PROTECT Deliverable 4: *Evaluation of approaches for protecting the environment from ionising radiation in a regulatory context.*
Collation of comments received on the September 2008 draft and the consortiums responses to these. In some instances resposnes were discussed with the originators of the comments – additional comments received as a consequence (and any further response) are identified by red text.

The final version of Deliverable 4 is available from: http://www.ceh.ac.uk/protect/outputs/

Chapter /Section	Page	Para/location	Comment/Question	Revision/ Correction/Explanation
			When using EA R&D128 I also found whales to be a critical taxon in my assessments. However, in my case there is a complete lack of data to assess this outcome. Are you aware of any information that could be used to validate these findings? Despite the arguments against the Japanese whale sampling, is there any information deriving from those studies or other similar activities that may be used to support the modelled results.	EA R&D128 for marine ecosystems highlights sea mammals as the most exposed organisms for some radionuclides. Basically this is because with exception of Cs and Pu all the CR values within the R&D128 model are derived using very conservative assumptions given lack of data in the EA database. If you look at Table A2.1 in the follow-up report to R&D128 (http://www.ceh.ac.uk/protect/pages /documents/Habitatsregulationsforstage3assessment.pdf) you will see that in many cases whales and seals are assumed to have the same activity concentration as sediment or plankton. This issue is discussed in the deliverable (section 3.2.2) and the EA intend to move to the ERICA parameters (where possible) for this reason.
			AQUASCOPE model also calculates concentrations of Cs, Sr & I in aquatic ecosystems using default Kds and CFs.	The models listed are those we are aware people have proposed could be used in environmental assessments. There are probably more models especially those considering aquatic ecosystems which could be used – this is now acknowledged within the deliverable (section 4).
			I have no major comments. On page 48-49 3.2.4. Discussion You there first state (underlined) that with a high degree of confidence decide if sites can be considered to present negligible risk or not and be excluded from further assessments. A few lines further (p 49) you write "The large variation in RQ values estimated by the approaches does not promote the level of confidence required by the users .... Is this not rather contradictory???? I would not feel confident at all anymore. I thought I could rather rely on ERICA but when I now see	No it is not contradictory – whilst this is the aim of a screening tier the three models can give very different results. But yes it does reduce confidence in the outputs. We have, hopefully, improved discussion around some of these issues and we agree in hoping that the IAEA guidance on transfer as proposed by the EMRAS-BWG will help progress this issue.

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			the difference in output with R&D128 and RESRAD biota, I would feel more or less obliged to do the assessments with the three models and if RQ would be lower than 1 for all models, I think one can be rather confident. If RQs will be very different, the user will be obliged each time to search for the reason for the differences. I hope that the next EMRAS-BIOTA can provide progress on this.	
Executive Summary	4/101	5	The Executive Summary states that RESRAD-BIOTA requires site-specific data at anything above the initial screening level. It should be noted that although this is often the approach taken, in some cases, additional site-specific data may not be required. Instead, less conservative assumptions could be applied (such as using 'typical' exposure concentrations via key pathways instead of maximum values at the screening level).	Minor edit to summary – now reads 'initial screening levels'. The comment is more directly addressed within body of the report (section 4).
2.2	22/101	1	The first sentence of Paragraph 1 in Section 2.2 is a bit hard to follow. It is suggested that a comma be placed after '… *the ICRP framework, …*' to break this sentence up. Also, it would be useful if a more general statement briefly commenting on what draft ICRP (2007b) is, etc. were included to ease the reader into this section.	Amended as suggested
2.2	22/101	2	The first sentence of Paragraph 2 mentions ICRP's objective to develop an approach [for ionizing radiation] that is compatible with those applied for '*other stressors*'. Does this mean physical, chemical or radiological stressors? Also, it is suggested that the focus of the ICRP on ionizing radiation be added to the sentence prior to the mention of other stressors (as shown in blue in the sentence above).	A more direct quote from the draft ICRP report is now given (although we recognise that this may not directly answer the comment). Given the amendments made in response to the comment above it should now be evident to the reader that the ICRP approach is for ionising radiation.
2.2	22/101	2	In the 2nd last sentence of Paragraph 2, it is noted that *although the tools under development for environmental*	The draft ICRP report considers only the concept and use of RAPs. The report notes that further reports will expand

			protection employ the use of a multi-tiered approach, this is clearly not the structural format of the ICRP approach. It might be worthwhile to also mention that the ICRP is focused on protection of humans at the individual level, whereas in most cases, environmental protection is undertaken at the level of the population. Therefore, in the case of environmental protection, application of a multi-tiered approach (with the potential for screening) is practicable and extremely useful/desirable, and should be considered by ICRP in their guidance.	upon this, including application of their approach to different exposure scenarios. Given this, we do not feel we can comment any further. We will, however, draw the attention of ICRP C5 to comments received which relate to their draft RAP report.
2.2	22/101	3	Paragraph 3 states that ICRP Reference Animals and Plants (RAPs) are not meant to represent an exhaustive list, but are meant to serve as 'points of reference' for the protection of other species. It might be noted that it is somewhat unclear how one could bridge the gap between protection of RAPs and other species. How can RAPs versus ROs be used to ensure the protection of resident biota at a given site?	The point was made in the Appendix. A number of comments on the draft ICRP report from the Appendix, including this one, have now been included at the end of section 2.2
2.2	22/101	4	Paragraph 4 states that ICRP RAPs have been developed to the level of Family (or 'Super Family') because no internationally-accepted rules on classification above Family (or Super Family) exist. Although useful for consistency of naming/taxonomic identification, it is unclear whether this is a strong enough criterion and it might be worthwhile to include a bit more information on the other criteria considered in selecting the RAPs (e.g., to represent a range of dosimetric geometries, exposure pathways and radiosensitivities). It is later noted in the paragraph that Reference Organism categories, as defined in other approaches (such as ERICA and EA R&D128) are broader. It is likely more practicable to allow for broader categories, since it would allow for greater flexibility. It might be useful to provide some discussion about how RAPs and ROs could be applied as references on a site-specific basis, which is often required when possible issues	To our knowledge the selection of the RAPs was not based on the criteria listed in the comment (as recognised in your comment below on the last sentence of this paragraph). See response to the previous comment.

			arise. OK, but the first sentence stating that 'ICRP RAPs have been developed to the level of Family (or 'Super Family') because no internationally-accepted rules on classification above Family (or Super Family) exist' was taken from PROTECT D4. The authors may wish to clarify (?). In addition, it would be useful if you could clarify if ICRP and the EU are taking the same approach on dosimetry, and if not, which assumptions are the same and different? On a similar note, what are the overall similarities and differences of the RAPs and ROs? Also, what would be the advantages and disadvantages of using RAPs versus ROs and how can each be applied when doing a risk assessment for specific organisms on a site? Later in the Paragraph (in the last sentence), it is stated that RAPs are not meant as 'sentinel organisms', to represent key links in the food chain or ecosystem function. Such assumptions likely limit the applicability of RAPs, since these concepts are integral to environmental protection. Therefore, it is unclear why such species would not be included.	The final report version notes the difference in selection of ICRP RAPs and (e.g. ERICA) reference organisms. Whilst ERICA was an EC funded project there is no 'EU approach'. The ICRP draft report states that it has used the same underlying methodology as that used by the ERICA Tool to derive DCC values. The terrestrial scenario presented in the Appendix allows a comparison of dose rates estimated for a number of radionuclides using the DCC presented in the ICRP draft report with those estimate for the same geometries using the ERICA Tool – most values are similar. The comparison is now noted in the main text report and discussed in the Appendix.
3.2.3 (and elsewhere)	43/101 (and elsewhere)	1st Bullet in 2nd bulleted list	Should 'Handford Bear Creek' be changed to 'Hanford Bear Creek'? This should be checked throughout the document (as well as in draft PROTECT Deliverable 5b).	Corrected in both deliverables.
3.2.3	43/101 – 48/101	Section	On reviewing PROTECT draft Deliverable 4, "Evaluation of the practicability of different approaches for protecting the environment from ionising radiation in a regulatory context and their relative merits", we found a case study based on the Pickering nuclear power plant (Section 3.2.3, pages 43/101 to 48/101).	

			Although the text states that these are screening level calculations and that they are being used (only?) for the purposes of comparing 3 assessment tools, we are somewhat concerned that the results show some RQ's for Pickering to be much higher than 1, when our own conservative screening assessment resulted in lower values. We would appreciate if a statement could be added that *these results do not necessarily reflect actual potential risk at the case study sites, as the data sets were used for illustrative purposes only, and detailed knowledge of the sites was not applied.* This would provide context for any members of the public living near the Pickering site who may read this report. One reason for the difference is the choice of a screening benchmark of 10 µGy/h, a factor of 4 to 10 times lower than values used in Canada for benthic invertebrates and terrestrial mammals, respectively. However, from what we can determine of the way in which our data were used, the concentrations of tritium in groundwater may have been used improperly. The elevated groundwater tritium levels that were found were never accessible to terrestrial mammals or even to earthworms (locations were not compatible with earthworm habitat, i.e. depth and/or under asphalt/gravel) and did not likely influence tritium in air concentrations (depth and nearby discharge channel to the lake which is a sink for groundwater in the area). Hence, it is puzzling as to how the model came up with such a high exposure level for terrestrial animals.	The final paragraph of this section now incorporates this text and reads: *Note, whilst the case study applications presented here use available data from actual sites they are conducted for comparative purposes only and should not be interpreted as 'complete' screening tier assessments. Some of the available data for radionuclides not considered within EA R&D128 were not used and input data have been derived solely from the SENES (2007) report without reference to original sources. Furthermore, the results do not necessarily reflect actual potential risk at the case study sites, as the data sets were used for illustrative purposes only, and detailed knowledge of the sites was not applied; the SENES report outlines the outcomes of more refined assessments where initial conservative assessments identified that this was required.* A footnote now draws the reader's attention to the fact that the various assessments as discussed in the SENES report used different methodologies and benchmark dose rates. Whilst the groundwater H-3 concentrations were used they only contributed 10 % to the H-3 RQ value – soil H-3 dominating the RQ estimate [now more clearly stated in text]. Reference to the SENES report and Garisto et al. 2005 (see reference details below) shows that the initial conservative assessment for this site did estimate an RQ >1 as a consequence of H-3 activity concentrations.

			In any case, it appears that the use of data without additional knowledge of its origin and of the site, and the application of a tool without ensuring that it is using data appropriately, may lead to erroneous results. It would have been useful for the authors to have consulted the site operator for more information before using these data. At some point in the future, it would be useful to discuss the assumptions that were made and how these led to the total dose estimates, as well as the isotope-specific estimates in more detail (as a follow-up to this work). We also note that draft Deliverable 5, "Numerical benchmarks for protecting biota against radiation in the environment: proposed levels and underlying reasoning", also contains dose rates to biota at the Pickering site (pages 42/63 and 43/63). The screening level doses that exceed the proposed benchmarks are for different receptors than those identified in Deliverable 4 as exceeding benchmarks, and the maximum RQ's (based on a generic 10 mGy/h benchmark) would also be different. This appears to be an inconsistency between the 2 reports, and another possible source of confusion to residents near the Pickering site. Thank you for your disposition. Overall, for the purposes of this document, the clarifications added to PROTECT D4	Responses to these comments were discussed with the site operator. We will be happy to discuss/investigate the results further Deliverable 5 uses the ERICA Tool only (to compare different potential screening values) whereas D4 compares three models. The ERICA Tool results for the Pickering terrestrial assessment are similar to those presented in Deliverable 4 although differ slightly as in Deliverable 5 we had to use Tier 2 (to estimate total dose rates) of the Tool whereas Tier 1 was used in Deliverable 4. Deliverable 4 now makes reference to the Tier 2 predictions in Deliverable 5 (and *vice-versa*). Garisto, N.C., S.L. Fernandes, M. Monabbati, D. Brown and F. Bajurny. 2005. Screening "No-Effect Concentrations" for Radionuclides in the Abiotic Environment from a Generic Ecological Risk Perspective: Derivation and Application for the Pickering Nuclear Site. Proceeding from the 2nd International Conference on Radioactivity in the Environment. 2-6 October 2005. Nice, France.

			specifying that this is a screening level assessment cover the concerns raised. However, at some point in the future, it would be nice to take another look at the Tier 1 versus Tier 2 assessments that were done as part of PROTECT D4 versus D5 reports and their underlying assumptions (e.g., with respect to exposure levels, occupancy times, etc.). In both cases, some exceedances occurred and it would, therefore, be useful to know how 'realistic' the Tier 2 estimates were as presented in PROTECT D5 and how 'conservative' the Tier 1 assumptions were. For example, the Tier 2 ERICA results appear to be higher at Pickering than the Tier 1 results, which may be a problem conceptually (since Tier 1 assessments are designed to be highly conservative for use in screening and therefore, additional issues would not be expected to occur at the Tier 2). That said, although it would be interesting to explore the technical reasons for differences mentioned above (which, as noted earlier, is something that we should plan to do), it is not necessary to resolve them now, and we are quite satisfied with the additional text added which will put the Pickering results here in context.	It should be noted that Tier 2 of the ERICA Tool was used in D5 to consider the influence of different screening values on an assessment (which could not be done using Tier 1). However, Tier 2 was used to provide conservative screening level outputs – maximal media concentrations being input and 95th percentile outputs being presented. Therefore results in D5 were no more 'realistic' than those in D4 and as noted above they are broadly compatible. Prior to publication of a final version of D5 we will review to ensure that this is clear to readers.
			In short, I would like to commend the authors for providing a very comprehensive and detailed overview. Our group will find the summaries of the models and other relevant information, such as where different models can be found etc., very useful in coming days.	
			I think that this is another useful report. Table 2.1 gives a good summary of the tools and models that are available for assessing radiological impacts on non-human biota. However, I agree with the authors that it largely comes down to use of EA R&D 128, the ERICA Tool and RESRAD-BIOTA. Of these, the EA R&D 128 model is the most primitive and is underpinned by the least well justified database of concentration ratios.	

			An important conclusion arising from the report is that the above three tools used in screening mode yield very different results, with screening ratios differing by several orders of magnitude and the limiting types of organism differing between the various models. This results from different assumptions and bases used in the various models. Overall, distinctions in dosimetry are of little significance, as all the models are based on average whole body doses to organisms of different sizes and highly stylised geometries (typically ellipsoids). Virtually no consideration is given to differences in bioaccumulation and hence dose between organs and tissues. Distinctions in location are of some significance, as are some methodological assumptions (e.g. use of a single organism geometry versus use of a large organism for internal exposure and a small organism for external exposure, which is a dose maximising assumption). However, the big difference between the models is the selection of bioaccumulation factors. Many of the values in EA R&D 128 seem to be arbitrary, e.g. whole-body activity concentrations in sea mammals and birds were mainly derived using CR values for phyto- and zoo-plankton. This is scientific nonsense. The ERICA approach is much more structured (see page 33), but there are still deficiencies in the database. The database is described as being based on literature reviews that were extensive 'relative to the two other approaches considered', i.e. EA R&D 128 and RESRAD-BIOTA. Overall, the report indicates that the ERICA Tool is the preferred screening model at the present time, but that significant improvements could be made to enhance its flexibility and, more particularly, to strengthen the database. ..... development of a *(IAEA)* TECDOC on concentration ratios for biota for use in this context to complement that	Regarding values in R&D128: A full set of CR values were needed to allow the required assessments to be completed. This meant making what were assumed to be (highly) conservative assumptions where there were data gaps. As the purpose of these derived CRs was for screening to identify sites and organisms that were potentially at risk then this approach was pragmatic and has been taken forward in a more refined manner within the ERICA Tool. Both the R&D128 documentation and the ERICA Tool (and associated documentation) clearly identify such derived CR values. However, we are aware that there is potential misuse of such values (i.e. users not acknowledging their limitations). The developers of the R&D128 approach (England & Wales Environment Agency) state that: *There was an action on the assessors that if any of these derived CRs were causing the assessment to exceed the screening level then further work (including the taking of*

			being developed for food-chain pathways of exposure to humans (replacement of TRS 364). I think that there is merit in supporting this, to ensure that the ERICA database is enhanced and made appropriately defensible for the key radionuclides of interest in solid radioactive waste disposal, e.g. Cl-36, I-129, Tc-99 and Se-79.	*appropriate measurements) would be required.*