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Radiation Recovery Record Form User guide

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Abstract

This user guide provides information on the Radiation Recovery Record Form (RRF). This tool, developed to complement the existing UK Recovery Handbooks for Radiation Incidents, covers the 3 environments of food production systems, inhabited areas and drinking water supplies. The form records the decisions made to offer a clear, auditable record of the decision process. This guide gives comprehensive instructions on using the RRF, together with a set of worked examples.

1 Introduction

The UK Recovery Handbooks for Radiation Incidents have been developed, in conjunction with a wide range of expert stakeholders, to assist in the management of contaminated food production systems, inhabited areas and drinking water supplies following a radiation incident. The 3 parts of the handbooks (Food Productions Systems Handbook, referred to in this guide as ‘the Food Handbook’ for brevity; Inhabited Areas Handbook; Drinking Water Supplies Handbook, referred to as ‘the Drinking Water Handbook’) are user-friendly guidance documents, specifically designed to aid the decision-making process for developing and implementing a recovery strategy in the aftermath of a radiation incident. They are aimed at national and local authorities, central government departments and agencies, radiation and health protection experts, emergency services, industry and others who may be involved in the recovery from a radiation incident. Included in the handbooks are decision-aiding frameworks for each environment with decision trees and look-up tables to be used as part of the decision-aiding process to develop a recovery strategy following an incident.

The latest version of the handbooks (Version 4) (Nisbet and others, 2015) (7) was released in June 2015. In conjunction with this an interactive tool, the Radiation Recovery Record Form (RRF), was developed to record decisions made by the user in order to provide a clear, auditable record of the decision-making process. The RRF is intended to be used in conjunction with the handbooks, but not to replace them.

This guide describes the RRF (Section 2) for each of the 3 environments: food production systems, inhabited areas and drinking water supplies. Section 3 then works through an example for each environment.

This report from the PHE Centre for Radiation, Chemical and Environmental Hazards reflects understanding and evaluation of the current scientific evidence as presented and referenced in this document. This work was undertaken under the Radiation Assessments Department's Quality Management System, which has been approved by Lloyd's Register to the Quality Management Standard ISO 9001:2015, Approval No: ISO 9001 – 00002655.

2 Radiation Recovery Record Form (RRF)

2.1 Information about the Radiation Recovery Record Form

The Radiation Recovery Record Form (RRF) is a Microsoft Excel spreadsheet to allow the user to record decisions made at each stage of the decision-making process. This allows a clear record to be made of how the process was followed; where and why recovery management options were eliminated; what issues were noted that may influence the final choice of management options; and, where appropriate, for supporting information to be included in the record. This should provide a transparent audit trail allowing decisions to be reviewed in the future.

It must be noted that the radiation RRF was developed in Microsoft Excel 2010, and some functionality may not work in different versions of Excel. In particular, there may be problems with adding pages for additional drinking water supplies, resetting the display on drinking water pages ([Section 2.5](#)), and the use of links to specific pages of the RRF from Navigation Menu ([Section 2.2.2](#)) on the incident information page.

The RRF consists of 6 pages (or worksheet tabs) that are accessible to the user.

1. Status page – provides basic information about the RRF.
2. Incident information page – allows the user to record basic information about the incident, see [Section 2.2](#).
3. Food page – allows the user to record decisions related to recovery of food production systems, see [Section 2.3](#).
4. Inhabited areas page – allows the user to record decisions related to recovery of inhabited areas, see [Section 2.4](#).
5. Drinking water page – allows the user to record decisions related to recovery of drinking water supplies, see [Section 2.5](#).
6. Printing page – allows the user to print easily from the RRF, see [Section 2.6](#).

With a worksheet tab for each of the environments covered by the UK Recovery Handbooks for Radiation Incidents (Nisbet and others, 2015) (7) it is possible to use the same copy of the radiation RRF if multiple environments are affected by one incident. The food and inhabited areas pages are set up to function in the same way, although the management options used for recovery of food production systems are different to those used for inhabited areas. Both of these pages use the 8-step process described in the Food and Inhabited Areas Handbooks (Nisbet and Watson, 2015a, b) (5,6) . The drinking water page functions in a different way to the food and inhabited areas pages, following the decision tree shown in the Drinking Water Handbook (Brown and others, 2015) (1). This is because with the smaller number of

management options available for drinking water, the 8-step process used for the other environments is neither necessary nor particularly useful for drinking water supplies.

2.1.1 Protection of spreadsheet information and setting options

The functionality of the RRF uses macros to process the choices made by the user. Use of macros in Excel is often disabled for security reasons, however, unless permission is given by the user. Therefore, to allow the RRF to function correctly, it is important that the user chooses to allow the use of macros when opening the form by selecting 'Enable content' in the yellow bar that may appear at the top of the form on opening the RRF.

In order to prevent inadvertently overwriting parts of the spreadsheet forms, each page has been protected so that the user can only select and enter information in appropriate parts of the page.

Many parts of the RRF involve progressing down a column of the spreadsheet, considering each row in turn. The user may therefore find it beneficial to set Excel to move down after pressing enter. This can be done by selecting 'File – Options – Advanced' and selecting 'Down' as the direction in which to move the selection after pressing enter. Because of the protection settings applied to each page, preventing the selection of certain cells, as the user moves down the column in this way, any rows used as headers, or to separate parts of the form, will be skipped over automatically, helping the user navigate quickly through the form.

2.2 Incident information page (worksheet tab 'Incident_Information')

There are 2 parts to the incident information page, an incident information form and a navigation menu.

2.2.1 Incident information form

The left-hand side of the page (see [Figure 4.1](#)) provides a form for the user to record information related to the incident. Only those cells which are shaded pale grey are available for the user to enter information. Although it will be beneficial to have as much information in the record as possible, it is recognised that in some circumstances there may not be much information available. Therefore, all fields are optional, and the user can continue without providing any information if necessary.

The user is asked to provide:

1. Contact details – name, organisation, email address, role in the incident of the person completing the form, plus information about other agencies involved in the incident, and the date of completing the form.

2. Information about the incident – name, city or location, county, postcode, date contamination occurred, date contamination was reported, incident status (for example, still in emergency phase, in recovery phase or closed), and a reference number (if applicable).
3. Circumstances of the incident – a list of incident types is provided, and the user should indicate ‘yes’ or ‘no’ to each type. If applicable, the user may answer ‘yes’ to more than one type, for example, an overseas civil nuclear site accident. The list of incident types covers civil nuclear site accident, military nuclear site accident, radiopharmaceutical (or other non-nuclear site) accident, transport accident (civil), transport accident (military), radiological terrorism, nuclear terrorism, overseas accident and ‘other’. If ‘other’ is chosen, the user should specify the type of incident in the space provided. There are also spaces for the user to specify the source of information about the accident, and any additional relevant information.

In addition, the user may add hyperlinks to the form, to provide links to related files that are relevant to the incident. This is done by scrolling to the bottom of the form and clicking on the ‘Add hyperlink’ button. Added hyperlinks are listed at the bottom of the form. The user can remove all added hyperlinks from the form by using the ‘Remove all hyperlinks’ button, but individual hyperlinks cannot be removed.

2.2.2 Navigation menu

The right-hand side of the page provides a navigation menu containing links to the 3 parts of the UK Recovery Handbooks for Radiation Incidents, and also to the food, inhabited areas and drinking water forms held on other pages of the spreadsheet (see [Figure 4.2](#)).

2.3 Food page (worksheet tab ‘Food’)

When first opened, the food page should appear blank, as shown in [Figure 4.3](#). To view a list of the food production systems that may be affected (cereals and grassland; fruit and vegetables; milk; meat; eggs; honey; freshwater and marine fish; domestic and wild foods and game) the user should click on the ‘Show/hide food systems’ button. Similarly, to see a list of radionuclides that may be involved, the user should click on the ‘Show/hide radionuclides’ button. Initially none of the food systems or radionuclides will be selected, as shown in [Figure 4.4](#).

The user can indicate any systems that have been contaminated by clicking on the green buttons next to the list of production systems – this corresponds to step 1 of the 8-step process. More than one system can be selected. Once a food production system has been selected, the display in the right hand column, headed ‘Contaminated?’ should change from ‘No’ to ‘Yes’ (see [Figure 4.5](#)) and that cell becomes green to make it clear which systems have been selected.

The user can also click on the green radionuclide buttons to indicate which radionuclides are involved. Once a radionuclide has been selected, the display for that radionuclide should change from 'No' to 'Yes' (see [Figure 4.5](#)) and that cell should become red to make it clear which radionuclides have been selected. The more relevant radionuclides, as featured in the handbook, are listed, and these are used to help eliminate options at step 3. If another radionuclide is involved, not listed on screen, the user will have to answer the step 3 question independently using the information in the Food Handbook as a guide for the properties to be considered.

When the user has selected the food production system(s) and radionuclide(s), these parts of the form can be hidden from view, using the 'Show/hide food systems' and 'Show/hide radionuclides' buttons. If the user wants to access these sections later, clicking the buttons will open them up again.

For each food production system that has been selected, possible recovery management options are listed. Management options are divided into sections: pre-deposition options; general applicability options; options specific to the management system; and waste disposal options. It may be necessary to scroll down the page to see all management options listed, especially if more than one food production system has been selected. The user should work through steps 2 to 8 for each selected food production system in turn, consulting the handbook and relevant experts as necessary.

Each of steps 2 to 7 asks if the management option is to be eliminated, with some questions (steps 2, 3, 5 and 7) requiring a simple 'yes' or 'no' answer, and others (steps 4 and 6) having more options available. At each step, the question given in the column header should be answered, using the drop down lists provided (see the example given in [Figure 4.6](#)), or where a 'yes' or 'no' answer is required the user may prefer to simply type 'Y' or 'N' (in upper or lower case) into the cell. The column headers for steps 3 to 7 contain a comment (indicated by a small red triangle; to read the comment, the mouse should be hovered over the cell) indicating where information can be found to help answer the question. [Table 2.1](#) also gives a summary of information about the questions, sources of information to help answer the questions, and the permitted answers and their outcomes, for each of steps 2 to 7. It should be noted that for steps 2 to 6, leaving an answer blank is equivalent to choosing not to eliminate a management option, keeping the option in the list for further consideration. However, at option 7, an answer should be given for every remaining option; this acts as confirmation that the option has been considered throughout all the steps. Once a question has been completed for each management option, the user should click on the filter button (see [Section 2.3.1](#)) at the bottom of the column before progressing to the next step.

2.3.1 Using the filter buttons

At each step, when the question has been answered for each management option in the list, the user should click on the green 'Filter options on step X' button at the bottom of the list of available options. Each step should be completed for all options before scrolling right across the

screen to the next step. Because there are a lot of steps to perform while processing the information entered in the form, it is not unusual for the display to appear to flicker for several seconds as updates are made.

2.3.1.1 Elimination of management options using the filter button

Having completed a step and filtered the management options based on the responses given, any management options that were chosen for elimination are removed from the list of available options by 'greying out' the rest of the row. There is then no need to answer questions for that option at subsequent steps. When a management option is eliminated the cell immediately to the right of that step becomes green and a prompt is given to the user to provide some information about why the option was eliminated. If the user does not add any information here, the subsequent steps in the process can still be followed. However, the user is encouraged to enter some information as this makes a more complete record, which will be of greater use. The user need not provide a detailed explanation and may choose to simply add a brief note based on known information. For example, the incineration option is not applicable for some radionuclides, with the Food Handbook giving the explanation 'Not recommended as boiling temperature is below temperature of option. 'Volatilisation may occur'; however, the user may choose simply to record 'Volatilisation may occur' in the RRF.

In the example shown in [Figure 4.7](#), management options 17, 32 and 36 have already been eliminated at previous steps so there is no need to answer the question at step 5 for these options. It has then been decided to eliminate option 18 at step 5, the next cell has been shaded green and a prompt given to the user to provide more detail about the reason for elimination. From this point the rest of the row for option 18 has also been greyed out to show the option is eliminated.

2.3.1.2 Automated elimination of management options at step 3

When the 'Filter options on step 2' button is pressed, as well as eliminating any options selected by the user for elimination at step 2, the RRF considers if any management options can be automatically eliminated at step 3, based on any radionuclides selected by the user. The applicability of each relevant management option to the selected radionuclides is checked. If all selected radionuclides have some form of restriction for a management option, then that option is automatically eliminated at step 3. If more than one radionuclide has been selected, and there are restrictions for some, but not all, of these radionuclides, the option is not eliminated but a note is made to check restrictions for the relevant radionuclides. If no radionuclides have been selected, then no automatic entries are made at step 3. In the example given in [Figure 4.8](#), showing the entries automatically made for step 3, the user had indicated that the incident involved ^{137}Cs and ^{131}I . Two management options, 17 and 36, had restrictions recorded for both of these radionuclides. These options have therefore been automatically eliminated at step 3. Some other options have restrictions for ^{131}I only. These have not been eliminated, but the user is prompted to check the restrictions. The user should review any automatic eliminations and check other restrictions where indicated. Adjustments may be required at step 3, in which case

the user should press the ‘Filter at step 3’ button to implement those changes. Where prompted, the user should add relevant details about restrictions, whether or not an option is eliminated.

2.3.1.3 Retaining an option while noting potential issues or constraints

At steps 4 and 6, it is possible to choose to continue to consider a management option, while noting that there is an issue that will influence the ultimate choice of recovery strategy. In these cases, the same green colour is used, together with prompts for the user to provide further information. In the example shown in [Figure 4.9](#), management option 36 has already been eliminated, while option 33 is eliminated at step 4 due to a major constraint, and several other options are still considered, despite major constraints. As well as being asked for further details about the constraints for option 33, the user is prompted to provide further information where constraints exist, but the option is not eliminated.

2.3.2 Combining management options

Once steps 2 to 7 have been completed, step 8 is to select and combine management options that should be considered as part of the strategy. In the step 8 column of the spreadsheet page, the remaining options (ie those that have not been eliminated) are listed, together with any relevant comments entered by the user. Options with no restrictions noted at steps 4 or 6 are displayed in bold; any management options that were not eliminated, but had constraints (step 4) or wastes and incremental doses (step 6) are marked in pink (see [Figure 4.10](#)) to indicate that there may be issues to be overcome with this option. This ‘short list’, which can be printed without the full information given in steps 2 to 7 (see [Section 2.6.3](#)), should help with determining the final strategy.

2.3.3 Clearing the form, or selecting another food type

At any point the answers recorded within a food production system can be cleared by using the ‘Clear answers’ button at the bottom of the list of available management options. The user is always asked to confirm before answers are cleared. It is possible for the user to save the RRF prior to clearing information in this way in order to retain information and then save updated information as a separate file. If required, the user can work through the 8-step process for another food production system, scrolling to the relevant part of the page for the system selected.

Table 2.1 Steps 2 to 7 in the RRF for food production systems			
Step	Question	Sources of information*	Possible answers and outcomes
2	Is the management option eliminated on basis of	No specific information is required at this step. Only those management options which can easily	Y – indicates that the management option is to be eliminated; justification for

Table 2.1 Steps 2 to 7 in the RRF for food production systems			
Step	Question	Sources of information*	Possible answers and outcomes
	common sense (not expert knowledge)?	be eliminated without expert knowledge should be eliminated	elimination should be provided N – indicates to keep the option for further consideration
3	Is the management option eliminated as inappropriate for radionuclide(s) considered?	If one or more radionuclide(s) are selected this step is automatically filled in when the ‘filter on step 2’ button is pressed. Options are eliminated if there is a restriction for every selected radionuclide. If only some selected radionuclides have restrictions, the user is prompted to check these. Further information is given in Tables 5.10 and 5.11 in the Food Handbook	Y – indicates that the management option is to be eliminated; justification for elimination should be provided N – indicates to keep the option for further consideration
4	Is the management option eliminated because of major constraints (wastes, technical, costs, time, social) in this scenario?	Tables 5.12 and 5.13 in the Food Handbook Note that constraints should be related to the specific circumstances being considered; The handbooks may indicate a constraint, but in the circumstances being considered the constraint may not be applicable	No major constraints – indicates to keep the option for further consideration Eliminate option due to major constraint - indicates that the management option is to be eliminated; justification for elimination should be provided Major constraint, but continue to consider

Table 2.1 Steps 2 to 7 in the RRF for food production systems			
Step	Question	Sources of information*	Possible answers and outcomes
			option – indicates to keep the option for further consideration, while noting that there may be a major constraint; further information about the constraint should be provided
5	Is the management option eliminated because of effectiveness?	Table 5.14 in the Food Handbook Note that effectiveness is not applicable to waste disposal options	Y – indicates that the management option is to be eliminated; justification for elimination should be provided
			N – indicates to keep the option for further consideration
6	Is the management option eliminated because of wastes or incremental doses?	Tables 5.15 and 5.16 in the Food Handbook	No wastes or incremental doses – indicates to keep the option for further consideration
			Wastes or incremental doses, but continue to consider option – indicates to keep the option for further consideration, while noting that there may be an issue with wastes and/or incremental doses; further information about wastes or doses should be provided
			Eliminate due to wastes or incremental doses –

Table 2.1 Steps 2 to 7 in the RRF for food production systems			
Step	Question	Sources of information*	Possible answers and outcomes
			indicates that the management option is to be eliminated; justification for elimination should be provided
7	Is the management option eliminated by any information in the datasheet?	Datasheets in section 7 of the Food Handbook	Y – indicates that the management option is to be eliminated; justification for elimination should be provided
			N – indicates to keep the option for further consideration
* Additionally, advice from expert organisations (For example, Food Standards Agency, Public Health England, Environment Agency or Department for Environment, Food and Rural Affairs (Defra)) may be sought if required.			

2.4 Inhabited areas page

When first opened, the inhabited areas page should appear blank, as shown in [Figure 4.11](#). To view a list of the surface types that may be affected (external building surfaces; internal building surfaces; semi-enclosed surfaces; roads and paved areas; vehicles; and soils and vegetation) the user should click on the 'Show/hide surfaces' button. Similarly, to see a list of radionuclides that may be involved, the user should click on the 'Show/hide radionuclides' button. Initially none of the surface types or radionuclides will be selected, as shown in [Figure 4.12](#).

The user can indicate any surfaces that have been contaminated by clicking on the purple buttons next to the list of surface types – this corresponds to step 1 of the 8-step process. More than one surface type can be selected. Once a surface type has been selected, the display in the right hand column, headed 'Contaminated?' should change from 'No' to 'Yes' (see [Figure 4.13](#)) and that cell should become purple to make it clear which surfaces have been selected.

The user can also click on the purple radionuclide buttons to indicate which radionuclides are involved. Once a radionuclide has been selected, the display for that radionuclide should change from 'No' to 'Yes' (see [Figure 4.13](#)) and that cell should become red to make it clear which radionuclides have been selected. The more relevant radionuclides, as featured in the Inhabited Areas Handbook, are listed and these are used to help eliminate options at step 3. If another radionuclide is involved, not listed on screen, the user will have to answer the step 3 question independently using the information in the Inhabited Areas Handbook as a guide for the properties to be considered.

When the user has selected the surface(s) and radionuclide(s), these parts of the form can be hidden from view, using the 'Show/Hide Surfaces' and 'Show/Hide Radionuclides' buttons. If the user wants to access these sections later, clicking the buttons again will open them up again.

For each surface type that has been selected, possible recovery management options are listed. Management options are divided into restrict access options and remediation options. It may be necessary to scroll down the page to see all management options listed, especially if more than one surface type has been selected. The user should work through steps 2 to 8 for each selected surface type in turn, consulting the Inhabited Areas Handbook and relevant experts if necessary.

Each of steps 2 to 7 asks if the management option is to be eliminated, with some questions (steps 2, 3, 5 and 7) requiring a simple 'yes' or 'no' answer, and others (steps 4 and 6) having more options available. At each step, the question given in the column header should be answered, using the drop down lists provided (see [Figure 4.14](#)), or where a 'yes' or 'no' answer is required the user may prefer to type 'Y' or 'N' (in upper or lower case) in the cell. The column headers for steps 3 to 7 contain a comment (indicated by a small red triangle; to read the comment, the mouse should be hovered over the cell) indicating where information can be found to help answer the question. [Table 2.2](#) also gives a summary of information about the questions, sources of information to help answer the question, and the permitted answers and their outcomes, for each of steps 2 to 7. It should be noted that for steps 2 to 6, leaving an answer blank is equivalent to choosing not to eliminate a management option, keeping the option in the list for further consideration. However, at option 7, an answer should be given for every remaining option; this acts as confirmation that the option has been considered throughout all the steps. Once a question has been completed for each management option, the user should click on the filter button (see [Section 2.4.1](#)) at the bottom of the column before progressing to the next step.

2.4.1 Using the filter buttons

At each step, when the question has been answered for each management option in the list, the user should click on the purple 'Filter options on step X' button at the bottom of the list of available options. Each step should be completed for all options before scrolling right across the screen to the next step. Because there are a lot of steps to perform while processing the

information entered in the form, it is not unusual for the display to appear to flicker for several seconds as updates are made.

2.4.1.1 Elimination of management options using the filter button

Having completed a step and filtered the management options based on the responses given, any management options that were chosen for elimination are removed from the list of available options by 'greying out' the rest of the row. There is then no need to answer questions for that option at subsequent steps. When a management option is eliminated the cell immediately to the right of that step becomes purple to act as a reminder that the user should give some information about why the option was eliminated. If the user does not add any information here, the subsequent steps in the process can still be followed. However, the user is encouraged to enter some information as this makes a more complete record, which will be of greater use. The user need not provide a detailed explanation and may choose simply to add a brief note based on known information. For example, the manual and mechanical digging option has several major constraints listed in the Inhabited Areas Handbook; however, the user may choose simply to record 'Only on a small scale' in the RRF.

In the example shown in [Figure 4.15](#), management options 1, 3, 4, 6, 7, 14, 18 and 23 have already been eliminated at previous steps so there is no need to answer the question at step 5 for these options. It has then been decided to eliminate options 10 and 27 at step 5, and the next cells have been shaded purple and prompts are given to the user to provide more details about the reasons for elimination. From this point the rest of the rows for options 10 and 27 have also been greyed out to show the options are eliminated.

2.4.1.2 Automated elimination of management options at step 3

When the 'Filter options on step 2' button is pressed, as well as eliminating any options selected by the user for elimination at step 2, the RRF considers if any management options can be automatically eliminated at step 3, based on any radionuclides selected by the user. The applicability of each relevant management option to the selected radionuclides is checked. If all selected radionuclides have some form of restriction for a management option, then that option is automatically eliminated at step 3. If more than one radionuclide has been selected, and there are restrictions for some, but not all, of these radionuclides, the option is not eliminated but a note is made to check restrictions for the relevant radionuclides. If no radionuclides have been selected, then no automatic entries are made at step 3. In the example given in [Figure 4.16](#), showing the entries automatically made for step 3, the user has indicated that the incident involved ^{137}Cs and $^{99}\text{Mo}/^{99\text{m}}\text{Tc}$. Options 1, 3, 4, 14 and 18 had already been eliminated at step 2, so are greyed out with no need to provide answers for these at step 3. Of the remaining options, only option 23 had restrictions recorded for both of these radionuclides and has automatically been eliminated at step 3. Some other options have restrictions for $^{99}\text{Mo}/^{99\text{m}}\text{Tc}$ only. These have not been eliminated, but the user is prompted to check the restrictions. The user should review any automatic eliminations and check other restrictions where indicated. Adjustments may be required at step 3, in which case the user should press the 'Filter options on step 3' button to

implement those changes. Where prompted, the user should add relevant detail about restrictions, whether or not an option is eliminated.

2.4.1.3 Retaining an option while noting potential issues or constraints

At steps 4 and 6, it is possible to choose to continue to consider a management option, while noting that there is an issue that will influence the ultimate choice of recovery strategy. In these cases, the same purple colour is used to prompt the user to provide further information. In the example shown in [Figure 4.17](#), management options 1, 3, 4, 6, 14, 18 and 23 have already been eliminated, while option 7 is eliminated at step 4 due to a major constraint, and several other options are still considered, despite major constraints. As well as being asked for further details about the constraints for option 7, the user is prompted to provide further information where constraints exist, but the option is not eliminated.

2.4.2 Combining management options

Once steps 2 to 7 have been completed, step 8 is to select and combine management options that should be considered as part of the strategy. In the step 8 column of the spreadsheet page, the remaining options (ie those that have not been eliminated) are listed, together with any relevant comments entered by the user. Options with no restrictions noted at steps 4 or 6 are displayed in bold; any management options that were not eliminated, but had constraints (step 4) or wastes and incremental doses (step 6) are marked in pink (see [Figure 4.18](#)) to indicate that there may be issues to be overcome with this option. This 'short list', which can be printed without the full information given in steps 2 to 7 (see [Section 2.6.5](#)), should help with determining the final strategy.

2.4.3 Clearing the form, or selecting another surface type

At any point the answers recorded for a surface type can be cleared by using the 'Clear answers' button at the bottom of the list of available management options. The user is always asked to confirm before the answers are cleared. It is possible for the user to save the RRF prior to clearing information in this way in order to retain information and then save updated information as a separate file. If required, the user can work through the 8-step process for another surface type, scrolling to the relevant part of the page for the surface selected.

Table 2.2 Steps 2 to 7 in the RRF for inhabited areas			
Step	Question	Sources of information*	Possible answers and outcomes
2	Is the management option eliminated on basis of common sense (not expert knowledge)?	No specific information is required at this step. Only those management options which can easily be eliminated without expert knowledge should be eliminated	Y – indicates that the management option is to be eliminated; justification for elimination should be provided
			N – indicates to keep the option for further consideration
3	Is the management option eliminated as inappropriate for radionuclide(s) considered?	If one or more radionuclide(s) are selected this step is automatically filled in when the 'filter on step 2' button is pressed. Options are eliminated if there is a restriction for every selected radionuclide. If only some selected radionuclides have restrictions, the user is prompted to check these. Further information is given in Tables 5.8 and 5.9 in the Inhabited Areas Handbook	Y – indicates that the management option is to be eliminated; justification for elimination should be provided
			N – indicates to keep the option for further consideration
4	Is the management option eliminated because of major constraints	Tables 5.10 and 5.11 in the Inhabited Areas Handbook	No major constraints – indicates to keep the option for further consideration

Table 2.2 Steps 2 to 7 in the RRF for inhabited areas			
Step	Question	Sources of information*	Possible answers and outcomes
	(wastes, technical, costs, time, social) in this scenario?	Note that constraints should be related to the specific circumstances being considered; The handbooks may indicate a constraint, but in the circumstances being considered the constraint may not be applicable	Eliminate option due to major constraint - indicates that the management option is to be eliminated; justification for elimination should be provided Major constraint, but continue to consider option – indicates to keep the option for further consideration, while noting that there may be a major constraint; further information about the constraint should be provided
5	Is the management option eliminated because of effectiveness?	Table 5.12 in the Inhabited Areas Handbook Note that effectiveness is not applicable to waste disposal options	Y – indicates that the management option is to be eliminated; justification for elimination should be provided N – indicates to keep the option for further consideration
6	Is the management option eliminated because of wastes or incremental doses?	Tables 5.13 in the Inhabited Areas Handbook	No wastes or incremental doses – indicates to keep the option for further consideration

Table 2.2 Steps 2 to 7 in the RRF for inhabited areas			
Step	Question	Sources of information*	Possible answers and outcomes
			<p>Wastes or incremental doses, but continue to consider option – indicates to keep the option for further consideration, while noting that there may be an issue with wastes and/or incremental doses; further information about wastes or doses should be provided</p>
			<p>Eliminate due to wastes or incremental doses – indicates that the management option is to be eliminated; justification for elimination should be provided</p>
7	Is the management option eliminated by any information in the datasheet?	Datasheets in section 7 of the Inhabited Areas Handbook	<p>Y – indicates that the management option is to be eliminated; justification for elimination should be provided</p>
			<p>N – indicates to keep the option for further consideration</p>
<p>* Additionally, advice from expert organisations (For example, Food Standards Agency, Public Health England, Environment Agency or Defra) may be sought if required.</p>			

2.5 Drinking water page

When first opened, the drinking water page should appear, as shown in [Figure 4.19](#). The drinking water page is divided into 4 sections, as follows.

1. Information about the supply (rows 1 to 4).
2. Questions to be answered by the user (rows 5 to 11).
3. Area for the user to provide additional information to be added to the record (rows 12 to 17).
4. Complete record of all answers, information, instructions and recommendations (rows 18 onwards).

2.5.1 Information about the supply

Before answering the questions asked in the decision tree in the handbook, the user should answer questions A and B at the top of the form, entering information in the pale blue cells to give the type of supply (public, or private, chosen from a drop down list) and the supply name. The supply name can be up to 25 characters long. Once this information is provided, the user should click on the 'Process information about drinking water supply/supplies' button, and the supply name will be appended to the page name, so, for example, 'DW1' may become 'DW1 Town mains supply'. The type of supply and name will also be added to the record produced.

2.5.1.1 Adding additional supplies

The drinking water page can only be used to consider one drinking water supply (or group of similar supplies). However, it is possible to add additional supplies up to a maximum of 9 supplies. When adding the first additional supply, this is done by clicking the 'add another supply (or group of supplies)' button which is found in the top right hand corner of the drinking water page DW1. The newly added page is then labelled DW2. As additional drinking water pages are added, the 'Add another supply (or group of supplies)' button on the previous page becomes disabled and appears grey to indicate this. Therefore, if further additional supplies are added, this must be done using the button on the highest numbered drinking water page. This is to ensure that additional pages are numbered correctly so that pages are labelled from DW1 up to DW9. As the supplies are named (see [Section 2.5.1](#)), the page names will be changed, but each will retain the DW n as the initial 3 characters of the page name; it is important that this is maintained.

2.5.2 Answering the questions from the decision tree

Once the supply type and name have been established, the RRF page considers the other questions included in the decision tree and asks them as questions 1 to 8. Questions 1 and 2 are answered by clicking on the 'Yes' and 'No' buttons. When an answer is given to either of these questions, the text on the button for the chosen answer turns red, to give the user a clear reminder of the option they selected. For the other questions (3 to 8) the user selects the required answer from a drop down box and then clicks the 'See recommendations' button underneath the question to process the answer supplied. As answers are given, information is displayed in a box in the middle of the screen (see [Figure 4.20](#) for an example) and also added to the record generated by the RRF. The user should always start with question 1 and should then answer questions as directed. If the user answers any question out of turn, they are either advised that this is not the question to be answered and redirected to the correct question or, if they go back to a previously answered question, a message is given warning that this will reset the form and they are given the option of proceeding or not. At any point the user can choose to reset the form and start again, by using the 'Reset' button. The user is always asked to confirm before a reset is carried out.

2.5.3 Adding additional information

In the middle of the drinking water page is an area, shaded pale blue, where the user can add any supporting information they wish to include in the record. For example, where a question asks about activity concentrations in drinking water, the user may wish to provide the activity concentration values, rather than simply answering the question to say whether the activity concentrations are above a given level. The user will be prompted at points to add information if required but can add information at any point in the process. To add information, the user should type in the area provided, then click on the 'Add user supplied info to record' button. After verifying that the user is happy to add the information, the text provided by the user is appended to the information held in the record, and the user supplied information area is cleared. The user can also clear this area at any time by clicking the 'Clear information box' button.

2.5.3.1 Adding hyperlinks to other documents

There may be useful information, for example, results of a water analysis, that the user wishes to record with the RRF. This can be done by clicking on the 'Add hyperlink' button found to the right of the user supplied information box. Clicking this button opens a window that allows to user to browse to the required file. After selecting the file, the user is asked to confirm if this should be included with the record. If the user selects 'Yes', a numbered hyperlink is added to the display at the end of the RRF, and a note is added within the record that the user has added a hyperlink, and the relevant hyperlink is referenced. All hyperlinks within the display are cleared if the user resets the form.

2.5.4 Complete record

As well as displaying information to the user after a question is answered, all output is added to the record of information shown at the bottom of the page. The user will need to scroll down the page to see the complete record. The main purpose of this record is to provide a complete record of progress through the decision tree, showing the path that was taken, the instructions and information provided to the user, as well as information provided by the user and the recommendations about which management options should be considered.

2.6 Printing

The 'Printing' page of the RRF provides a menu (see [Figure 4.21](#)) with 6 options that can be used to produce printouts of parts of the form, depending on the user's requirements. The user should click on the appropriate option(s) to print the desired part(s) of the RRF. See [Sections 2.6.1 to 2.6.6](#) for details of what is included in each type of printout. Printouts are sent to the default printer set for the computer being used, and settings are automatically adjusted to give the best display. The user does not see a print dialogue window but does see a notification message as printing occurs.

Printouts include following information in the headers and footers.

1. Incident name, as provided by the user on the incident information page, at the left of the header
2. Page name in the middle of the header
3. Date of printing at the right of the header
4. Path of the saved file in the footer

2.6.1 Printout of incident information

Selecting the incident information print option produces a single page report consisting of the incident record form part of the 'Incident_Information' page of the RRF.

2.6.2 Printout of all food production systems information

The full set of food production systems information is printed out over a number of pages. The first page of the printout shows which food production system(s) and radionuclide(s) have been selected by the user (see the example in [Figure 4.22](#)). This is followed by a set of printouts for each food production system selected. Each set consists of a printout for each of steps 2 to 7 (see [Figure 4.23](#) for an example printout for step 3).

2.6.3 Printout of summary information for food production systems

If only a printout of the final set of options available for selecting and combining at step 8 is required, the user should click on the 'Print food production systems summary' button. This prints a page showing the selected food production system(s) and radionuclide(s) (see the example in [Figure 4.22](#)), and then just step 8 listing the remaining options, together with any relevant comments on constraints or other issues, as supplied by user at each of steps 2 to 7. An example of such a printout is given in [Figure 4.24](#).

2.6.4 Printout of all inhabited areas information

The full set of inhabited areas information is printed out over a number of pages. The first page of the printout shows which surface(s) and radionuclide(s) have been selected by the user, following the same format as in the example of this shown for food production systems in [Figure 4.22](#). This is followed by a set of printouts for each surface selected. Each set consists of a printout for each of steps 2 to 7, in the same format as the example printout shown in [Figure 4.23](#), which shows a food production system printout for step 3.

2.6.5 Printout of summary information for inhabited areas

If only a printout of the final set of options available for selecting and combining at step 8 is required, the user should click on the 'Print inhabited areas summary' button. This prints a page showing the selected surface(s) and radionuclide(s), and then the step 8 information which lists the remaining options, together with any relevant comments on constraints or other issues, as supplied by the user at each of steps 2 to 7. The summary printout will follow the format of the examples from the food production systems, as given in [Figure 4.22](#) and [Figure 4.24](#).

2.6.6 Printout of drinking water supplies information

If there is more than one drinking water page (see [Section 2.5](#)) within the RRF, when the user clicks on the 'Print all drinking water information' button, they are asked which page they wish to print. Otherwise the page 'DW1' is selected for printing. [Figure 4.25](#) shows a list of the available drinking water pages presented to the user in order to select the page to be printed. The user is asked to enter the number of the required supply. Only the number should be entered, ie '1' not 'DW1'. If the user enters a number for which no page is found, a message is displayed to inform the user that there is no page with the name specified, and the user is asked to try again. Once the drinking water supply has been specified the printout consists of 2 parts. The first part (see [Figure 4.26](#)) shows the answers given by the user to the questions asked; the second part includes the full record of information, instructions and recommendations collated on the drinking water page.

3 Worked examples

The following worked examples have been based on examples in version 4 of the UK Recovery Handbooks for Radiation Incidents. It is important to note that the scenarios provided are only illustrative, and the examples are included to help show how the radiation recovery record form (RRF) can be used, not to propose solutions for the contamination scenarios described.

3.1 Food production systems

3.1.1 Scenario

The scenario is based on the accident that took place at the Windscale site on 10 October 1957, for which ¹³¹I was the major radionuclide present in ground deposits (Crick and Linsley, 1982) (2). Estimates of the quantity of ¹³¹I released ranged from 600 to 740 TBq. Restrictions on milk were based on activity concentrations of ¹³¹I of 3,700 Bq l⁻¹. These were the limiting levels developed at the time; they are well above the current maximum permitted level of 500 Bq l⁻¹. Using published deposition data (Crick and Linsley, 1982 (2); Loutit and others, 1960 (4); Wilkins and others, 2001 (8)) a deposition map was produced for the Windscale ¹³¹I scenario (Figure 3.1).

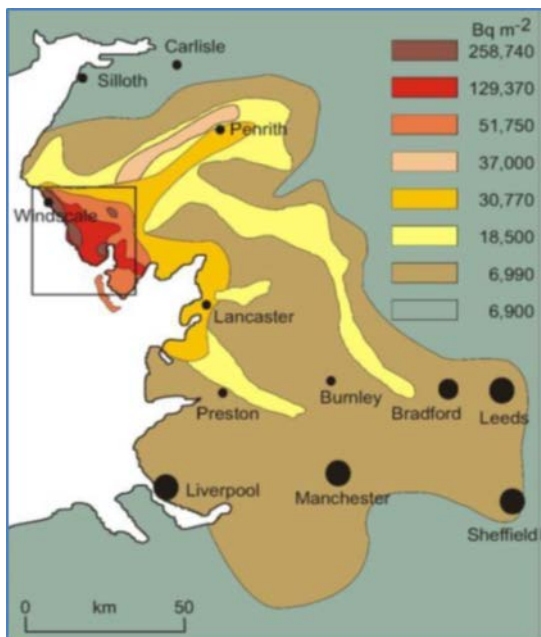


Figure 3.1 ¹³¹I deposition map for the Windscale scenario (Wilkins and others, 2001 (8)). Map showing part of north-west England showing levels of deposition (Bq m⁻²) of ¹³¹I following the accident at the Windscale site in 1957.

Some manipulation of the data was necessary to resolve the 6,990 Bq m⁻² deposition contour corresponding to an activity concentration in milk of 500 Bq l⁻¹. The duration of restrictions on milk within each deposition contour is presented in Table 3.1. The total quantity of contaminated milk produced was estimated using the duration of milk restrictions and agricultural production

data for the affected area (Table 3.1). The total quantity of contaminated milk produced in the Windscale scenario would be about 86 million litres, assuming that no management options were implemented to reduce ^{131}I transfer to milk.

It should be noted that in this example, although the scenario is based on the 1957 accident, it is assumed that there would be enough warning of a release to allow the pre-deposition options to be deployed.

Table 3.3 Estimated areas and duration of restrictions on milk within each deposition contour (taken from Wilkins and others, 2001 (8))				
Deposition level (Bq m ⁻²)	Area (ha)	Duration of restrictions (d)	Milk requiring disposal (l d ⁻¹)	Total milk requiring disposal (l)
6,990	6.80 10 ⁵	11	6.6 10 ⁶	7.2 10 ⁷
18,500	2.39 10 ⁵	14	2.48 10 ⁶	7.4 10 ⁶
30,770	8.65 10 ⁴	16	1.11 10 ⁶	2.24 10 ⁶
37,000	4.00 10 ⁴	17	5.9 10 ⁵	5.9 10 ⁵
51,750	3.90 10 ⁴	23	3.8 10 ⁵	3.8 10 ⁵
129,370	2.18 10 ⁴	26	1.7 10 ⁵	1.7 10 ⁵
258,740	1.13 10 ⁴	44	5.9 10 ⁴	5.9 10 ⁴
Total	1.12 10 ⁶	–	–	8.6 10 ⁷

3.1.2 Using the RRF while working through the scenario

Step 1: Identify contaminated food production system

From the scenario described, milk is the production system that has been affected and the radionuclide is ^{131}I . The user should therefore select milk and ^{131}I in the RRF (see Figure 4.27).

Step 2: List applicable management options for the food production system

The RRF lists the available management options (see Figure 4.28) and asks the user if any options are eliminated on the basis of common sense (not expert knowledge). There are 21 management options to consider in total. In this example no options are eliminated, so the answer 'N' has been given for each management option, before clicking the 'Filter milk options on step 2' button.

Step 3: Consider applicability of management options for radionuclide of concern

As described in Section 2.3.1.2, clicking the 'Filter milk options on step 2' button includes a check if any of the management options can automatically be eliminated at step 3, based on the

radionuclide(s) selected by the user. This uses the information from Tables 5.10 and 5.11 in the Food Handbook, which indicate where there are restrictions for certain radionuclides for some options. Where restrictions are found to apply, the user is prompted in the RRF to check the restrictions, and if a management option has restrictions for all selected radionuclides then it is automatically eliminated. [Figure 4.29](#) includes the display of those options where restrictions have been found and options eliminated, together with details of the restrictions. For example, Table 5.10 of the food production systems handbook states that option 16 is specific for caesium, and this information has been entered in column F for this option. Depending on the food type and radionuclide(s) chosen, several options may be eliminated at this stage. In this example of a milk production system contaminated with ^{131}I , a total of 11 management options are eliminated based on the applicability of the options to the radionuclide of concern. For the eliminated options, cells are greyed out at step 4 and beyond.

Step 4: Consider key constraints for each management option

Table 5.13 in the Food Handbook provides an overview of where major and moderate constraints exist for each option. For example, it is shown that option 20 (clean feeding) has a major technical constraint and moderate constraints associated with waste and costs. However, the indication of even a major constraint does not necessarily eliminate a management option from consideration, as shown in [Table 3.2](#). The RRF does allow for an option to continue to be considered even with possible major constraints. To make these types of judgements the user should consult Table 5.12 in the Food Handbook for more details about the nature of the constraints and also refer to the specific scenario being considered. In this scenario, it is suggested that options are eliminated or retained, as specified in [Table 3.2](#).

Table 3.2 Major constraints on the options			
Option	Major constraint indicated	Notes	Conclusion
1 Close air intake systems at food processing plant	Yes: time	Although in 1957 there may have been no advanced warning, for most foreseeable future accidents today some form of early notification of a possible release would be expected, making implementation of precautionary options more likely, especially at increasing distances from the site	No major constraint
4 Short-term sheltering of animals	Yes: technical and time	Although in 1957 there may have been no advanced warning, for most foreseeable future accidents today some form of early notification of a possible release would be expected, making implementation of precautionary	No major constraint

Table 3.2 Major constraints on the options			
		options more likely, especially at increasing distances from the site There are also unlikely to be any constraints such as availability of suitable housing and feeding as in October a farm should be adequately prepared for sheltering and feeding livestock over winter	
5 Natural attenuation (with monitoring)	Yes: technical and time	Natural attenuation with monitoring is unlikely to be feasible for intensive milk production due to the large volumes of milk produced daily that would exceed intervention levels	Eliminate
6 Product recall	Yes: waste	Where there is uncertainty that contaminated milk products may have entered the food chain before restrictions had been put in place, product recall is a possible option; this requires plans for subsequent management of waste foodstuffs	Record a constraint, but continue to consider this option at further steps
7 Restrict entry into the foodchain (inc FEPA orders)	Yes: waste	Restrictions on the entry of milk into the foodchain are based on FEPA food restriction orders imposed by the Food Standards Agency and will be legally binding, irrespective of any constraints	Record a constraint, but continue to consider this option at further steps
20 Clean feeding	Yes: technical	In this scenario, technical constraints such as availability of suitable housing and clean feeding of livestock are unlikely to exist as in October a farm should be adequately prepared for sheltering and feeding livestock over winter	No major constraints
32 Biological treatment (digestion) of milk	Yes: technical	Biological treatment facilities have very limited capacity for milk and would not be able to provide a major disposal route in this particular scenario. Furthermore, feedback from United Utilities in northwest England has suggested that it would not permit its waste water treatment works to be used for contaminated milk	Eliminate
35 Disposal of contaminated milk to sea	Yes: technical	Disposal of contaminated milk to sea through long sea outfalls may be possible (subject to authorisation by the Environment Agency) through the Sellafield site	Record a constraint, but continue to consider

Table 3.2 Major constraints on the options			
		as well as sewage treatment works along the north west coast of England	this option at further steps
38 Landspreading	Yes: technical	For milk held on the farm, landspreading of milk is possible, depending on the suitability of the land. In this scenario it is considered that the land is suitable	No major constraint
40 Processing and storage of milk products for disposal	Yes: social and technical	Processing of milk into powder (for storage until a suitable disposal route is found) may be possible, though owners of suitable facilities have suggested that they would not accept contaminated milk into their factories, due to issues of consumer confidence. These plants would therefore have to be requisitioned	Record a constraint, but continue to consider this option at further steps

Figure 4.30 shows how this information is applied in the RRF. Options that were eliminated, and therefore greyed out, at step 3 need not be considered. In this example the information in Table 3.2 has been used to fill in the step 4 cells for the remaining options and the 'Filter milk options on step 4' button has been clicked. Where an option has been eliminated, the next column has been shaded green to prompt the user for justification and the row is greyed out for step 5 and beyond. Where an option has been retained despite a major constraint, the next column is shaded green to prompt the user to provide further information. Explanations have been provided by the user in the green cells.

Step 5: Consider effectiveness of management options

Table 5.14 in the Food Handbook indicates the effectiveness of the management options available for milk for a range of radionuclides. Figure 4.31 shows how this information is applied in the RRF. In this example the step 5 column of the RRF has been filled in with a 'N' to indicate that none of the remaining options is to be eliminated based on effectiveness. The 'Filter milk options on step 5' button has been clicked, but no further shading was required as no options were eliminated at this step.

Step 6: Consider wastes and incremental doses

Tables 5.15 in the Food Handbook shows which management options produce incremental doses from implementation of the option, which produce wastes, and which produce incremental doses from waste management. Table 5.16 in the Food Handbook shows which waste management options lead to doses to the implementers, and which options lead to doses to the public, from either primary or secondary waste. At step 6 the RRF allows the user to keep an option for further consideration even if it leads to wastes or incremental doses. Table 3.3 shows the conclusions for management options at this step.

Figure 4.32 shows how this information is applied in the RRF. In this example the step 6 column of the RRF has been filled to indicate that none of the remaining options is to be eliminated, 2 have no wastes or incremental doses, and that the rest are still to be considered, although there are wastes and/or incremental doses. The ‘Filter milk options on step 6’ button has been clicked, and for those options where there are wastes and/or incremental doses, the next column has been shaded green to prompt the user to provide explanations, which have been given.

Table 3.3 Wastes and incremental doses				
Option	Wastes	Incremental doses	Notes	Conclusion
1 Close air intake systems at food processing plant	No	No	–	No wastes or incremental doses
4 Short-term sheltering of animals	No	No	–	No wastes or incremental doses
6 Product recall	Yes	Yes – from wastes	Placing restrictions on the entry of milk into the food chain and product recall generates waste. The management of this waste leads to incremental doses to those carrying out disposal. Calculations using the methodology developed by Hesketh and others (2006) (3) can be carried out to determine the magnitude of the incremental doses on a site-specific basis	Wastes or incremental doses but continue to consider
7 Restrict entry into the foodchain (inc FEPA orders)	Yes	Yes – from wastes	Wastes or incremental doses but continue to consider	

Table 3.3 Wastes and incremental doses				
Option	Wastes	Incremental doses	Notes	Conclusion
20 Clean feeding	Yes	Yes – from option and from wastes	Clean feeding of housed dairy livestock incurs small incremental doses to the farmer from carrying out a grassland management programme (cutting and disposing of contaminated grass) while the animals are indoors	Wastes or incremental doses but continue to consider
35 Disposal of contaminated milk to sea	N/A	Yes – to implementers and to public from primary waste	Authorisation is required for disposal to sea	Wastes or incremental doses but continue to consider
38 Landspreading	N/A	Yes – to implementers and to public from primary waste	Waste in the form of contaminated slurry is generated by housed animals during their period of clean feeding. The collection and disposal of this waste incurs a further small incremental dose to the farmer	Wastes or incremental doses but continue to consider
40 Processing and storage of milk products for disposal	N/A	Yes – to implementers only	Calculations using the methodology developed by Hesketh and others (2006) (3) can be carried out to determine the magnitude of the incremental doses on a site-specific basis	Wastes or incremental doses but continue to consider

Step 7: Refer to individual datasheets for remaining options

Datasheets, which can be found in section 7 of the Food Handbook, should be consulted at this point, to check if any of the remaining management options should be eliminated. [Figure 4.33](#) shows the RRF and the recording for each of the remaining management options, whether or not the option is eliminated. In this scenario no options are eliminated at this stage.

Step 8: Select and combine remaining options

The user should select and combine management options, based on steps 1 to 7, for managing each phase, both for maintaining production and for disposing of wastes. In [Figure 4.34](#) the right hand column shows the management options remaining after steps 1 to 7. Some are highlighted in pink; these are the options where the user had noted the existence of either major constraints at step 4 or wastes and/or incremental doses at step 6. Information about the developed recovery strategy can be printed, following the instructions given in [Section 2.6.2](#) (full information) or [Section 2.6.3](#) (summary only).

3.1.3 Comments on the strategy developed

It is important for the user to appreciate that in this example a recovery strategy for the scenario given in [Section 3.1.1](#) has been developed independently, by implementing the generic process described in the Food Handbook, using the RRF. In a real situation, however, it would be important to develop a dialogue with local and national stakeholders, to have some understanding of the structure and contents of the handbooks, and some knowledge of relevant technical information and the factors influencing implementation of options and selection of a strategy.

3.2 Inhabited areas

3.2.1 Scenario

There has been a major accident in June at a nuclear power plant close to a city. There has been an atmospheric release of ^{137}Cs , which gives rise to a long-lived gamma radiation hazard. It was raining as the contaminated plume passed overhead, resulting in wet deposition of contaminants to the ground and surfaces below. The release has now finished, and the contaminated plume has passed. The population of the city was not evacuated and is still sheltering. Because the contaminated area is a city, there is a high chance of critical facilities and services (for example, water supplies and power) being present which need to be staffed, especially because the population has not been evacuated. Both the critical facilities and areas where people are sheltering are high priority areas for monitoring.

As people are sheltering in the city, it may not be practicable to carry out the more disruptive options or those that affect properties where people are living or those which produce dust. Consideration could be given to temporarily relocating people during the implementation of management options. There is no pressure to remove the contamination from the whole area.

However, the city contains locations that are particularly sensitive (for example, schools). In such locations, there is likely to be pressure to undertake decontamination.

Grass and soil samples are taken to the laboratory. Analysis shows the contamination on the surface to be dominated by an average of 1 MBq m^{-2} ^{137}Cs on grassed garden areas (see Figure 3.2).



Figure 3.2 Contamination levels of ^{137}Cs on the various types of surface in the city for the hypothetical scenario. The diagram shows deposition (MBq m^{-2}) of ^{137}Cs on a range of surfaces for a hypothetical scenario involving an atmospheric release of radionuclides to an inhabited area. Highest levels of deposition are to horizontal soil and grassed areas (1.0 MBq m^{-2}). Conversely, lowest levels of deposition are to vertical surfaces such as walls (0.01 MBq m^{-2}).

3.2.2 Using the RRF while working through the scenario

Step 1: Identify affected surfaces in inhabited areas

From the scenario described, city gardens are the surfaces that have been most affected, and the relevant radionuclide is ^{137}Cs . The user should therefore select soil and vegetation and ^{137}Cs in the RRF (Figure 4.35).

Step 2: List applicable management options for the inhabited area

The RRF lists the available management options (Figure 4.36) and asks the user if any options are eliminated on the basis of common sense (not expert knowledge). There are 14 management options to consider in total. In this example, various options can be eliminated immediately.

1. Controlling workforce access (1) and restricting public access (4) to non-residential areas are not appropriate as city gardens are in residential areas.
2. At the predicted level of dose ($<10 \text{ mSv}$ in the first year) permanent relocation (3) would not be justified.
3. As leaves would still be on trees, leaf collection (6) would not be applicable

4. Ploughing methods (14) are not relevant to city gardens because they can only be implemented in large open spaces because of the size of the equipment required.
5. Snow/ice removal (18) would not be required for the time of year of the accident (June).

Although temporary relocation (5) could be considered to allow the more disruptive options to be carried out, there may be competing factors which make it preferable to leave people in the area. Therefore, this option should not be eliminated at this stage.

In [Figure 4.36](#) the 'Filter soil & veg options on step 2' button has been clicked, and the user has provided explanations for those options eliminated at step 2.

Step 3: Consider applicability of management options for radionuclide of concern

As described in [Section 2.4.1.2](#), clicking the 'Filter soil & veg options on step 2' button includes a check on whether any of the management options can automatically be eliminated at step 3, based on the radionuclide(s) selected by the user. This uses the information from Tables 5.8 and 5.9 in the Inhabited Areas Handbook, which indicate where there are restrictions for certain radionuclides for some options. Where restrictions are found to apply, the user is prompted in the RRF to check the restrictions and, if a management option has restrictions for all selected radionuclides, then it is automatically eliminated. [Figure 4.37](#) includes the display of those options where restrictions have been found and options eliminated, together with details of the restrictions. For example, it is shown in Table 5.9 in the Inhabited Areas Handbook that option 23 has restrictions for ^{137}Cs as this option reduces doses from the inhalation of resuspended material, which is not an important pathway for this radionuclide. For the eliminated options, cells are greyed out at stage 4 and beyond.

Step 4: Consider key constraints for each management option

Table 5.11 in the Inhabited Areas Handbook provides an overview of where major and moderate constraints exist for each option. For example, it is shown that option 11 (manual and mechanical digging) has a major technical constraint and a moderate constraint associated with social factors. However, the indication of even a major constraint does not necessarily eliminate a management option from consideration, as shown in [Table 3.4](#). The RRF does allow for an option to continue to be considered even with possible major constraints. To make these types of judgements the user should consult Table 5.10 in the Inhabited Areas Handbook for more details about the nature of the constraints and also refer to the specific scenario being considered. In this scenario, it is suggested that options are eliminated or retained, as specified in [Table 3.4](#).

Table 3.4 Major constraints on the options			
Option	Major constraint indicated	Notes	Conclusion
5 Permanent relocation from residential areas	Yes: social and technical	Although there are social implications of temporary relocation, and there may be technical difficulties, if this is required it can be implemented	Record a constraint, but continue to consider this option at further steps
7 Cover grass/soil with clean soil/asphalt	Yes: social and technical	The acceptability of covering with asphalt is likely to be low and if clean soil was to be used very large quantities would be required (up to 10 cm) for this option to be effective	Eliminate
10 Grass cutting and removal	Yes: technical	Not effective if there is heavy rain after deposition and cannot be carried out in severe cold weather. However, this is unlikely to be a problem in June	Record a constraint, but continue to consider this option at further steps
11 Manual and mechanical digging	Yes: technical	Complicates further options involving removal of contaminated soil	Record a constraint, but continue to consider this option at further steps
13 Natural attenuation (with monitoring)	Yes: technical	Monitoring equipment and skilled personnel are required. May take a prolonged period of time for radionuclides to decay	Record a constraint, but continue to consider this option at further steps
24 Topsoil and turf removal	Yes: waste and technical	Large quantities of waste will be produced so a management strategy will be required	Record a constraint, but continue to consider this option at further steps

Table 3.4 Major constraints on the options			
Option	Major constraint indicated	Notes	Conclusion
27 Tree and shrub pruning and removal	Yes: technical	Needs to be implemented quickly and before rain	Record a constraint, but continue to consider this option at further steps

Figure 4.38 shows how this information is applied in the RRF. Options that were eliminated, and therefore greyed out, at steps 2 or 3 need not be considered. In this example, the information in Table 3.4 has been used to fill in the step 4 column for the remaining options, then the 'Filter soil & veg options on step 4' button has been clicked. Where an option has been eliminated, the next column has been shaded purple to prompt the user for justification and the row is greyed out for step 5 and beyond. Where an option has been retained despite a major constraint, the next column is shaded purple to prompt the user to provide further information. Explanations have been provided by the user in these purple cells.

Step 5: Consider effectiveness of management options

Table 5.12 in the Inhabited Areas Handbook indicates the effectiveness of the management options available for milk for a range of radionuclides. Figure 4.39 shows how this information is applied in the RRF. In this example, the step 5 column of the RRF has been filled in with a 'Y' to indicate that options 10 and 27 are to be eliminated based on their effectiveness. The 'Filter soil & veg options on step 5' button has been clicked and, where shading has been given for the options being eliminated at this step, the user has provided an explanation.

Step 6: Consider wastes and incremental doses

Table 5.13 in the Inhabited Areas Handbook presents information on the quantities and types of waste produced for each management option considered in the handbook. Of the remaining options, only option 24 (topsoil and turf removal) produces wastes, but it is noted that there may be large volumes produced and a waste management strategy will be required. At step 6 the RRF allows the user to keep an option for further consideration even if it leads to wastes. Therefore, when this information is used in the RRF (see Figure 4.40) all remaining options are retained, although it is noted that option 24 does generate wastes. Once the 'Filter soil & veg options on step 6' button has been clicked, the next column has been shaded purple for option 24 to prompt the user to provide an explanation, which has been completed.

Step 7: Refer to individual datasheets for remaining options

Datasheets, which can be found in section 7 of the Inhabited Areas Handbook, should be consulted at this point, to check if any of the remaining management options should be eliminated. Figure 4.41 shows the RRF and the recording for each of the remaining

management options, whether or not the option is eliminated. In this scenario no options are eliminated at this stage.

Step 8: Select and combine options to consider as part of the recovery strategy

The user should select and combine management options, based on steps 1 to 7, for managing each phase, both for maintaining production and for disposing of wastes. In [Figure 4.42](#) the right-hand column shows the management options remaining after steps 1 to 7. Some are highlighted in pink; these are the options where the user had noted the existence of either major constraints at step 4 or wastes and/or incremental doses at step 6. Information about the developed recovery strategy can be printed, following the instructions given in [Section 2.6.4](#) (full information) or [Section 2.6.5](#) (summary only).

3.2.3 Comments on the strategy developed

It is important for the user to appreciate that in this example a recovery strategy for the scenario given in [Section 3.2.1](#) has been developed independently, by implementing the generic process described in the Inhabited Areas Handbook, using the RRF. In a real situation, however, it would be important to develop a dialogue with local and national stakeholders, to have some understanding of the structure and contents of the handbooks, and some knowledge of relevant technical information and the factors influencing implementation of options and selection of a strategy.

3.3 Drinking water supplies

3.3.1 Scenario

A large nuclear reactor accident has occurred, which has resulted in a release of radioactive material into the atmosphere. It rained as the contaminated plume passed overhead, which has led to a wet deposition of contaminants over surface water supplies (open air) in a large area. At present, the contaminated plume has passed, deposition has occurred on to the surface water supplies, but contamination levels have not yet been determined. The affected surface water supplies provide water for a large city and a number of other smaller inhabited areas.

A number of water supplies are potentially affected and could be of concern. One major treatment works that provides the public drinking water supply to a large number of members of the public, including several hospitals, was under the passage of the plume (supply 1). A private supply in the rural area has also been identified (supply 2).

Supporting information:

1. It will take about 24 hours before drinking water storage tanks containing uncontaminated water are depleted (assuming normal usage).

2. It could take from several hours up to 1 to 2 days for radioactive contamination to reach the water treatment plant (supply 1).
3. Water treatment plant providing supply 1 has a water throughput of 50 MI a day
4. Private supply comes from a borehole.
5. No measurements of gross alpha and gross beta concentrations in drinking water are available yet. However, ground deposition measurements made in the environment indicate that the radionuclide most likely to be of concern is ^{137}Cs (classified as long lived in the Drinking Water Handbook) and that gross beta activity concentrations in treated water originating from the surface water supplies are likely to exceed the screening level.

3.3.2 Using the RRF while working through the scenario

The scenario describes 2 drinking water supplies. The first, from a major treatment works supplying public drinking water to a large number of members of the public, has been recorded on the first drinking water page, and an additional page added for the second supply, which is a private borehole. Each supply must be considered in turn. In this worked example, the process followed is initially the same for each supply, as described below. Then at question 3 the 2 supplies follow different paths, which are discussed in turn below.

3.3.2.1 Providing information about the supplies being considered and answering initial questions

The user should enter information about the supplies in the RRF. [Figure 4.43](#) shows part of the RRF where the user has entered the type and name of supply 1 and clicked the 'Process information about drinking water supply/supplies' button. To add supply 2, the private borehole, to the RRF the user should click on the 'Add another supply (or group of supplies)' button, which will open another tab, titled 'DW2'. The user can then enter the type (Private) and name (Borehole supply) and click the 'Process information ...' button in the same way as was done for supply 1. As seen in [Figure 4.44](#), an additional tab, showing the second water supply, appears in the workbook.

Question 1: Is it suspected that drinking water has been, or could become, contaminated?

For both supplies 1 and 2, the user should click 'Yes' answer to the question in the RRF. A message is displayed to confirm the user's response and to direct them to answer question 2 ([Figure 4.45](#)). The user's response to question 1 is also added to the recovery record.

Question 2: Is it suspected that contamination of the water supply has occurred after treatment?

In the scenario described, contamination of the supply occurs before treatment. This is true for both supplies, and the user should answer 'No' to question 2 in the RRF ([Figure 4.46](#)) on both pages 'DW1 Town water supply' and 'DW2 Borehole supply'. The RRF then displays a message with instructions, which are also added to the recovery record, and the user is directed to answer question 3.

From this point the 2 supplies follow different paths and are considered separately in this worked example. The worked example for the public supply (supply 1) is given in [Section 3.3.2.2](#); that for the borehole supply (supply 2) is given in [Section 3.3.2.3](#).

3.3.2.2 Worked example for supply 1 (public supply), question 3 onwards

Question 3: Based on early estimates of activity concentrations in drinking water, is it VERY UNLIKELY that levels will exceed gross alpha or beta screening levels?

In the case of supply 1, the town drinking water supply, early ground deposition measurements suggest that the main radionuclide of concern is ^{137}Cs , and measurements of gross beta activity concentrations in treated water originating from surface water supplies suggest that screening levels are likely to be exceeded. The user therefore selects 'Possible to exceed screening levels' for question 3 in the RRF and clicks the 'See recommendations from Q3' button. The RRF displays instructions and prompts the user to add further information to the record, if required, and then to answer question 4. It is suggested that the user could add a quick note about early measurements here (see example in [Figure 4.47](#)) or add a link to a document containing the measurements.

Question 4: Are measured concentrations in drinking water (water supplied 'at the tap') greater than screening levels?

Analytical results for supply 1 show that gross beta screening levels have been exceeded. The user therefore selects 'Y' in the RRF for question 4 ([Figure 4.48](#)) and clicks the 'See recommendations from Q4' button. A message confirms that measured concentrations are greater than screening levels, which is added to the recovery record; the user is prompted to add further information to the record, if required, and then to answer question 5.

Question 5: Are measured concentrations in treated drinking water (water supplied 'at the tap') greater than UK action levels?

As the analysis of treated drinking water indicates levels of 500 Bq l⁻¹ for ^{134}Cs and 1000 Bq l⁻¹ for ^{137}Cs , the UK action level of 1000 Bq l⁻¹ has been met for supply 1. The user therefore selects 'Y' in the RRF for question 5 and clicks the 'See recommendations from Q5' button ([Figure 4.49](#)). A message confirms that concentrations in treated water are greater than UK action levels, which is added to the recovery record; the user is prompted to add further information to the record, if required, and then to answer question 7.

Question 7: Is the radionuclide short lived?

The user should ignore question 6 and go straight to question 7. With a half-life of 30 years, ^{137}Cs is not short lived. The user therefore selects 'N' for question 7 in the RRF and clicks the 'See recommendations from Q7' button ([Figure 4.50](#)). A message displays recommendations about which management options could be considered ([Figure 4.51](#)), and confirms that this is the end of the assessment. The recommendations and information are also added to the recovery record. The user may also add further information to the recovery record if required. The output from a completed RRF is shown in [Figure 4.52](#).

3.3.2.3 Worked example for supply 2 (private supply), question 3 onwards

In this worked example, the initial part of the process for supply 2 is the same as for supply 1, although the type of supply will be different, as described below.

Question 3: Based on early estimates of activity concentrations in drinking water, is it VERY UNLIKELY that levels will exceed gross alpha or beta screening levels?

While it was possible that screening levels could be exceeded with supply 1, as supply 2 is a borehole it is very unlikely that contamination will reach the supply at an early stage. Therefore, the user selects 'Very unlikely to exceed screening levels' in the RRF and clicks the 'See recommendations from Q3' button (Figure 4.53). This displays information, which is added to the recovery record; the user is prompted to add further information to the recovery record, if required, and is then directed to question 6.

Question 6: Is there a requirement to reduce activity concentrations in drinking water irrespective of screening levels being exceeded?

The borehole supply is used by families with young children, leading to increased concern about the safety of the supply, and a need to reduce activity concentrations whether or not screening levels are being exceeded. The user therefore selects 'Y' in the RRF and clicks the 'See recommendations from Q6' button (Figure 4.54), which displays a message to confirm there are other requirements to reduce activity concentrations, and adds this to the recovery record; the user is prompted to add further information to the recovery record, if required, and is then directed to question 7.

Question 7: Is the radionuclide short lived?

As for supply 1, with a half-life of 30 years, ^{137}Cs is not short lived. The user therefore selects 'N' in the RRF for question 7 and clicks the 'See recommendations from Q7' button (as in Figure 4.50), which then prompts the user to add further information to the recovery record, if required, and directs them to question 8.

Question 8: Is adding or modifying treatment of a private supply an option?

In this worked example it is assumed that adding or modifying treatment of the private supply is possible. The user therefore selects 'Y' in the RRF and clicks the 'See recommendations from Q8' button (Figure 4.55), which provides a display (Figure 4.56) suggesting the recommended options if adding or modifying treatment is possible and confirms that the assessment is ended. This information is also added to the recovery record, for which the RRF can be seen for supply 2 in Figure 4.57.

3.3.3 Comments on the strategy developed

It is important for the user to appreciate that in this example a recovery strategy for the 2 drinking water supplies included in the scenario given in Section 3.3.1 has been developed independently, by following the decision tree provided in the Drinking Water Handbook, using

the RRF. In a real situation, however, it would be important to develop a dialogue with local and national stakeholders, to have some understanding of the structure and contents of the handbooks, and some knowledge of relevant technical information and the factors influencing implementation of options and selection of a strategy.

4 Screenshots from RRF

Radiation recovery record form: Incident information			
<i>This form should be completed in conjunction with the UK Recovery Handbook for Radiation Incidents (see right for links)</i>			
Please provide contact details			
Name			
Organisation			
Email address			
Role and responsibility in incident (eg RCG Chair)			
Other agencies or departments involved in the incident (e.g. Defra, DH, FSA, APHA, DfT, EA, PHE)			
Date of completing form (dd/mm/yy)			
Please provide information regarding the incident			
<i>If fields are not applicable, or if answers are not known, please leave blank or enter an approximate date or location</i>			
Incident name			Worked examples
City/Location			
County			
Postcode			
Date contamination occurred			
Date contamination reported			
Incident status			
Ref No (if applicable)			
What were the circumstances/source of the incident?			
<i>Please indicate yes/no for each incident type, including all that apply. If "other" then please provide more information</i>			
Civil nuclear site accident		Transport accident (civil)	
Military nuclear site accident		Transport accident (military)	
Radiopharmaceutical/non-nuclear accident		Nuclear terrorism	
Other		Radiological terrorism	
		Overseas accident	
<i>How do you know it was this type of incident? (eg informed by police)</i>			
<i>Add any additional information here:</i>			

Figure 4.1: Incident information form

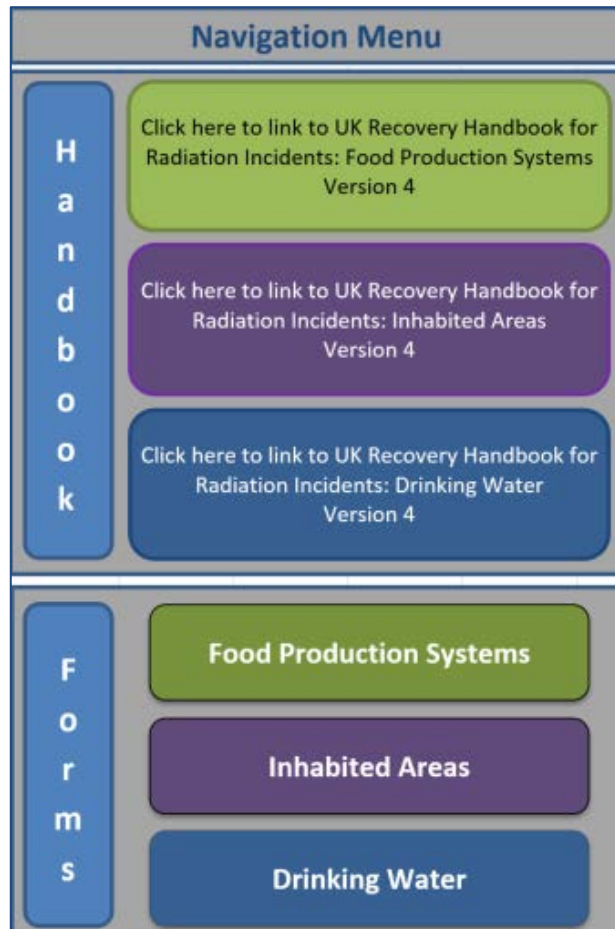


Figure 4.2: Navigation menu

Radiation Recovery Record Form (RRF)

Step 1a Select the Food Production System(s) that has/have been contaminated - click on green button(s) to select/deselect				<input type="button" value="Show/Hide Food Systems"/>	
Step 1b Select the radionuclide(s) that are involved - click on the green buttons to select/deselect				<input type="button" value="Show/Hide Radionuclides"/>	
Applicable Management Options (MOs) are listed below. At each of steps 2 to 7, answer the question for each available MO then click the "filter" button at the bottom of the list. If the "justification" column is coloured green, then provide any relevant information there.		Step 2: Is the MO eliminated on basis of common sense (not expert knowledge)?	If eliminating management option(s) after step 2, provide justification for this in the green shaded cells	Step 3: Is the MO eliminated, based on applicability for radionuclide(s)?	If eliminating management option(s) after step 3, provide justification for this in the green shaded cells, or note if option not suitable for some radionuclides, while being considered for others

Figure 4.3 Top of blank food page of the RRF

Step 1a Select the Food Production System(s) that has/have been contaminated - click on green button(s) to select/deselect				<input type="button" value="Show/Hide Food Systems"/>	
Production System	Sources/examples		Contaminated?		
Cereals and grassland	Cereals	Wheat, barley, oats, oil seed rape, rye, maize, grassland	No		
Fruit and vegetables	Fruit&veg	All fruit and vegetables, including herbs and edible flowers	No		
Milk	Milk	Milk and dairy products (cow, sheep, goat)	No		
Meat	Meat	Beef, lamb, pork, fowl, chicken	No		
Eggs	Eggs	Hens, ducks, geese and wildfowl	No		
Honey	Honey	Beehives	No		
Freshwater and marine fish	Fish	Marine and freshwater fish and shellfish	No		
Domestic and wild foods and game	Domestic	Domestically produced fruit, vegetables, meat, eggs; wild foods; game	No		
Step 1b Select the radionuclide(s) that are involved - click on the green buttons to select/deselect				<input type="button" value="Show/Hide Radionuclides"/>	
Am-241	No		Ru-103	No	
Co-60	No		Ru-106	No	
Cs-134	No		Se-75	No	
Cs-137	No		Sr-89	No	
I-131	No		Sr-90	No	
Pu-238	No				

Figure 4.4 Food page with food production systems and radionuclides expanded

Radiation Recovery Record Form (RRF)

Step 1a Select the Food Production System(s) that has/have been contaminated - click on green button(s) to select/deselect				Show/Hide Food Systems
Production System	Sources/examples		Contaminated?	
Cereals and grassland	Cereals	Wheat, barley, oats, oil seed rape, rye, maize, grassland	No	
Fruit and vegetables	Fruit&veg	All fruit and vegetables, including herbs and edible flowers	No	
Milk	Milk	Milk and dairy products (cow, sheep, goat)	Yes	
Meat	Meat	Beef, lamb, pork, fowl, chicken	No	
Eggs	Eggs	Hens, ducks, geese and wildfowl	No	
Honey	Honey	Beehives	No	
Freshwater and marine fish	Fish	Marine and freshwater fish and shellfish	No	
Domestic and wild foods and game	Domestic	Domestically produced fruit, vegetables, meat, eggs; wild foods; game	No	
Step 1b Select the radionuclide(s) that are involved - click on the green buttons to select/deselect				Show/Hide Radionuclides
Am-241	No		Ru-103	No
Co-60	No		Ru-106	No
Cs-134	No		Se-75	No
Cs-137	Yes		Sr-89	No
I-131	Yes		Sr-90	No
Pu-238	No			

Figure 4.5 Selecting food types and radionuclides

Applicable Management Options (MOs) are listed below. At each of steps 2 to 7, answer the question for each available MO then click the "filter" button at the bottom of the list. If the "justification" column is coloured green, then provide any relevant information there.	Step 2: Is the MO eliminated on basis of common sense (not expert knowledge)?	If eliminating management option, provide justification (shaded green)
Milk		
Pre-deposition options		
Close air intake systems at food processing plant (1)	N	
Short term sheltering of animals (4)	N	
General applicability		
Natural attenuation (with monitoring) (5)	N	
Product recall (6)	N	
Restrict entry into the foodchain (inc FEPA orders) (7)	N	
Select alternative land use (8)		
Milk		
Addition of AFCF to concentrate ration (16)	Y	
Addition of calcium to concentrate ration (17)	N	
Addition of clay minerals to feed (18)		
Clean feeding (20)		
Selective grazing (23)		
Slaughtering (culling) of livestock (24)		
Suppression of lactation before slaughter (25)		
Waste disposal		
Biological treatment (digestion) of milk (32)		
Burial of carcasses (33)		

Figure 4.6 Example of answering a question with drop down list

Applicable <u>Management Options (MOs)</u> are listed below. At each of steps 2 to 7, answer the question for each available MO then click the "filter" button at the bottom of the list. If the "justification" column is coloured green, then provide any relevant information there.	Step 5: <u>Is the MO eliminated</u> because of effectiveness?	If eliminating management option(s) after step 5, provide justification for this in the green shaded cells
Milk		
Addition of AFCF to concentrate ration (16)	N	
Addition of calcium to concentrate ration (17)		
Addition of clay minerals to feed (18)	Y	Please add detail about reason for elimination
Clean feeding (20)	N	
Selective grazing (23)	N	
Slaughtering (culling) of livestock (24)	N	
Suppression of lactation before slaughter (25)	N	
Waste disposal		
Biological treatment (digestion) of milk (32)		
Burial of carcasses (33)	N	
Disposal of contaminated milk to sea (35)	N	
Incineration (36)		
Landfill (37)	N	
Landspreading milk/slurry (38)	N	
Processing and storage of milk products for disposal (40)	N	
Rendering (41)	N	

Figure 4.7 Example of elimination of management options and request for reasons for elimination

Applicable Management Options (MOs) are listed below. At each of steps 2 to 7, answer the question for each available MO then click the "filter" button at the bottom of the list. If the "justification" column is coloured green, then provide any relevant information there.	Step 3: Is the MO eliminated, based on applicability for radionuclide(s)?	If eliminating management option(s) after step 3, provide justification for this in the green shaded cells, or note if option not suitable for some radionuclides, while being considered for others
Milk Pre-deposition options		
Close air intake systems at food processing plant (1)	N	
Short term sheltering of animals (4)	N	
General applicability		
Natural attenuation (with monitoring) (5)	N	
Product recall (6)	N	
Restrict entry into the foodchain (inc FEPA orders) (7)	N	
Select alternative land use (8)	N	Check restrictions for I-131
Milk		
Addition of AFCF to concentrate ration (16)	N	Check restrictions for I-131
Addition of calcium to concentrate ration (17)	Y	Check restrictions for Cs-137, I-131
Addition of clay minerals to feed (18)	N	Check restrictions for I-131
Clean feeding (20)	N	
Selective grazing (23)	N	Check restrictions for I-131
Slaughtering (culling) of livestock (24)	N	Check restrictions for I-131
Suppression of lactation before slaughter (25)	N	Check restrictions for I-131
Waste disposal		
Biological treatment (digestion) of milk (32)	N	
Burial of carcasses (33)	N	Check restrictions for I-131
Disposal of contaminated milk to sea (35)	N	
Incineration (36)	Y	Check restrictions for Cs-137, I-131
Landfill (37)	N	Check restrictions for I-131
Landspreading milk/slurry (38)	N	
Processing and storage of milk products for disposal (40)	N	
Rendering (41)	N	Check restrictions for I-131

Figure 4.8 Example of elimination of options based on applicability for radionuclides, step 3

Radiation Recovery Record Form (RRF)

<p>Applicable Management Options (MOs) are listed below. At each of steps 2 to 7, answer the question for each available MO then click the "filter" button at the bottom of the list. If the "justification" column is coloured green, then provide any relevant information there.</p>	<p>Step 4: Is the MO eliminated because of major constraints (wastes, technical, costs, time, social) in this scenario?</p>	<p>If eliminating management option(s) after step 4, OR if retaining an option with major constraints, provide justification for this in the green shaded cells</p>
<p>Waste disposal</p>		
<p>Biological treatment (digestion) of milk (32)</p>	<p>Major constraint but continue to consider option</p>	<p>Please add detail about constraints</p>
<p>Burial of carcasses (33)</p>	<p>Eliminate option due to major constraint</p>	<p>Please add detail about constraints</p>
<p>Disposal of contaminated milk to sea (35)</p>	<p>Major constraint but continue to consider option</p>	<p>Please add detail about constraints</p>
<p>Incineration (36)</p>	<p></p>	<p></p>
<p>Landfill (37)</p>	<p>No major constraints</p>	<p></p>
<p>Landspreading milk/slurry (38)</p>	<p>Major constraint but continue to consider option</p>	<p>Please add detail about constraints</p>
<p>Processing and storage of milk products for disposal (40)</p>	<p>Major constraint but continue to consider option</p>	<p>Please add detail about constraints</p>
<p>Rendering (41)</p>	<p>No major constraints</p>	<p></p>

Figure 4.9 Example showing where to record information about potential constraints

Step 8: Select and combine options that should be considered as part of the strategy. Based on answers given for steps 1 to 7 the remaining MOs are listed below. Those with a pink background have issues that may need attention.	Summary of comments relevant to remaining options, as supplied by user at each of steps 2 to 7
Milk	
Pre-deposition options	
Close air intake systems at food processing plant (1)	
Short term sheltering of animals (4)	
General applicability	
Product recall (6)	Waste management strategy required; will generate waste; dose assessment required;
Restrict entry into the foodchain (inc FEPA orders) (7)	Waste management strategy required; will generate waste; dose assessment required;
Milk	
Clean feeding (20)	small incremental doses to farmer;
Waste disposal	
Disposal of contaminated milk to sea (35)	Need authorisation; authorisation required;
Landspreading milk/slurry (38)	small incremental doses to farmer;
Processing and storage of milk products for disposal (40)	May be problems getting facilities; presmises and dose assessment required;

Figure 4.10 Step 8, example display of short-listed options for recovery of a contaminated milk production system

Radiation Recovery Record Form (RRF)

Step 1a: Select the Surface(s) that have been contaminated (Step 1) (Click on purple button to select/deselect)		Show/Hide Surfaces	
Step 1b: Select the radionuclide(s) that are involved (Click on purple button to select/deselect)		Show/Hide Radionuclides	
Applicable Management Options (MOs) are listed below. At each of steps 2 to 7, answer the question for each available MO then click the "filter" button at the bottom of the list. If the "justification" column is coloured purple, then provide any relevant information there.	Step 2: Is the MO eliminated on basis of common sense (not expert knowledge)?	If eliminating management option(s) after step 2, provide justification for this in the purple shaded cells	Step 3: Is the MO eliminated as inappropriate for radionuclide(s) considered?

Figure 4.11 Top of blank inhabited areas page of the RRF

Step 1a: Select the Surface(s) that have been contaminated (Step 1) (Click on purple button to select/deselect)			Show/Hide Surfaces	
Surface	Description	Contaminated?		
Buildings - external surfaces	Ext Build <i>External hard surfaces eg walls, roofs, windows and doors of all buildings</i>	No		
Buildings - internal surfaces	Int Build <i>Indoor building surfaces eg walls, floors, ceilings, soft furnishings and furniture</i>	No		
Buildings - semi-enclosed surfaces	Semi-enc <i>Transport networks: train and bus stations, underground systems</i>	No		
Roads and paved areas	Roads <i>Roads, pavements, large paved or asphalt areas eg playgrounds, yards car parks</i>	No		
Vehicles	Vehicles <i>Public transportation vehicles: cars, lorries, trains, buses, trams, boats, aircraft</i>	No		
Soils and vegetation	Soils/Veg <i>Lawn, flowerbeds, and vegetable plots associated with the gardens of residential dwellings, landscaping around commercial and public buildings, allotments, parks, playing fields and other managed green areas. Also includes all woody plants (eg trees, shrubs and bushes) associated with these areas.</i>	No		
Step 1b: Select the radionuclide(s) that are involved (Click on purple button to select/deselect)			Show/Hide Radionuclides	
Am-241	No	Pu-239	No	
Ba-140	No	Ra-226	No	
Ce-144	No	Ru-103	No	
Co-60	No	Ru-106	No	
Cs-134	No	Se-75	No	
Cs-136	No	Sr-89	No	
Cs-137	No	Sr-90/Y-90	No	
I-131	No	Te-132	No	
Ir-192	No	U-235	No	
Mo-99/Tc-99m	No	Yb-169	No	
Pu-238	No	Zr-95	No	

Figure 4.12 Inhabited areas page with surface types and radionuclides expanded

Radiation Recovery Record Form (RRF)

Step 1a: Select the Surface(s) that have been contaminated (Step 1) (Click on purple button to select/deselect)							Show/Hide Surfaces
Surface		Description		Contaminated?			
Buildings - external surfaces	Ext Build	External hard surfaces eg walls, roofs, windows and doors of all buildings		No			
Buildings - internal surfaces	Int Build	Indoor building surfaces eg walls, floors, ceilings, soft furnishings and furniture		No			
Buildings - semi-enclosed surfaces	Semi-enc	Transport networks: train and bus stations, underground systems		No			
Roads and paved areas	Roads	Roads, pavements, large paved or asphalt areas eg playgrounds, yards car parks		No			
Vehicles	Vehicles	Public transportation vehicles: cars, lorries, trains, buses, trams, boats, aircraft		No			
Soils and vegetation	Soils/Veg	Lawn, flowerbeds, and vegetable plots associated with the gardens of residential dwellings, landscaping around commercial and public buildings, allotments, parks, playing fields and other managed green areas. Also includes all woody plants (eg trees, shrubs and bushes) associated with these areas.		Yes			
Step 1b: Select the radionuclide(s) that are involved (Click on purple button to select/deselect)							Show/Hide Radionuclides
Am-241	No			Pu-239	No		
Ba-140	No			Ra-226	No		
Ce-144	No			Ru-103	No		
Co-60	No			Ru-106	No		
Cs-134	No			Se-75	No		
Cs-136	No			Sr-89	No		
Cs-137	Yes			Sr-90/Y-90	No		
I-131	No			Te-132	No		
Ir-192	No			U-235	No		
Mo-99/Tc-99m	No			Yb-169	No		
Pu-238	No			Zr-95	No		

Figure 4.13 Selecting surface types and radionuclides

22	Applicable Management Options (MOs) are listed below. At each of steps 2 to 7, answer the question for each available MO then click the "filter" button at the bottom of the list. If the "justification" column is coloured purple, then provide any relevant information there.	Step 2: Is the MO eliminated on basis of common sense (not expert knowledge)?	If eliminating management option(2, provide justification for this in shaded cells
127	Soils and vegetation		
128	Restrict access options		
129	Control workforce access (1)	N	
130	Permanent relocation from residential areas (3)	N	
131	Restrict public access (4)	N	
132	Temporary relocation from residential areas (5)	<input type="text" value=""/>	
133	Remediation options	Y	
134	Collection of leaves (6)	N	
135	Cover grass/soil with clean soil/asphalt (7)		
136	Grass cutting and removal (10)		
137	Manual and mechanical digging (11)		
138	Natural attenuation (with monitoring) (13)		
139	Ploughing methods (14)		
140	Snow/ice removal (18)		
141	Tie down (23)		
142	Topsoil and turf removal (24)		
143	Tree and shrub pruning and removal (27)		

Figure 4.14 Example of answering a question with drop down list

Applicable <u>Management Options (MOs)</u> are listed below. At each of steps 2 to 7, answer the question for each available MO then click the "filter" button at the bottom of the list. If the "justification" column is coloured purple, then provide any relevant information there.		Step 5: <u>Is the MO eliminated because of effectiveness?</u>	If eliminating management option(s) after step 5, provide justification for this in the purple shaded cells
Soils and vegetation			
Restrict access options			
Control workforce access (1)			
Permanent relocation from residential areas (3)			
Restrict public access (4)			
Temporary relocation from residential areas (5)		N	
Remediation options			
Collection of leaves (6)			
Cover grass/soil with clean soil/asphalt (7)			
Grass cutting and removal (10)		Y	Please add detail about reason for elimination
Manual and mechanical digging (11)		N	
Natural attenuation (with monitoring) (13)		N	
Ploughing methods (14)			
Snow/ice removal (18)			
Tie down (23)			
Topsoil and turf removal (24)		N	
Tree and shrub pruning and removal (27)		Y	Please add detail about reason for elimination

Figure 4.15 Example of elimination of management options and request for reasons for elimination

<p>Applicable <u>Management Options (MOs)</u> are listed below. At each of steps 2 to 7, answer the question for each available MO then click the "filter" button at the bottom of the list. If the "justification" column is coloured purple, then provide any relevant information there.</p>	<p>Step 3: <u>Is the MO eliminated as inappropriate for radionuclide(s) considered?</u></p>	<p>If eliminating management option(s) after step 3, provide justification for this in the purple shaded cells</p>
<p>Soils and vegetation</p>		
<p>Restrict access options</p>		
Control workforce access (1)		
Permanent relocation from residential areas (3)		
Restrict public access (4)		
Temporary relocation from residential areas (5)	N	
<p>Remediation options</p>		
Collection of leaves (6)		
Cover grass/soil with clean soil/asphalt (7)	N	Check restrictions for Mo-99/Tc-99m
Grass cutting and removal (10)	N	Check restrictions for Mo-99/Tc-99m
Manual and mechanical digging (11)	N	Check restrictions for Mo-99/Tc-99m
Natural attenuation (with monitoring) (13)	N	
Ploughing methods (14)		
Snow/ice removal (18)		
Tie down (23)	Y	Check restrictions for Cs-137, Mo-99/Tc-99m
Topsoil and turf removal (24)	N	Check restrictions for Mo-99/Tc-99m
Tree and shrub pruning and removal (27)	N	Check restrictions for Mo-99/Tc-99m

Figure 4.16 Elimination of options based on applicability for radionuclides, step 3

Radiation Recovery Record Form (RRF)

Applicable Management Options (MOs) are listed below. At each of steps 2 to 7, answer the question for each available MO then click the "filter" button at the bottom of the list. If the "justification" column is coloured purple, then provide any relevant information there.	Step 4: Is the MO eliminated because of major constraints (wastes, technical, costs, time, social) in this scenario?	If eliminating management option(s) after step 4, OR if retaining an option with major constraints, provide justification for this in the purple shaded cells
Soils and vegetation		
Restrict access options		
Control workforce access (1)		
Permanent relocation from residential areas (3)		
Restrict public access (4)		
Temporary relocation from residential areas (5)		Major constraint but continue to consider option
Remediation options		
Collection of leaves (6)		
Cover grass/soil with clean soil/asphalt (7)		Eliminate option due to major constraint
Grass cutting and removal (10)		Major constraint but continue to consider option
Manual and mechanical digging (11)		Major constraint but continue to consider option
Natural attenuation (with monitoring) (13)		Major constraint but continue to consider option
Ploughing methods (14)		
Snow/ice removal (18)		
Tie down (23)		
Topsoil and turf removal (24)		Major constraint but continue to consider option
Tree and shrub pruning and removal (27)		Major constraint but continue to consider option

Figure 4.17 Example showing where to record information about potential constraints

Radiation Recovery Record Form (RRF)

Applicable <u>Management Options (MOs)</u> are listed below. At each of steps 2 to 7, answer the question for each available MO then click the "filter" button at the bottom of the list. If the "justification" column is coloured purple, then provide any relevant information there.	Step 8: Select and combine options that should be considered as part of the strategy. Based on answers given for steps 1 to 7 the remaining MOs are listed below. Those with a pink background have issues that may need attention.	Summary of comments relevant to remaining options, as supplied by user at each of steps 2 to 7
Soils and vegetation	Soil and vegetation	
Restrict access options	Restrict access options	
Control workforce access (1)		
Permanent relocation from residential areas (3)		
Restrict public access (4)		
Temporary relocation from residential areas (5)	Temporary relocation from residential areas (5)	Disruptive and needs accomodation and transport;
Remediation options	Remediation options	
Collection of leaves (6)		
Cover grass/soil with clean soil/asphalt (7)		
Grass cutting and removal (10)		
Manual and mechanical digging (11)	Manual and mechanical digging (11)	Check restrictions for Mo-99/Tc-99m; Small scale only;
Natural attenuation (with monitoring) (13)	Natural attenuation (with monitoring) (13)	Equipment and personnel required;
Ploughing methods (14)		
Snow/ice removal (18)		
Tie down (23)		
Topsoil and turf removal (24)	Topsoil and turf removal (24)	Check restrictions for Mo-99/Tc-99m; Waste Management Strategy required;
Tree and shrub pruning and removal (27)		

Figure 4.18 Step 8, example display of short-listed options for recovery of contaminated soils and vegetation

Radiation Recovery Record Form (RRF)

Please provide information about the supply (or group of supplies) being considered:					
A: Is the supply (or group of supplies) public or private?				Process information about drinking water supply/supplies	
B: Name of supply (maximum of 25 characters)				Add another supply (or group of supplies)	
If there is another another supply (or group of supplies) to consider click the button to add another supply, then answer questions below, as prompted for this supply					
Please answer Question 1:					
Q1. Is it suspected that drinking water has been, or could become, contaminated?				Yes	No
If answer to Question 1 is "Yes", please answer Questions 2 and 3, then answer further questions as prompted:				Reset	
Q2. Is it suspected that contamination of the water supply has occurred after treatment?					
Yes		No			
Q3. Based on early estimates of activity concentrations in drinking water, is it VERY UNLIKELY that levels will exceed gross alpha or beta screening levels? (Table 5.5)	Q4. Are measured concentrations in treated drinking water (water supplied "at the tap") > screening levels? (Table 5.5)	Q5. Are concentrations in treated drinking water > UK Action Levels? (Table 1.3)	Q6. Is there a requirement to reduce activity concentrations in drinking water irrespective of screening levels being exceeded?	Q7. Is the radionuclide short lived?	Q8. Is adding/modifying treatment of private supply an option?
See recommendations from Q3	See recommendations from Q4	See recommendations from Q5	See recommendations from Q6	See recommendations from Q7	See recommendations from Q8
User supplied information:					
				Add user supplied info to record	
				Clear information box	
				Add hyperlink	
Complete record of supplied answers, user supplied information, and recommendations:					

Figure 4.19 Drinking water page of the RRF

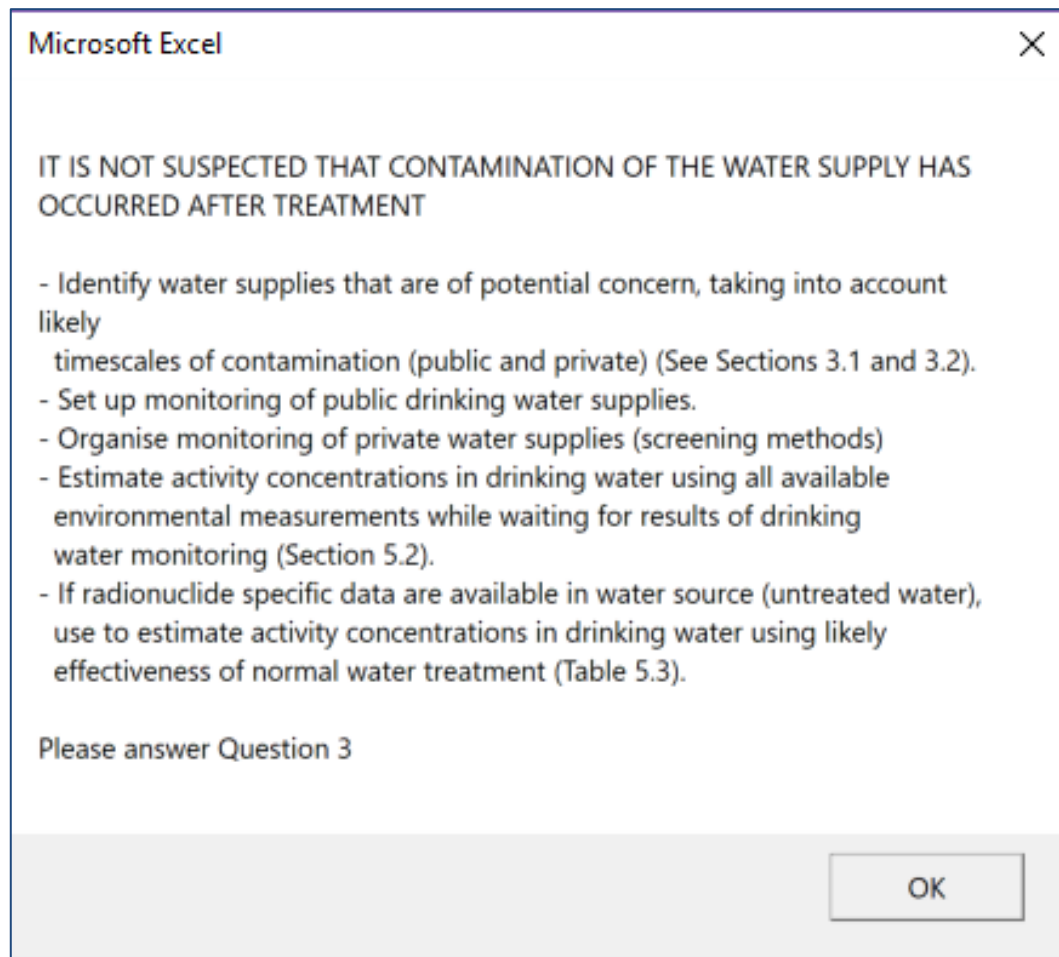


Figure 4.20 Example of information displayed after answering a question on the drinking water page

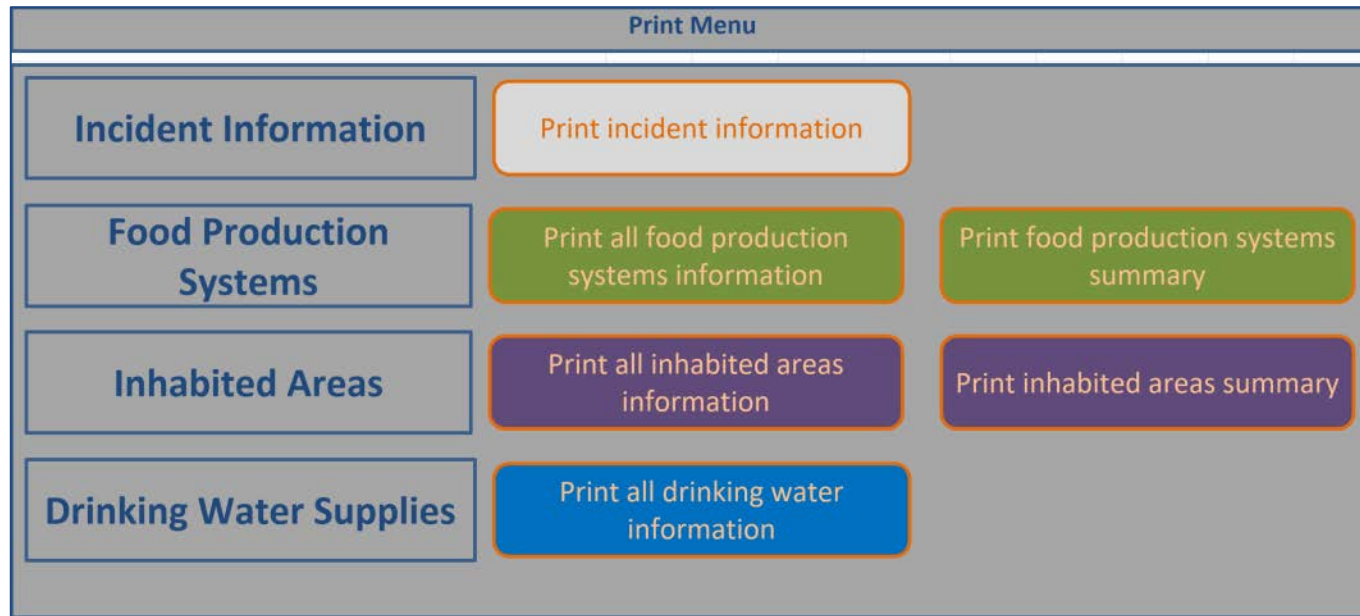


Figure 4.21 Print menu

Radiation Recovery Record Form (RRF)

Test incident Food Printed on 24/09/2020

Step 1a Select the Food Production System(s) that has/have been contaminated - click on green button(s) to select/deselect				
Production System	Sources/examples		Contaminated?	
Cereals and grassland	Cereals	Wheat, barley, oats, oil seed rape, rye, maize, grassland	No	
Fruit and vegetables	Fruit&veg	All fruit and vegetables, including herbs and edible flowers	No	
Milk	Milk	Milk and dairy products (cow, sheep, goat)	Yes	
Meat	Meat	Beef, lamb, pork, fowl, chicken	No	
Eggs	Eggs	Hens, ducks, geese and wildfowl	No	
Honey	Honey	Beehives	No	
Freshwater and marine fish	Fish	Marine and freshwater fish and shellfish	No	
Domestic and wild foods and game	Domestic	Domestically produced fruit, vegetables, meat, eggs; wild foods; game	No	
Step 1b Select the radionuclide(s) that are involved - click on the green buttons to select/deselect				
Am-241	No		Ru-103	No
Co-60	No		Ru-106	No
Cs-134	No		Se-75	No
Cs-137	No		Sr-89	No
I-131	Yes		Sr-90	No
Pu-238	No			

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Figure 4.22 Printout showing selected food production systems and radionuclides

Test incident		Food	Printed on 24/09/2020
<p>Applicable Management Options (MOs) are listed below each of steps 2 to 7, answer the question for each and then click the "filter" button at the bottom of the list. If the "justification" column is coloured green, then provide relevant information there.</p>			
<p>Step 3: Is the MO eliminated, based on applicability for radionuclide(s)?</p>		<p>If eliminating management option(s) after step 3, provide justification for this in the green shaded cells, or note if option not suitable for some radionuclides, while being considered for others</p>	
Milk			
Pre-deposition options			
Close air intake systems at food processing plant (1)	N		
Short term sheltering of animals (4)	N		
General applicability			
Natural attenuation (with monitoring) (5)	N		
Product recall (6)	N		
Restrict entry into the foodchain (inc FEPA orders) (7)	N		
Select alternative land use (8)	Y		Comparatively short half-life compared to implementation time
Milk			
Addition of AFCF to concentrate ration (16)	Y		Option specific to Cs
Addition of calcium to concentrate ration (17)	Y		Option specific to group II of the periodic table
Addition of clay minerals to feed (18)	Y		Option specific to Cs
Clean feeding (20)	N		
Selective grazing (23)	Y		Comparatively short half-life compared to implementation time
Slaughtering (culling) of livestock (24)	Y		Comparatively short half-life compared to implementation time
Suppression of lactation before slaughter (25)	Y		Comparatively short half-life compared to implementation time
Waste disposal			
Biological treatment (digestion) of milk (32)	N		
Burial of carcasses (33)	Y		Not recommended due to potential movement in ground after burial
Disposal of contaminated milk to sea (35)	N		
Incineration (36)	Y		Volatilisation may occur
Landfill (37)	Y		Not recommended due to potential movement in ground after burial
Landspreading milk/slurry (38)	N		
Processing and storage of milk products for disposal (40)	N		
Rendering (41)	Y		Comparatively short half-life compared to implementation time
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Figure 4.23 Printout showing example of step 3 information

Radiation Recovery Record Form (RRF)

Test incident: _____ Food _____ Printed on 24/09/2020

Applicable Management Options (MOs) are listed by steps 2 to 7, answer the question for each available option. If the "justification" column is coloured green, then provide relevant information there.	Step 8: Select and combine options that should be considered as part of the strategy. Based on answers given for steps 1 to 7 the remaining MOs are listed below. Those with a pink background have issues that may need attention.	Summary of comments relevant to remaining options, as supplied by user at each of steps 2 to 7
Milk	Milk	
Pre-deposition options	Pre-deposition options	
Close air intake systems at food processing plant (1)	Close air intake systems at food processing plant (1)	
Short term sheltering of animals (4)	Short term sheltering of animals (4)	
General applicability	General applicability	
Natural attenuation (with monitoring) (5)		
Product recall (6)	Product recall (6)	Waste management strategy required; will generate waste; dose assessment required;
Restrict entry into the foodchain (inc FEPA orders) (7)	Restrict entry into the foodchain (inc FEPA orders) (7)	Waste management strategy required; will generate waste; dose assessment required;
Select alternative land use (8)		
Milk	Milk	
Addition of AFCF to concentrate ration (16)		
Addition of calcium to concentrate ration (17)		
Addition of clay minerals to feed (18)		
Clean feeding (20)	Clean feeding (20)	small incremental doses to farmer;
Selective grazing (23)		
Slaughtering (culling) of livestock (24)		
Suppression of lactation before slaughter (25)		
Waste disposal	Waste disposal	
Biological treatment (digestion) of milk (32)		
Burial of carcasses (33)		
Disposal of contaminated milk to sea (35)	Disposal of contaminated milk to sea (35)	Need authorisation; authorisation required;
Incineration (36)		
Landfill (37)		
Landspreading milk/slurry (38)	Landspreading milk/slurry (38)	small incremental doses to farmer;
Processing and storage of milk products for disposal (40)	Processing and storage of milk products for disposal (40)	May be problems getting facilities; premises and dose assessment required;
Rendering (41)		

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Figure 4.24 Printout showing example of step 8 (summary) information

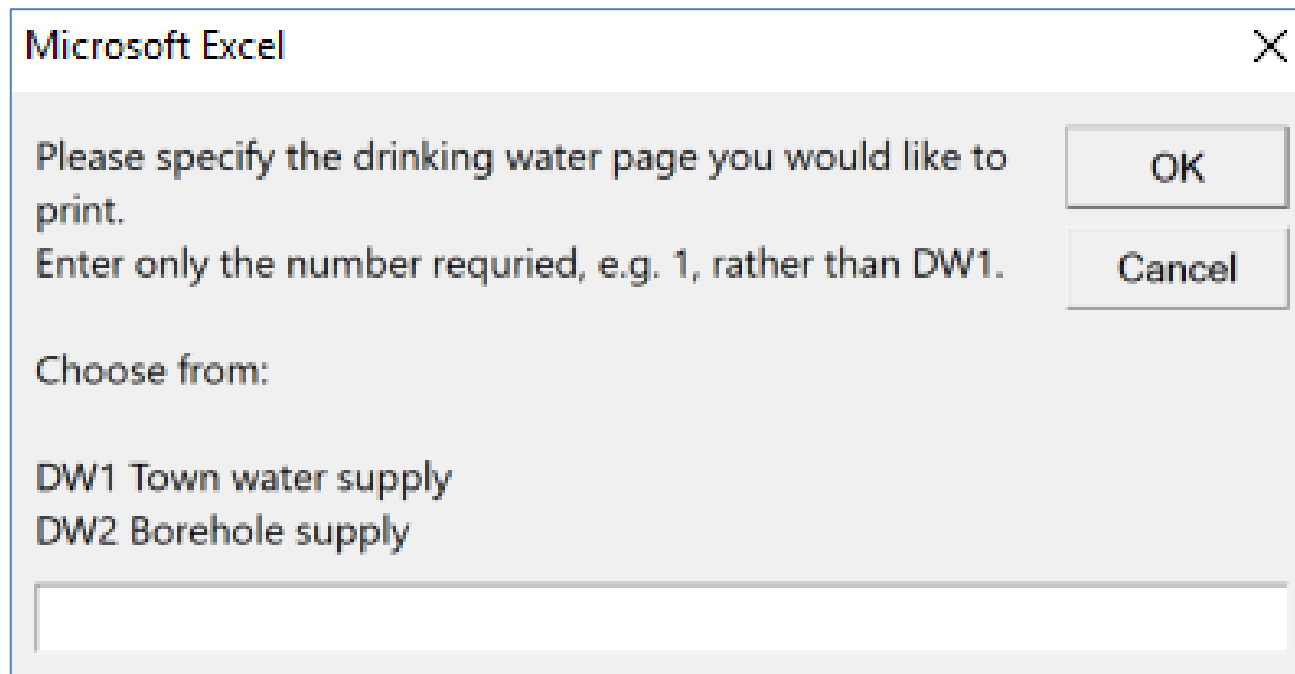


Figure 4.25 Selecting which drinking water page to print

Radiation Recovery Record Form (RRF)

Test incident		DW1 Town water supply		Printed on 24/09/2020	
Please provide information about the supply (or group of supplies) being considered:					
A: Is the supply (or group of supplies) public or private?		Public		Process information about drinking water supply/supplies	
B: Name of supply (maximum of 25 characters)		Town water supply		Add another supply (or group of supplies)	
If there is another another supply (or group of supplies) to consider click the button to add another supply, then answer questions below, as prompted for this supply					
Please answer Question 1:					
Q1. Is it suspected that drinking water has been, or could become, contaminated?		Yes		No	
If answer to Question 1 is "Yes", please answer Questions 2 and 3, then answer further questions as prompted:					
Q2. Is it suspected that contamination of the water supply has occurred after treatment?		Yes		No	
Q3. Based on early estimates of activity concentrations in drinking water, is it VERY UNLIKELY that levels will exceed gross alpha or beta screening levels? (Table 5.5)		Q4. Are measured concentrations in treated drinking water (water supplied "at the tap") > screening levels? (Table 5.5)		Q5. Are concentrations in treated drinking water > UK Action Levels? (Table 1.3)	
Q6. Is there a requirement to reduce activity concentrations in drinking water irrespective of screening levels being exceeded?		Q7. Is the radionuclide short lived?		Q8. Is adding/modifying treatment of private supply an option?	
Possible to exceed screening levels	Y	Y		N	

Figure 4.26 Part 1 of drinking water printout

Radiation Recovery Record Form (RRF)

Step 1a Select the Food Production System(s) that has/have been contaminated - click on green button(s) to select/deselect						Show/Hide Food Systems
Production System	Sources/examples			Contaminated?		
Cereals and grassland	Cereals	Wheat, barley, oats, oil seed rape, rye, maize, grassland		No		
Fruit and vegetables	Fruit&veg	All fruit and vegetables, including herbs and edible flowers		No		
Milk	Milk	Milk and dairy products (cow, sheep, goat)		Yes		
Meat	Meat	Beef, lamb, pork, fowl, chicken		No		
Eggs	Eggs	Hens, ducks, geese and wildfowl		No		
Honey	Honey	Beehives		No		
Freshwater and marine fish	Fish	Marine and freshwater fish and shellfish		No		
Domestic and wild foods and game	Domestic	Domestically produced fruit, vegetables, meat, eggs; wild foods; game		No		
Step 1b Select the radionuclide(s) that are involved - click on the green buttons to select/deselect						Show/Hide Radionuclides
Am-241	No		Ru-103	No		
Co-60	No		Ru-106	No		
Cs-134	No		Se-75	No		
Cs-137	No		Sr-89	No		
I-131	Yes		Sr-90	No		
Pu-238	No					

Figure 4.27 Selecting milk as the contaminated food production system and ¹³¹I as the radionuclide in the RRF

Radiation Recovery Record Form (RRF)

Applicable Management Options (MOs) are listed below. At each of steps 2 to 7, answer the question for each available MO then click the "filter" button at the bottom of the list. If the "justification" column is coloured green, then provide any relevant information there.	Step 2: Is the MO eliminated on basis of common sense (not expert knowledge)?	If eliminating management option(s) after step 2, provide justification for this in the green shaded cells
Milk		
Pre-deposition options		
Close air intake systems at food processing plant (1)	N	
Short term sheltering of animals (4)	N	
General applicability		
Natural attenuation (with monitoring) (5)	N	
Product recall (6)	N	
Restrict entry into the foodchain (inc FEPA orders) (7)	N	
Select alternative land use (8)	N	
Milk		
Addition of AFCF to concentrate ration (16)	N	
Addition of calcium to concentrate ration (17)	N	
Addition of clay minerals to feed (18)	N	
Clean feeding (20)	N	
Selective grazing (23)	N	
Slaughtering (culling) of livestock (24)	N	
Suppression of lactation before slaughter (25)	N	
Waste disposal		
Biological treatment (digestion) of milk (32)	N	
Burial of carcasses (33)	N	
Disposal of contaminated milk to sea (35)	N	
Incineration (36)	N	
Landfill (37)	N	
Landspreading milk/slurry (38)	N	
Processing and storage of milk products for disposal (40)	N	
Rendering (41)	N	

Figure 4.28 RRF listing of available management options for milk (step 2)

Radiation Recovery Record Form (RRF)

Applicable Management Options (MOs) are listed below. At each of steps 2 to 7, answer the question for each available MO then click the "filter" button at the bottom of the list. If the "justification" column is coloured green, then provide any relevant information there.	Step 3: Is the MO eliminated, based on applicability for radionuclide(s)?	If eliminating management option(s) after step 3, provide justification for this in the green shaded cells, or note if option not suitable for some radionuclides, while being considered for others
Milk		
Pre-deposition options		
Close air intake systems at food processing plant (1)	N	
Short term sheltering of animals (4)	N	
General applicability		
Natural attenuation (with monitoring) (5)	N	
Product recall (6)	N	
Restrict entry into the foodchain (inc FEPA orders) (7)	N	
Select alternative land use (8)	Y	Comparatively short half-life compared to implementation time
Milk		
Addition of AFCF to concentrate ration (16)	Y	Option specific to Cs
Addition of calcium to concentrate ration (17)	Y	Option specific to group II of the periodic table
Addition of clay minerals to feed (18)	Y	Option specific to Cs
Clean feeding (20)	N	
Selective grazing (23)	Y	Comparatively short half-life compared to implementation time
Slaughtering (culling) of livestock (24)	Y	Comparatively short half-life compared to implementation time
Suppression of lactation before slaughter (25)	Y	Comparatively short half-life compared to implementation time
Waste disposal		
Biological treatment (digestion) of milk (32)	N	
Burial of carcasses (33)	Y	Not recommended due to potential movement in ground after burial
Disposal of contaminated milk to sea (35)	N	
Incineration (36)	Y	Volatilisation may occur
Landfill (37)	Y	Not recommended due to potential movement in ground after burial
Landspreading milk/slurry (38)	N	
Processing and storage of milk products for disposal (40)	N	
Rendering (41)	Y	Comparatively short half-life compared to implementation time

Figure 4.29 Elimination of options based on applicability for radionuclides (step 3)

Radiation Recovery Record Form (RRF)

Applicable Management Options (MOs) are listed below. At each of steps 2 to 7, answer the question for each available MO then click the "filter" button at the bottom of the list. If the "justification" column is coloured green, then provide any relevant information there.	Step 4: Is the MO eliminated because of major constraints (wastes, technical, costs, time, social) in this scenario?	If eliminating management option(s) after step 4, OR if retaining an option with major constraints, provide justification for this in the green shaded cells
Milk		
Pre-deposition options		
Close air intake systems at food processing plant (1)	No major constraints	
Short term sheltering of animals (4)	No major constraints	
General applicability		
Natural attenuation (with monitoring) (5)	Eliminate option due to major constraint	Large volumes of milk
Product recall (6)	Major constraint but continue to consider option	Waste management strategy required
Restrict entry into the foodchain (inc FEPA orders) (7)	Major constraint but continue to consider option	Waste management strategy required
Select alternative land use (8)		
Milk		
Addition of AFCF to concentrate ration (16)		
Addition of calcium to concentrate ration (17)		
Addition of clay minerals to feed (18)		
Clean feeding (20)	No major constraints	
Selective grazing (23)		
Slaughtering (culling) of livestock (24)		
Suppression of lactation before slaughter (25)		
Waste disposal		
Biological treatment (digestion) of milk (32)	Eliminate option due to major constraint	Very limited capacity for disposal
Burial of carcasses (33)		
Disposal of contaminated milk to sea (35)	Major constraint but continue to consider option	Need authorisation
Incineration (36)		
Landfill (37)		
Landspreading milk/slurry (38)	No major constraints	
Processing and storage of milk products for disposal (40)	Major constraint but continue to consider option	May be problems getting facilities
Rendering (41)		

Figure 4.30 Recording eliminations due to management option constraints in the RRF (step 4)

Radiation Recovery Record Form (RRF)

Applicable <u>Management Options (MOs)</u> are listed below. At each of steps 2 to 7, answer the question for each available MO then click the "filter" button at the bottom of the list. If the "justification" column is coloured green, then provide any relevant information there.	Step 5: <u>Is the MO eliminated because of effectiveness?</u>	If eliminating management option(s) after step 5, provide justification for this in the green shaded cells
Milk		
Pre-deposition options		
Close air intake systems at food processing plant (1)	N	
Short term sheltering of animals (4)	N	
General applicability		
Natural attenuation (with monitoring) (5)		
Product recall (6)	N	
Restrict entry into the foodchain (inc FEPA orders) (7)	N	
Select alternative land use (8)		
Milk		
Addition of AFCF to concentrate ration (16)		
Addition of calcium to concentrate ration (17)		
Addition of clay minerals to feed (18)		
Clean feeding (20)	N	
Selective grazing (23)		
Slaughtering (culling) of livestock (24)		
Suppression of lactation before slaughter (25)		
Waste disposal		
Biological treatment (digestion) of milk (32)		
Burial of carcasses (33)		
Disposal of contaminated milk to sea (35)	N	
Incineration (36)		
Landfill (37)		
Landspreading milk/slurry (38)	N	
Processing and storage of milk products for disposal (40)	N	
Rendering (41)		

Figure 4.31 Recording eliminations due to effectiveness in the RRF (step 5)

Radiation Recovery Record Form (RRF)

Applicable Management Options (MOs) are listed below. At each of steps 2 to 7, answer the question for each available MO then click the "filter" button at the bottom of the list. If the "justification" column is coloured green, then provide any relevant information there.	Step 6: Is the MO eliminated because of wastes or incremental doses?	If eliminating management option(s) after step 6, OR if retaining an option with wastes or doses, provide justification for this in the green shaded cells
Milk		
Pre-deposition options		
Close air intake systems at food processing plant (1)	No wastes or inc. doses	
Short term sheltering of animals (4)	No wastes or inc. doses	
General applicability		
Natural attenuation (with monitoring) (5)		
Product recall (6)	Wastes or inc. doses but continue to consider	will generate waste; dose assessment required
Restrict entry into the foodchain (inc FEPA orders) (7)	Wastes or inc. doses but continue to consider	will generate waste; dose assessment required
Select alternative land use (8)		
Milk		
Addition of AFCE to concentrate ration (16)		
Addition of calcium to concentrate ration (17)		
Addition of clay minerals to feed (18)		
Clean feeding (20)	Wastes or inc. doses but continue to consider	small incremental doses to farmer
Selective grazing (23)		
Slaughtering (culling) of livestock (24)		
Suppression of lactation before slaughter (25)		
Waste disposal		
Biological treatment (digestion) of milk (32)		
Burial of carcasses (33)		
Disposal of contaminated milk to sea (35)	Wastes or inc. doses but continue to consider	authorisation required
Incineration (36)		
Landfill (37)		
Landspreading milk/slurry (38)	Wastes or inc. doses but continue to consider	small incremental doses to farmer
Processing and storage of milk products for disposal (40)	Wastes or inc. doses but continue to consider	presmises and dose assessment required
Rendering (41)		

Figure 4.32 Recording decisions about eliminations due to wastes, in the RRF (step 6)

Radiation Recovery Record Form (RRF)

Applicable Management Options (MOs) are listed below. At each of steps 2 to 7, answer the question for each available MO then click the "filter" button at the bottom of the list. If the "justification" column is coloured green, then provide any relevant information there.	Step 7: Is the MO eliminated by any information in the datasheet? (MUST ANSWER Y OR N TO COMPLETE RECORD)	If eliminating management option(s) after step 7, provide justification for this in the green shaded cells
Milk		
Pre-deposition options		
Close air intake systems at food processing plant (1)	N	
Short term sheltering of animals (4)	N	
General applicability		
Natural attenuation (with monitoring) (5)		
Product recall (6)	N	
Restrict entry into the foodchain (inc FEPA orders) (7)	N	
Select alternative land use (8)		
Milk		
Addition of AFCE to concentrate ration (16)		
Addition of calcium to concentrate ration (17)		
Addition of clay minerals to feed (18)		
Clean feeding (20)	N	
Selective grazing (23)		
Slaughtering (culling) of livestock (24)		
Suppression of lactation before slaughter (25)		
Waste disposal		
Biological treatment (digestion) of milk (32)		
Burial of carcasses (33)		
Disposal of contaminated milk to sea (35)	N	
Incineration (36)		
Landfill (37)		
Landspreading milk/slurry (38)	N	
Processing and storage of milk products for disposal (40)	N	
Rendering (41)		

Figure 4.33 Recording eliminations due to datasheets in the RRF (step 7)

Radiation Recovery Record Form (RRF)

Applicable Management Options (MOs) are listed below. At each of steps 2 to 7, answer the question for each available MO then click the "filter" button at the bottom of the list. If the "justification" column is coloured green, then provide any relevant information there.	Step 8: Select and combine options that should be considered as part of the strategy. Based on answers given for steps 1 to 7 the remaining MOs are listed below. Those with a pink background have issues that may need attention.	Summary of comments relevant to remaining options, as supplied by user at each of steps 2 to 7
Milk	Milk	
Pre-deposition options	Pre-deposition options	
Close air intake systems at food processing plant (1)	Close air intake systems at food processing plant (1)	
Short term sheltering of animals (4)	Short term sheltering of animals (4)	
General applicability	General applicability	
Natural attenuation (with monitoring) (5)		
Product recall (6)	Product recall (6)	Waste management strategy required; will generate waste; dose assessment required;
Restrict entry into the foodchain (inc FEPA orders) (7)	Restrict entry into the foodchain (inc FEPA orders) (7)	Waste management strategy required; will generate waste; dose assessment required;
Select alternative land use (8)		
Milk	Milk	
Addition of AFCF to concentrate ration (16)		
Addition of calcium to concentrate ration (17)		
Addition of clay minerals to feed (18)		
Clean feeding (20)	Clean feeding (20)	small incremental doses to farmer;
Selective grazing (23)		
Slaughtering (culling) of livestock (24)		
Suppression of lactation before slaughter (25)		
Waste disposal	Waste disposal	
Biological treatment (digestion) of milk (32)		
Burial of carcasses (33)		
Disposal of contaminated milk to sea (35)	Disposal of contaminated milk to sea (35)	Need authorisation; authorisation required;
Incineration (36)		
Landfill (37)		
Landspreading milk/slurry (38)	Landspreading milk/slurry (38)	small incremental doses to farmer;
Processing and storage of milk products for disposal (40)	Processing and storage of milk products for disposal (40)	May be problems getting facilities; premises and dose assessment required;
Rendering (41)		

Figure 4.34 Remaining options with notes about potential issues

Radiation Recovery Record Form (RRF)

Step 1a: Select the Surface(s) that have been contaminated (Step 1) (Click on purple button to select/deselect)							Show/Hide Surfaces
Surface		Description		Contaminated?			
Buildings - external surfaces	Ext Build	External hard surfaces eg walls, roofs, windows and doors of all buildings		No			
Buildings - internal surfaces	Int Build	Indoor building surfaces eg walls, floors, ceilings, soft furnishings and furniture		No			
Buildings - semi-enclosed surfaces	Semi-enc	Transport networks: train and bus stations, underground systems		No			
Roads and paved areas	Roads	Roads, pavements, large paved or asphalt areas eg playgrounds, yards car parks		No			
Vehicles	Vehicles	Public transportation vehicles: cars, lorries, trains, buses, trams, boats, aircraft		No			
Soils and vegetation	Soils/Veg	Lawn, flowerbeds, and vegetable plots associated with the gardens of residential dwellings, landscaping around commercial and public buildings, allotments, parks, playing fields and other managed green areas. Also includes all woody plants (eg trees, shrubs and bushes) associated with these areas.		Yes			
Step 1b: Select the radionuclide(s) that are involved (Click on purple button to select/deselect)							Show/Hide Radionuclides
Am-241	No		Pu-239	No			
Ba-140	No		Ra-226	No			
Ce-144	No		Ru-103	No			
Co-60	No		Ru-106	No			
Cs-134	No		Se-75	No			
Cs-136	No		Sr-89	No			
Cs-137	Yes		Sr-90/Y-90	No			
I-131	No		Te-132	No			
Ir-192	No		U-235	No			
Mo-99/Tc-99m	No		Yb-169	No			
Pu-238	No		Zr-95	No			

Figure 4.35 Selecting soil and vegetation as surface type and ¹³⁷Cs as radionuclide in the RRF

<p>Applicable <u>Management Options (MOs)</u> are listed below. At each of steps 2 to 7, answer the question for each available MO then click the "filter" button at the bottom of the list. If the "justification" column is coloured purple, then provide any relevant information there.</p>	<p>Step 2: Is the MO eliminated on basis of common sense (not expert knowledge)?</p>	<p>If eliminating management option(s) after step 2, provide justification for this in the purple shaded cells</p>
<p>Soils and vegetation</p>		
<p>Restrict access options</p>		
Control workforce access (1)	Y	Not appropriate for residential areas
Permanent relocation from residential areas (3)	Y	Too disruptive to be justified for predicted dose levels
Restrict public access (4)	Y	Not appropriate for residential areas
Temporary relocation from residential areas (5)		
<p>Remediation options</p>		
Collection of leaves (6)	Y	Leaves still on trees
Cover grass/soil with clean soil/asphalt (7)		
Grass cutting and removal (10)		
Manual and mechanical digging (11)		
Natural attenuation (with monitoring) (13)		
Ploughing methods (14)	Y	Not relevant to city gardens as areas too small
Snow/ice removal (18)	Y	Not relevant in June
Tie down (23)		
Topsoil and turf removal (24)		
Tree and shrub pruning and removal (27)		

Figure 4.36 RRF listing of available management options for soil and vegetation (step 2)

<p>Applicable <u>Management Options (MOs)</u> are listed below. At each of steps 2 to 7, answer the question for each available MO then click the "filter" button at the bottom of the list. If the "justification" column is coloured purple, then provide any relevant information there.</p>	<p>Step 3: <u>Is the MO eliminated as inappropriate for radionuclide(s) considered?</u></p>	<p>If eliminating management option(s) after step 3, provide justification for this in the purple shaded cells</p>
<p>Soils and vegetation</p> <p>Restrict access options</p>		
Control workforce access (1)		
Permanent relocation from residential areas (3)		
Restrict public access (4)		
Temporary relocation from residential areas (5)	N	
<p>Remediation options</p>		
Collection of leaves (6)		
Cover grass/soil with clean soil/asphalt (7)	N	
Grass cutting and removal (10)	N	
Manual and mechanical digging (11)	N	
Natural attenuation (with monitoring) (13)	N	
Ploughing methods (14)		
Snow/ice removal (18)		
Tie down (23)	Y	Inhalation of resuspended material not important for this radionuclide
Topsoil and turf removal (24)	N	
Tree and shrub pruning and removal (27)	N	

Figure 4.37 Elimination of options based on applicability for radionuclides (step 3)

Radiation Recovery Record Form (RRF)

<p>Applicable <u>Management Options (MOs)</u> are listed below. At each of steps 2 to 7, answer the question for each available MO then click the "filter" button at the bottom of the list. If the "justification" column is coloured purple, then provide any relevant information there.</p>	<p>Step 4: <u>Is the MO eliminated because of major constraints (wastes, technical, costs, time, social) in this scenario?</u></p>	<p>If eliminating management option(s) after step 4, OR if retaining an option with major constraints, provide justification for this in the purple shaded cells</p>
<p>Soils and vegetation</p>		
<p>Restrict access options</p>		
Control workforce access (1)		
Permanent relocation from residential areas (3)		
Restrict public access (4)		
Temporary relocation from residential areas (5)	Major constraint but continue to consider option	Disruptive and needs accomodation and transport
<p>Remediation options</p>		
Collection of leaves (6)		
Cover grass/soil with clean soil/asphalt (7)	Eliminate option due to major constraint	Asphalt unacceptable and soil requires too large a volume
Grass cutting and removal (10)	Major constraint but continue to consider option	Not effective if heavy rain after deposition
Manual and mechanical digging (11)	Major constraint but continue to consider option	Onlt on small scale
Natural attenuation (with monitoring) (13)	Major constraint but continue to consider option	Equipment and skilled personnel required
Ploughing methods (14)		
Snow/ice removal (18)		
Tie down (23)		
Topsoil and turf removal (24)	Major constraint but continue to consider option	Waste management required
Tree and shrub pruning and removal (27)	Major constraint but continue to consider option	Needs to be implemented quickly and before rain

Figure 4.38 Recording eliminations due to management option constraints in the RRF (step 4)

<p>Applicable <u>Management Options (MOs)</u> are listed below. At each of steps 2 to 7, answer the question for each available MO then click the "filter" button at the bottom of the list. If the "justification" column is coloured purple, then provide any relevant information there.</p>	<p>Step 5: <u>Is the MO eliminated because of effectiveness?</u></p>	<p>If eliminating management option(s) after step 5, provide justification for this in the purple shaded cells</p>
<p>Soils and vegetation</p>		
<p>Restrict access options</p>		
Control workforce access (1)		
Permanent relocation from residential areas (3)		
Restrict public access (4)		
Temporary relocation from residential areas (5)	N	
<p>Remediation options</p>		
Collection of leaves (6)		
Cover grass/soil with clean soil/asphalt (7)		
Grass cutting and removal (10)	Y	Not effective after wet deposition
Manual and mechanical digging (11)	N	
Natural attenuation (with monitoring) (13)	N	
Ploughing methods (14)		
Snow/ice removal (18)		
Tie down (23)		
Topsoil and turf removal (24)	N	
Tree and shrub pruning and removal (27)	Y	Not effective after wet deposition

Figure 4.39 Recording eliminations due to effectiveness in the RRF (step 5)

Radiation Recovery Record Form (RRF)

<p>Applicable <u>Management Options (MOs)</u> are listed below. At each of steps 2 to 7, answer the question for each available MO then click the "filter" button at the bottom of the list. If the "justification" column is coloured purple, then provide any relevant information there.</p>	<p>Step 6: <u>Is the MO eliminated because of wastes?</u></p>	<p>If eliminating management option(s) after step 6, OR if retaining an option with wastes, provide justification for this in the purple shaded cells</p>
Soils and vegetation		
Restrict access options		
Control workforce access (1)		
Permanent relocation from residential areas (3)		
Restrict public access (4)		
Temporary relocation from residential areas (5)	No wastes or inc. doses	
Remediation options		
Collection of leaves (6)		
Cover grass/soil with clean soil/asphalt (7)		
Grass cutting and removal (10)		
Manual and mechanical digging (11)	No wastes or inc. doses	
Natural attenuation (with monitoring) (13)	No wastes or inc. doses	
Ploughing methods (14)		
Snow/ice removal (18)		
Tie down (23)		
Topsoil and turf removal (24)	Wastes or inc. doses but continue to consider	Waste management strategy required
Tree and shrub pruning and removal (27)		

Figure 4.40 Recording decisions about eliminations due to wastes, in the RRF (step 6)

Radiation Recovery Record Form (RRF)

<p>Applicable <u>Management Options (MOs)</u> are listed below. At each of steps 2 to 7, answer the question for each available MO then click the "filter" button at the bottom of the list. If the "justification" column is coloured purple, then provide any relevant information there.</p>	<p>Step 7: Is the MO eliminated by any information in the datasheet? (MUST ANSWER Y OR N TO COMPLETE RECORD)</p>	<p>If eliminating management option(s) after step 7, provide justification for this in the purple shaded cells</p>
<p>Soils and vegetation</p> <p>Restrict access options</p>		
Control workforce access (1)		
Permanent relocation from residential areas (3)		
Restrict public access (4)		
Temporary relocation from residential areas (5)	N	
<p>Remediation options</p>		
Collection of leaves (6)		
Cover grass/soil with clean soil/asphalt (7)		
Grass cutting and removal (10)		
Manual and mechanical digging (11)	N	
Natural attenuation (with monitoring) (13)	N	
Ploughing methods (14)		
Snow/ice removal (18)		
Tie down (23)		
Topsoil and turf removal (24)	N	
Tree and shrub pruning and removal (27)		

Figure 4.41 Recording eliminations due to datasheets, in the RRF (step 7)

Step 8: Select and combine options that should be considered as part of the strategy. Based on answers given for steps 1 to 7 the remaining MOs are listed below. Those with a pink background have issues that may need attention.		Summary of comments relevent to remaining options, as supplied by user at each of steps 2 to 7
Soil and vegetation		
Restrict access options		
Temporary relocation from residential areas (5)	Disruptive and needs accomodation and transport;	
Remediation options		
Manual and mechanical digging (11) Natural attenuation (with monitoring) (13)	Onlt on small scale; Equipment and skilled personnel required;	
Topsoil and turf removal (24)	Waste management required; Waste management strategy required;	

Figure 4.42 Remaining options with notes about potential issues

Radiation Recovery Record Form (RRF)

Please provide information about the supply (or group of supplies) being considered:

A: Is the supply (or group of supplies) public or private?	Public	Process information about drinking water supply/supplies
B: Name of supply (maximum of 25 characters)	Town water supply	

If there is another another supply (or group of supplies) to consider click the button to add another supply, then answer questions below, as prompted for this supply

Add another supply (or group of supplies)

Figure 4.43 Entering information about the water supply in the RRF

Complete record of supplied answers, user supplied information, and recommendations:

Status Incident_Information Food Inhabited_Areas DW1 Town water supply DW2 Borehole supply Printing Answers

Figure 4.44 Addition of a second drinking water supply to the RRF

Please answer Question 1:

Q1. Is it suspected that drinking water has been, or could become, contaminated? Yes No

If answer to Question 1 is "Yes", please answer Questions 2 and 3, then answer further questions as prompted:

Q2. Is it suspected that contamination of the water supply has occurred after treatment? Yes No

Q3. Based on early estimates of activity concentrations in drinking water, is it VERY UNLIKELY that levels will exceed gross alpha or beta screening levels? (Table 5.5)

Q4. Are measured concentrations in treated drinking water (water supplied "at the tap") > screening levels? (Table 5.5)

Q5. Are concentrations in drinking water > UK Action (Table 1.3)

Q8. Is adding/ private :

See recommendations from Q3 See recommendations from Q4 See recommendations from from Q7 See recomm

User supplied information:

Add user sup

Microsoft Excel
IT IS SUSPECTED THAT WATER IS (OR COULD BECOME) CONTAMINATED
Please answer Question 2
OK

Figure 4.45 RRF while answering question 1

Radiation Recovery Record Form (RRF)

Please provide information about the supply (or group of supplies) being considered:				
A: Is the supply (or group of supplies) public or private?	Public			Process information about drinking water supply/supplies
B: Name of supply (maximum of 25 characters)	Town water supply			
If there is another another supply (or group of supplies) to consider click the button to add another supply, then answer questions below, as prompted for this supply				Add another supply (or group of supplies)
Please answer Question 1:				
Q1. Is it suspected that drinking water has been, or could become, contaminated?		Yes	No	Reset
If answer to Question 1 is "Yes", please answer Questions 2 and 3, then answer further questions as prompted:				
Q2. Is it suspected that contamination of the water supply has occurred after treatment?		Yes	No	

Figure 4.46 RRF after answering question 2

Q3. Based on early estimates of activity concentrations in drinking water, is it VERY UNLIKELY that levels will exceed gross alpha or beta screening levels? (Table 5.5)	Q4. Are measured concentrations in treated drinking water (water supplied "at the tap") > screening levels? (Table 5.5)	Q5. Are concentrations in treated drinking water > UK Action Levels? (Table 1.3)	Q6. Is there a requirement to reduce activity concentrations in drinking water irrespective of screening levels being exceeded?	Q7. Is the radionuclide short lived?
Possible to exceed screening levels				
See recommendations from Q3	See recommendations from Q4	See recommendations from Q5	See recommendations from Q6	See recommendations from Q7
User supplied information:				
Early ground deposition measurements suggest concern is Cs-137. Early measurements of gross beta activity originating from surface water supplies suggest screening levels likely to be exceeded.				

Figure 4.47 Adding user supplied information to the RRF after answering question 3 for supply 1

is YES, please answer Questions 2 and 3, then answer further que
ination of the water supply has occurred after treatment?

ites of activity water, is it VERY ed gross alpha or (Table 5.5)	Q4. Are measured concentrations in treated drinking water (water supplied "at the tap") > screening levels? (Table 5.5)	Q5. Are concentrations drinking water > UK Act (Table 1.3)
vels	Y	
om Q3	See recommendations from Q4	See recommendations fr
on:		
rements suggest concern is Cs-137. Early measurements of gross beta activity originating		

Figure 4.48 RRF after answering question 4 for drinking water supply 1

rad concentrations in ter (water supplied "at ng levels? (Table 5.5)	Q5. Are concentrations in treated drinking water > UK Action Levels? (Table 1.3)	Q6. Is there a requ activity concentr water irrespective being ex
	Y	
ations from Q4	See recommendations from Q5	See recommenda
measurements of gross beta activity originating from surface water supplies sug		

Figure 4.49 RRF after answering question 5 for drinking water supply 1

<p>Q6. Is there a requirement to reduce activity concentrations in drinking water irrespective of screening levels being exceeded?</p>	<p>Q7. Is the radionuclide short lived?</p>
<p>N</p>	
<p>See recommendations from Q6</p>	<p>See recommendations from Q7</p>

Figure 4.50 RRF after answering question 7 for drinking water supply 1

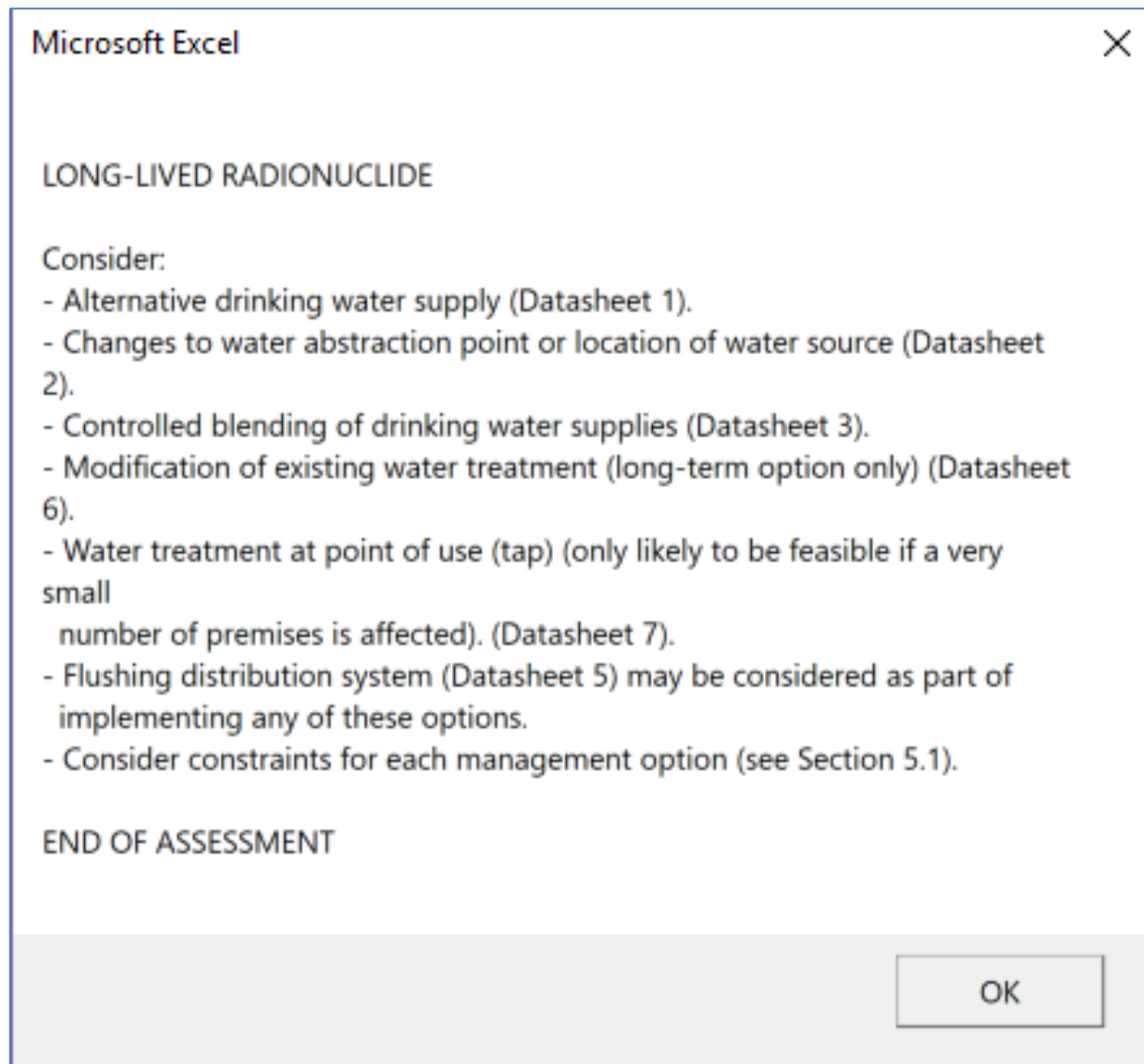


Figure 4.51 Recommendations for drinking water supply 1 displayed in the RRF

Public supply selected: Town water supply

IT IS SUSPECTED THAT WATER IS (OR COULD BECOME) CONTAMINATED

IT IS NOT SUSPECTED THAT CONTAMINATION OF THE WATER SUPPLY HAS OCCURRED AFTER TREATMENT

- Identify water supplies that are of potential concern, taking into account likely timescales of contamination (public and private) (See Sections 3.1 and 3.2)
- Set up monitoring of public drinking water supplies
- Organise monitoring of private water supplies (screening methods)
- Estimate activity concentrations in drinking water using all available environmental measurements while waiting for results of drinking water monitoring (Section 5.2). If radionuclide specific data are available in water source (untreated water), use to estimate activity concentrations in drinking water using likely effectiveness of normal water treatment (Table 5.3)

EARLY ESTIMATES SUGGEST THE CONCENTRATIONS IN DRINKING WATER MAY EXCEED SCREENING LEVELS:

- Consider advising people to stop using water supply for drinking or culinary preparation (perhaps other uses as well) and provide alternative supply (Datasheet 1) while awaiting sample analyses
- High priority for analyses and further monitoring
- Assess doses to people (Appendix A)
- Consider implementing other management options that can be put in place quickly while awaiting sample analyses (Section 7)
 - 'Changes to water abstraction or location of water source' (Datasheet 2)
 - 'Controlled blending of drinking water supplies' (Datasheet 3)
- If stored clean water is available, try and reduce water usage to maximise time this clean water supply will last
- If people are still sheltering in the area where drinking water supplies are affected, providing an alternative water supply (Datasheet 1) is unlikely to be feasible

USER SUPPLIED INFORMATION: Ground deposition measurements suggest that concern is Cs-137, and gross beta activity concentrations in treated water originating from surface water supplies are likely to exceed the screening level

MEASURED CONCENTRATIONS > SCREENING LEVELS:

- Undertake radionuclide specific analyses for radionuclides identified as potential concern using knowledge of incident

USER SUPPLIED INFORMATION: Analytical results for supply 1 show that gross beta screening level has been exceeded

CONCENTRATIONS IN TREATED DRINKING WATER > UK ACTION LEVELS:

- Radionuclides of concern need to have been identified using radionuclide specific analyses if not yet carried out

USER SUPPLIED INFORMATION: 500 Bq/litre for Cs-134 and 1000 Bq/l for Cs-137. UK action level exceeded

LONG-LIVED RADIONUCLIDE

Consider:

- Alternative drinking water supply (Datasheet 1)
- Changes to water abstraction point or location of water source (Datasheet 2)
- Controlled blending of drinking water supplies (Datasheet 3)
- Modification of existing water treatment (long-term option only) (Datasheet 6)
- Water treatment at point of use (tap) (only likely to be feasible if a very small number of premises is affected). (Datasheet 7)
- Flushing distribution system (Datasheet 5) may be considered as part of implementing any of these options.
- Consider constraints for each management option (see Section 5.1)

END OF ASSESSMENT

Figure 4.52 Completed RRF output for drinking water supply 1 (public supply)

Radiation Recovery Record Form (RRF)

Q3. Based on early estimates of activity concentrations in drinking water, is it VERY UNLIKELY that levels will exceed gross alpha or beta screening levels? (Table 5.5)	Q4. Are measured concentrations in treated drinking water (water supplied "at the tap") > screening levels? (Table 5.5)	Q5. Are concentrations in treated drinking water > UK Action Levels? (Table 1.3)	Q6. Is there a requirement to reduce activity concentrations in drinking water irrespective of screening levels being exceeded?	Q7. Is the radionuclide short lived?
Very unlikely to exceed screening levels				
See recommendations from Q3	See recommendations from Q4	See recommendations from Q5	See recommendations from Q6	See recommendations from Q7
User supplied information:				

Figure 4.53 RRF after answering question 3 for drinking water supply 2

Q5. Are concentrations in treated drinking water > UK Action Levels? (Table 1.3)	Q6. Is there a requirement to reduce activity concentrations in drinking water irrespective of screening levels being exceeded?	Q7. Is the radionuclide short lived?
	Y	
See recommendations from Q5	See recommendations from Q6	See recommendations from Q7

Figure 4.54 RRF after answering question 6 for drinking water supply 2

Q6. Is there a requirement to reduce activity concentrations in drinking water irrespective of screening levels being exceeded?	Q7. Is the radionuclide short lived?	Q8. Is adding/modifying treatment of private supply an option?
N	Y	
See recommendations from Q6	See recommendations from Q7	See recommendations from Q8

Figure 4.55 RRF after answering question 8 for drinking water supply 2

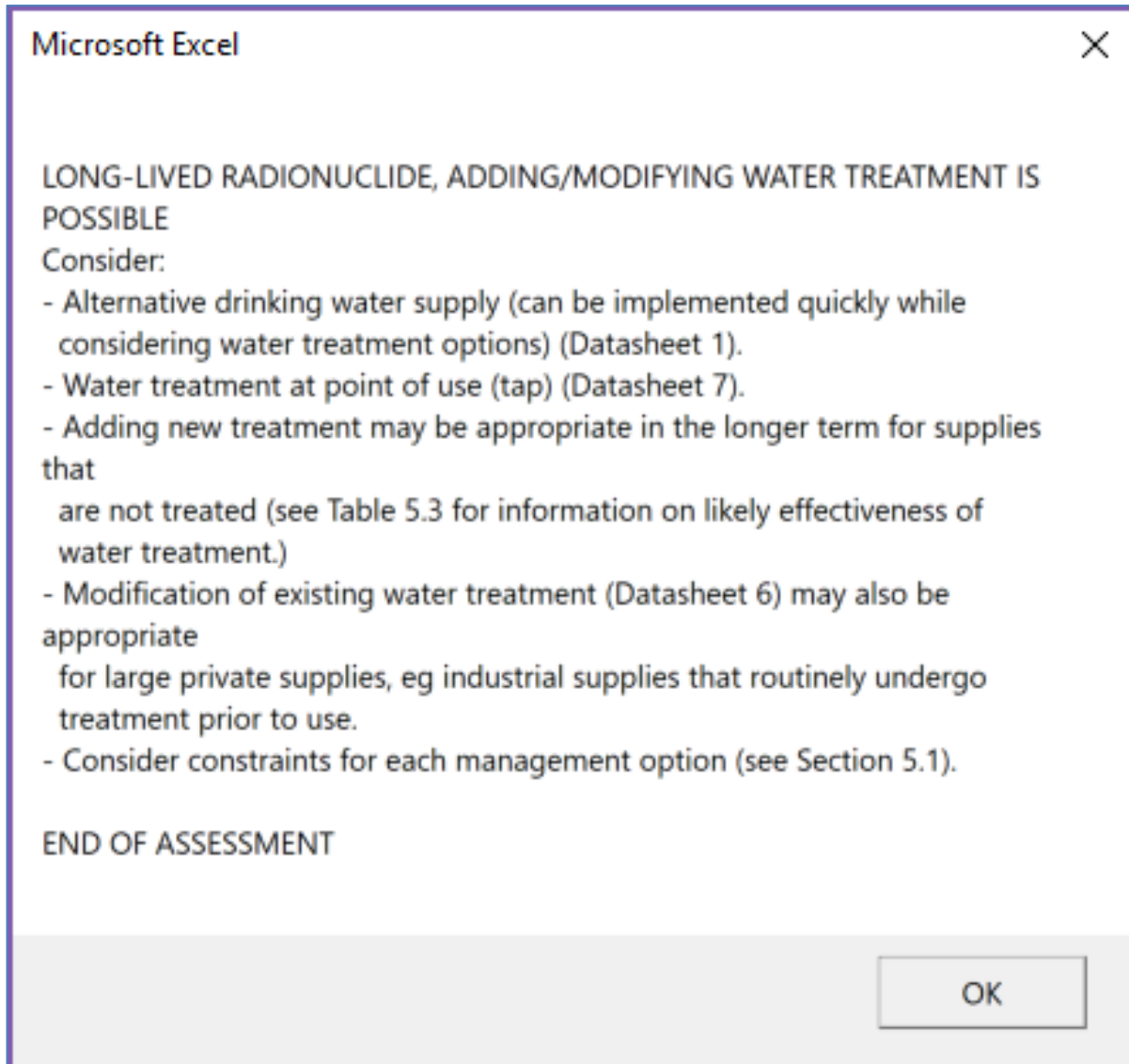


Figure 4.56 Recommendations for drinking water supply 2 displayed in the RRF

Private supply selected: Borehole supply

IT IS SUSPECTED THAT WATER IS (OR COULD BECOME) CONTAMINATED

IT IS NOT SUSPECTED THAT CONTAMINATION OF THE WATER SUPPLY HAS OCCURRED AFTER TREATMENT

- Identify water supplies that are of potential concern, taking into account likely timescales of contamination (public and private) (See Sections 3.1 and 3.2)
- Set up monitoring of public drinking water supplies
- Organise monitoring of private water supplies (screening methods)
- Estimate activity concentrations in drinking water using all available environmental measurements while waiting for results of drinking water monitoring (Section 5.2). If radionuclide specific data are available in water source (untreated water), use to estimate activity concentrations in drinking water using likely effectiveness of normal water treatment (Table 5.3)

EARLY ESTIMATES SUGGEST THE CONCENTRATIONS IN DRINKING WATER VERY UNLIKELY TO EXCEED SCREENING LEVELS:

- Sample analyses are lower priority than those for supplies exceeding screening levels
- There may be pressure to provide an alternative supply of clean water for reassurance purposes until measurement results can confirm estimates (Datasheet 1)
- For situations where early estimates suggest that no affected supplies have levels that exceed screening levels, prioritise sample analyses

USER SUPPLIED INFORMATION: Borehole supply so very unlikely that contamination will reach supply at this stage

THERE ARE OTHER REQUIREMENTS TO REDUCE ACTIVITY CONCENTRATIONS:

- Radionuclides of concern need to have been identified using radionuclide specific analyses if not yet carried out USER SUPPLIED INFORMATION: Supply used by families with young children leading to increased concern

LONG-LIVED RADIONUCLIDE, ADDING/MODIFYING WATER TREATMENT IS POSSIBLE

Consider:

- Alternative drinking water supply (can be implemented quickly while considering water treatment options) (Datasheet 1)
- Water treatment at point of use (tap) (Datasheet 7)
- Adding new treatment may be appropriate in the longer term for supplies that are not treated (see Table 5.3 for information on likely effectiveness of water treatment)
- Modification of existing water treatment (Datasheet 6) may also be appropriate for large private supplies, eg industrial supplies that routinely undergo treatment prior to use
- Consider constraints for each management option (see 135.1)

END OF ASSESSMENT

Figure 4.57 Completed RRF output for drinking water supply 2 (private supply)

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