you chose to represent it in stage (i).

iii) *Sediment data are now available*

You go out and measure the sediment data for Sites 3 and 4. The results of these measurements are given below:

	Site 3	Site 4
	Sediment Bq/kg dw	Sediment Bq/kg dw
H-3	1.6E-1	4.7E-2
Co-60	2.5E+1	7.2E+0
Sr-90	3.3E-1	9.6E-2
Tc-99	8.2E-1	2.4E-1
Ru-106	1.6E+3	4.8E+2
Cs-134	1.6E+2	4.8E+1
Cs-137	1.6E+3	4.8E+2
Pu-238	5.5E-1	1.6E-1
Pu-239	2.7E+1	1.0E+1
Am-241	1.1E+2	3.2E+1

Repeat the Tier 2 assessment with this additional information. Record your results in the table on the next page. Use the space below to note: What difference the sediment made to your assessment? Which reference organisms/protected species did you include in the assessment? Which sediment data did you use?

iv) *Zooplankton data are now available*

You have decided to make some measurements of zooplankton activity concentrations and these data are shown below.

	Bq/kg fw
H-3	2.0E+0
Co-60	2.5E+0
Sr-90	5.0E+0
Tc-99	4.0E-1
Ru-106	1.0E+2
Cs-134	4.5E+1
Cs-137	4.0E+2
Pu-238	1.5E+1
Pu-239	3.5E+1
Am-241	2.0E+1

Repeat the Tier 2 assessment with this additional information. What difference does this make to your results? Which reference organisms/protected species did you include in the assessment? Record your results in the table on the next page.

Part C: Tier 3 assessment

You decide that the assessment cannot be concluded at Tier 2 and move to a Tier 3 assessment you may need to make use of the different benchmark values described in the lecture (e.g. the ICRP DCRLs).

At Tier 3 run the assessment for all reference organism geometries that were 'red' or 'amber' in your final Tier 2 assessment. For ease of use, represent the protected species by the nearest reference organism geometry as you identified above. Use the default CR values and distributions. Additional samples of water and sediment have been collected from throughout the Natura 2000 site. The results are presented in the table below and should be used in the assessment assuming log-normal distributions. Use 300 simulations.

	Water concentrations Bq/l	Sediment (Bq/kg dw)
H-3	1 ± 0.9	0.1 ± 0.05
Co-60	$6E-4 \pm 5E-4$	10 ± 9
Sr-90	3.5 ± 4	0.1 ± 0.2
Tc-99	0.6 ± 0.4	0.6 ± 0.2
Ru-106	0.2 ± 0.15	1000 ± 500
Cs-134	0.3 ± 0.2	100 ± 60
Cs-137	3.1 ± 1.9	900 ± 700
Pu-238	$5E-4 \pm 6E-4$	0.2 ± 0.3
Pu-239	$3E-2 \pm 3E-2$	15 ± 10
Am-241	$6E-3 \pm 5E-3$	60 ± 40

Which organisms have you taken forward to Tier 3:

Take a screenshot of the total dose rate for each reference organism included in the assessment and paste these into a blank Word document.

Be prepared to discuss the implications of your Tier 3 assessment and, if appropriate, justify your choice (and application) of appropriate benchmark values.