HardSPEC Refinements – preliminary guidance

The following document is intended to detail some potential refinements which could be made to a HardSPEC assessment should further information be required to display an acceptable risk following a first tier evaluation. The document considers refinements for first tier assessments using any of the scenarios in HardSPEC version 1.4.2 which comprises the original HardSPEC amenity use scenario, as well as the home garden, and railway scenarios.

The tables below present all of the potential refinements for the amenity scenario, the railway scenario and the home garden scenario. They include summaries of potential refinements which are considered difficult or unlikely as well as those which are considered as potentially more feasible. The presentation of difficult or unlikely refinements is included to help Applicants make informed decisions as to whether an approach is likely to be considered inappropriate.

The table details considerations of refinements of specific input parameters or assumptions which underpin the modelling scenarios; the study, data or information types that may be required to refine them, and the quantity of the data/ information which would be likely to be required. Additional notes are presented in order to clarify the reasoning of the group and to present a conclusion on the feasibility of the approach.

The potential refinements considered below are intended to be comprehensive. Nevertheless, it is acknowledged that any such consideration may not be exhaustive, and therefore HSE would still assess refinements which are not included in the list below. However, it is recommended that Applicants contact HSE to discuss the feasibility of any alternative approach prior to undertaking or submitting that approach in an application.

Applicants may wish to note that the HardSPEC excel spreadsheet is protected so that cells not requiring inputs by the user for a first tier assessment cannot be altered in error. However a password is not required by the user to ‘unprotect’ the model, and therefore for revised higher tier assessments, users can amend underlying assumptions/ calculations which underpin the model if the refinement method used means that it is appropriate to do so. Any such amendments should be documented by the Applicant as part of a higher tier submission to HSE.

<u>Relationship between the Kp sorption study and wash-off study</u>

Information is given in the following tables (see points 2 and 3 in the Amenity Use Scenario table) regarding refinement of the first-tier model run by revising either the Kp input parameter or the underlying relationships within the model derived from wash-off studies and the relationship with the adsorption Kp derived from sorption studies. Because the two studies provide inter-related values it is suggested that the tiered refinement scheme shown in Figure 1 below is considered. As a first step to refinement it is envisaged that a Kp study would be easier and cheaper to perform than a wash-off study which is

practically more difficult to perform and more costly than the surface specific sorption study. However when making the decision on the refinement approach appropriate for a specific compound Applicants are advised to consider the following text as well as information supplied in the following tables and in the HardSPEC guidance document.

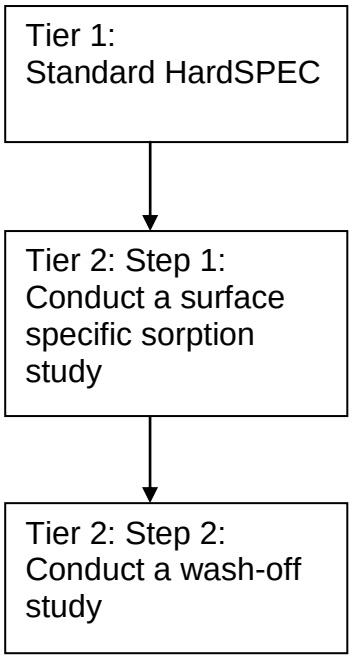

Figure 1: Tiered refinement scheme for consideration of refinements to input surface specific Kp parameters and wash-off from hard surfaces.

As described in the HardSPEC guidance document[1] the adsorption values from the sorption phase of surface specific sorption studies were used during model development to describe a standard relationship between a compounds Koc derived from soil in batch sorption studies and the surface specific Kp. The relationships derived are used in the model for the calculation of surface specific Kp values from the input Koc. Therefore the value of refinement of the input Kp via derivation from a Kp study arises when that relationship is uncertain for the specific compound being modelled. This may be, for example, when the Koc is derived from a wide-range of individual values or is uncertain for other reasons. Therefore, in this situation it would be appropriate to derive surface specific measured values for direct input to the HardSPEC model via a surface specific sorption study as in Tier 2: Step 1. However, it should be noted that owing to the time taken for sorption to be derived the method is not suitable for rapidly degrading or dissipating compounds.

The surface specific sorption Kp values are also used alongside the wash-off studies in order to derive relationships which underpin the model (see the

[1] HOLLIS, J.M., RAMWELL, C.T., and HOLMAN, I.P (2004). HardSPEC: A First-tier Model for Estimating Surface- and Ground-Water Exposure resulting from Herbicides applied to Hard Surfaces. (+ 3 Appendices - NB. the HardSPEC Guidance document is available from the HSE website).

HardSPEC guidance document[1] for full details). Therefore it is not appropriate to use a sorption specific Kp value derived in a different manner to that indicated in the following table. As examples, it is not appropriate to use Kp values derived for different sorption periods than recommended, or to use a Kp derived from a desorption phase.

Because relationships which underpin the model are derived from the relationship between the wash off study and the surface specific sorption study it is preferable to conduct the sorption study prior to performing a wash-off study. However, Kp values can be derived from wash-off studies and where Kp values derived from sorption studies are not available (e.g. because of rapid hydrolysis of the test compound) it is possible to proceed directly to the wash-off study in Tier 2: Step 2 in order to do this. Additionally, it is recognised that conducting both a sorption study and a wash off study may require significant resource and therefore where surface specific Kp values are not required to be derived it is considered possible to proceed directly to the wash-off study.

When presenting a refinement along these lines, Applicants are therefore advised to include their reasoning for the specific approach taken. However, unless it is considered that the specific physico-chemical characteristics of the compound being modelled would increase sorption or rapid dissipation of the compound within a 24 hour period, such an experiment is unlikely to reduce wash-off.

HardSPEC - Amenity Scenario

	Input parameter/ assumption to be refined	Study/ information/ data type	Amount of information required	Additional Notes
1.	Percentage of the applied amount impacting as spray drift.	Drift data from appropriate studies would be required. For products which utilise an application method specific to that product which would reduce the drift, it would need to be shown that the new method would be the only one used.	A large amount of data would be required. If amending drift data for an existing application method then the amount of that data would be required to at least match the amount of data from the Ganzelmeier data set. If the product utilises a different application method that is specific to that product then the amount of data required may be reduced.	The drift assumed in the model for the amenity scenario is currently based on application by hand held equipment to a crop < 50 cm high and 1 m from water body. The actual values assumed are based on spray drift from FOCUS which is derived from BBA (2000) data. It should also be noted that the model assumes that inputs to surface water bodies via drift are not deposited on the hard surface and are therefore not available for run-off. Therefore reducing the input to surface waters via drift would increase the amount of active substance deposited on the hard surface (due to sedimentation of larger droplets) and would increase the amount of active substance available for run-off.
2	Measured Kp	Surface specific	Applicants needing to carry out	Surface specific sorption studies are

	Input parameter/ assumption to be refined	Study/ information/ data type	Amount of information required	Additional Notes
	asphalt/ concrete.	sorption study.	the study should contact Dr. C. Ramwell, The Food and Environment Research Agency, Sand Hutton, York. YO41 1LZ (Email: carmel.ramwell@fera.co.uk; Tel: +44 (0)1904 462485).	recommended where uncertainty exists in the relationship in the first tier model between Kp and Koc. An example of this is where a compound's Koc derived from soil studies exhibits a wide range of values. It should be noted that for some active substances a Kp study may be inappropriate (e.g. those which rapidly hydrolyse) or of little use on its own and would be better employed with a wash-off study which ensures greater consistency between the parameters derived. See point 3 below for further considerations on the likelihood on acceptability of the use of measured surface specific Kp data. Also see text in the introduction section above.
3	Amendment of wash-off	Substance specific wash-off study.	Applicants needing to carry out the study should contact	In situations where it is not possible to measure a surface specific Kp

	Input parameter/ assumption to be refined	Study/ information/ data type	Amount of information required	Additional Notes
	percentage from concrete, asphalt and ballast.	Wash off studies are recommended to derive a compounds surface specific Kp values where appropriate Kp values cannot be derived from the sorption study described at point 2 above due to the compound's properties (e.g. for compounds that hydrolyse rapidly). Wash-off studies can also be used to derive wash off factors which would allow some of the parameters which underpin the model to be amended.	Dr. C. Ramwell, The Food and Environment Research Agency, Sand Hutton, York. YO41 1LZ (Email: carmel.ramwell@fera.co.uk; Tel: +44 (0)1904 462485).	value using the test described in point 2 above (i.e. for compounds which rapidly hydrolyse) it is possible to derive a calibrated Kp from a wash-off study. Where the Kp of a compound can be derived from the sorption study described it is preferable to do so. In the model, the surface specific Kp value (or that calculated from the user-input Koc) determines initial sorption and then the reduction in the amount of modelled compound sorbed to the hard surface after a rainfall event using the relationships derived from the wash-off and Kp studies which underpin the model assumptions. Therefore, it should be noted that a wash-off study is better employed with a sorption study where it is possible to do so because this ensures greater consistency between the parameters derived. However it is recognised that this may require significant resource and therefore it

	Input parameter/ assumption to be refined	Study/ information/ data type	Amount of information required	Additional Notes
				may be possible to perform the wash-off study alone. Applicants should consider the physico-chemical properties of the compound to be tested along with those compounds which have been used in the underlying tests which underpin the model assumptions, and further consider whether a substance specific wash–off study is required in addition to the surface specific Kp test. In such an instance it is appropriate to derive a Kp value from a Kp study prior to performing the wash-off study (if the study can be performed), as knowing the surface specific Kp allows the wash off study to be more appropriately conducted for the compound to be tested. Also see text in the introduction section above.
4	DT50 on hard surfaces (days).	For substances which are rapidly dissipating	Information to show that a compound is rapidly dissipating	It is recognized that some substances may dissipate very rapidly, for

	Input parameter/ assumption to be refined	Study/ information/ data type	Amount of information required	Additional Notes
		rather than degrading information or data would be required to show that a substance would be very rapidly dissipating via, for example, volatilisation. For both rapidly dissipating and degrading substances the model assumptions or input parameters may be amended. A study to determine the rate of dissipation of a compound on specific hard surfaces (i.e. a study to measure a DT50hard surface) would allow hard surface specific	from, for example, volatilisation studies, or validated measured vapour pressure from an EU LoEP could be used to support argumentation that the compound will be rapidly dissipating. A significant amount of study data should be presented to justify the proposed reduction in the application amount.	example as a result of volatilisation or very rapid degradation. In such cases, users should adjust the application amount input parameter to take account of the amount of substance applied that is likely to be lost via volatilization or other mechanisms during the 24 hours between application and rainfall. Such an approach should only be used where a significant amount of study data can be presented to justify the proposed reduction in the application amount. Based on previous precedent, taking into account uncertainty of the rain free period, the period when dissipation processes can be assumed to occur should be limited to 6 hours not the full 24 hours. In addition, where such an approach is applied, users must also undertake a model run using the full application amount, in order to estimate PECsw resulting from spray drift losses on the day of application. The subsequent risk assessment

	Input parameter/ assumption to be refined	Study/ information/ data type	Amount of information required	Additional Notes
		DT50 values to be input rather than calculated from available aerobic soil degradation studies. It should be noted that, at the time of writing, there are no study guidelines or protocols available for the determination of DT50hard surface.		must take into account the highest predicted concentration from the two model runs. Degradation DT50 on the hard surface or soil is not a sensitive parameter in terms of peak surface water PECs (apart from the pond scenario – which is also affected by the DT50 in water input parameter) unless the DT50 is very short (i.e. < 1 day). In that instance it should be considered whether the modelled compound is a precursor to the 'real active substance' or not. It is the 'real active substance' which possesses the herbicidal activity which should be modelled. Peak PECsw values are more likely to be sensitive to a change in the hard surface DT50 in the home garden scenario. For all other situations it is anticipated that amending the hard surface DT50 will not significantly affect the peak PECsw value. However degradation DT50 can affect peak groundwater

	Input parameter/ assumption to be refined	Study/ information/ data type	Amount of information required	Additional Notes
				PECs and time dependant surface water PECs significantly. The HardSPEC model assumes at the first tier that a hard surface DegT50 = 2 x DegT50soil. This is considered likely to be a worst case assumption but is not based on measured data. Therefore it would be feasible to refine the hard surface DegT50 value for specific substances if measured data were available. No guidelines are currently available to measure hard surface DT50 values, and due to potential analytical problems it is envisaged that DT50 values are likely to represent dissipation as they are likely to include losses due to degradation and sorption to the hard surface. Therefore implementation of a measured DT50 within the model may be problematical, since sorption may be double-counted. It is advised that in setting up any study to measure a compounds specific hard

	Input parameter/ assumption to be refined	Study/ information/ data type	Amount of information required	Additional Notes
				surface DegT50 Applicants should consider the 3 key degradation processes which could impact upon a compound on a hard surface; specifically these are photolysis, hydrolysis and microbial degradation.
5	Retention in the catchment.	It would be appropriate to start with a literature review in the first instance. It may be appropriate to perform field studies. Refinement of assumptions which underpin the model would then follow.	A significant amount of additional information (at least matching that which underpins the model plus additional information to contextualise or use all of the information which both underpins the model and any additional information) would be required.	Retention in the catchment includes two broad processes: physical retention of surface run-off and partitioning and sorption during catchment transport. The studies which underpin HardSPEC support the current assumptions within the model that relate to the physical retention in the catchment. i.e. that all run-off from the catchment occurs on a single day. Therefore the amount of information required to refine catchment retention would be large and it is considered that this approach is unlikely to be a practical way to refine the assessment.

	Input parameter/ assumption to be refined	Study/ information/ data type	Amount of information required	Additional Notes
				The model accounts for the partitioning and sorption during catchment transport by inputting the estimated total mass of compound washed off hard surfaces to the surface water body already partitioned between aqueous and sediment phases. This is based on the procedure used in the FOCUS STEP2 surface water model but is intended to account for the partitioning and sorption that occurs during transport through the catchment and its gully pots / drainage systems. Therefore individual processes which govern partitioning and sorption during catchment transport in the model are accounted for with 1 simple assumption. The mechanisms built into the model and the 'validation' studies suggest that if Applicants wish to refine the 'within catchment' transport dynamics, they should focus on the

	Input parameter/ assumption to be refined	Study/ information/ data type	Amount of information required	Additional Notes
				partitioning dynamics within the catchment rather than any physical retention. In particular it may be worthwhile reviewing existing data on partitioning within gully pots (see point 6 below) or attempting to measure the volumes of water, sediment and associated compound masses moving through gully pots within a catchment. This could then be used to modify the 'input masses' partitioning dynamics in the model. However, it is noted that care should be taken when applying this methodology as the current partitioning assumption comprises several individual processes all of these processes should be addressed when supporting refinement of partitioning of inputs to surface water bodies in a higher tier assessment. There is significant uncertainty over refining parameters relating to retention in gully pots. Gully pots are

	Input parameter/ assumption to be refined	Study/ information/ data type	Amount of information required	Additional Notes
				periodically cleaned and accumulated sediment removed. Therefore it is inappropriate to assume increase in retention due to gully pots as it cannot be guaranteed that applications to hard surfaces would not follow shortly after gully pot cleaning.
6	Amendment of surface characteristics of the model scenario.	Information to show that the current scenario is an extreme worst case. A subsequent catchment-type analysis similar to that which underpins the scenario would then be required, probably for several locations. Alternatively data for several other realistic worst case locations could be used to	A significant amount of information would be required as any less could be considered as selectively studied areas.	The amount of information which would be required renders this approach potentially impractical in the first instance. It should be noted that the generic properties of the catchment should not be changed on an individual basis as this could affect the overall vulnerability of the scenario, (rendering it overly protective or inappropriately un-protective), since the scenario has competing levels of worse case assumptions for the individual parameters which form the overall scenario vulnerability.

	Input parameter/ assumption to be refined	Study/ information/ data type	Amount of information required	Additional Notes
		define new scenarios. eg. Land cover stats for towns/ cities other than Milton Keynes., or a study of major road characteristics in the UK in order to refine that specific scenario.		
7	An assumption that spot application rather than a continuous swath is performed.	Information showing that the significant majority of amenity contractors apply using spot rather than swath application.	Significant work required to contact a large number of councils.	It is considered that currently reduction in application rate for spot application is included as far as possible, and reduction in application rates taking this in to account further is not possible at this time.
8	Amend water body characteristics, e.g. size or volume.	Amendment of water body characteristics would require an investigation of water bodies in the scenario environments modelled. It is envisaged that such a GIS based approach	A study would be required to investigate a large number of water bodies in areas relevant to the modelled scenario in order to support the amendment of water body dimensions.	It is considered that a large scale GIS study would be required in order to amend the water body characteristics which would require a large resource and is likely to be time-consuming. For example, the amendment of the original FOCUS pond in the model to the current larger SUDS pond demanded significant effort and

	Input parameter/ assumption to be refined	Study/ information/ data type	Amount of information required	Additional Notes
		would be used to show that any refinements to water body characteristics, which would be required to be made in the underlying model scenario, are appropriate.		detailed consideration by the Environmental Panel. Thus HSE would be unlikely to accept such a refinement without significant consideration. Therefore it is considered that other approaches to refinement may be preferable in the first instance.
9	Amend water body dilution.	Include dilution due to upstream inputs in major road stream scenario. A reasoned argument to justify it would be required followed by the amendment of the HardSPEC model.	The inclusion of upstream dilution would require a small amount of information to support the change. However information should additionally be provided to show that a realistic worst case scenario is being modelled following refinements.	The modelled urban catchment represents a small headwater catchment in which there is no additional input to the surface water body from outside the catchment. Additional inputs via run-off not containing applied herbicide do occur, but these are from within the catchment itself (e.g. run-off from soft surfaces). Therefore it is not considered appropriate to alter the dilution due to upstream inputs in the urban catchment. However the lack of dilution for inputs from upstream is an acknowledged

	Input parameter/ assumption to be refined	Study/ information/ data type	Amount of information required	Additional Notes
				worst case default for the major road scenario, and it is considered that dilution due to upstream inputs in this scenario could potentially be supported with appropriate information.
10	Water body dynamics	Amend the water body dynamics within the HardSPEC model by reducing the residence time in the stream such that it is more in line with FOCUS assumptions.	It is likely that any amendment would require a significant amount of information to support the change in order to display that a realistic worst case scenario was still being modelled following any refinements.	The stream dynamics are currently represented very crudely in HardSPEC by assuming that chemicals loads (derived from wash-off and spray drift) which enter the stream are accumulated over a 24 hour period and are then “released”. This approach does not take into account the dynamic nature of the stream in terms of both water and chemical load. In reality, water and chemical are added to the stream via spray drift and wash-off over specific periods of time but, **concurrently**, they are lost from the stream in discharge at the downstream end. Even in a low flow stream with a relatively long residence time, chemical will be lost continuously via

	Input parameter/ assumption to be refined	Study/ information/ data type	Amount of information required	Additional Notes
				advection. Whilst the current implementation of the stream in HardSPEC is likely to be worst case, it is also quite unrealistic and this may partly explain over predictions with respect to the (few) comparisons with measured data. It may be possible to develop an alternative representation of stream dynamics which is more realistic. However, this would need higher level consideration by HSE.
11	What happens to drainflow inputs to streams?	A study could be performed to investigate concentrations being emitted from the drain and those in the stream. However any such study would be required to be for multiple inputs and multiple sites in order to provide an appropriate data set to support refinement.	A large amount of additional data would be required.	Available validation studies suggest that some measured stream concentrations are overestimated by up to 3 times. However it is not clear what happens from drainage concentrations moving to stream concentrations to affect this. A study could be performed, or a large amount of publicly available information could be summarised in order to address this knowledge gap. Any amendments would need higher level consideration by HSE.

	Input parameter/ assumption to be refined	Study/ information/ data type	Amount of information required	Additional Notes
		Such a study could be a literature review in the first instance or a field study could be performed. It could then be possible for an argument to be made based upon over prediction if supported by the information/ data obtained.		
12	Assume buffer zone/ greater drift distance	Drift inputs for greater distances could be assumed with an appropriate phrase included on the label to indicate a buffer zone requirement. Alternatively, GIS based information could be utilised to	The use of a buffer zone label phrase would mean that no additional data are required and that risk assessment could be performed using the drift data currently available for different distances. A significant amount of information would be required from the GIS based approach in	Spray drift buffer zones for hand-held application are permitted up to 5m therefore where spray drift is the most significant contributor to surface water contamination the default spray drift value could be reduced accordingly.

	Input parameter/ assumption to be refined	Study/ information/ data type	Amount of information required	Additional Notes
		show that drift less than a given distance is unlikely. Drift inputs in the HardSPEC modelling could then be amended accordingly.	order to refine drift distances and consequently drift inputs. It is likely that any such study would be required to investigate drift distances in several towns/ cities in areas analogous to those modelled.	
13	Use a range of rainfall patterns in the model to produce a range of PEC values.	Investigate a range of rainfall patterns, by inputting new rainfall patterns in to the HardSPEC model.	The approach would require a number of rainfall patterns at locations representing dry, medium and wet locations in the UK. This would appear to require a large number of model runs following amendment of the rainfall data in each case.	Currently a 75th %ile daily rainfall and a 75 %ile highest total spring rainfall are assumed in deriving the rainfall pattern used in the model scenarios. However amending this to a lower percentile can give higher PECs, depending upon the compound being studied, and not just lower ones as may be anticipated. Therefore it is appropriate to investigate a range of rainfall patterns from a number of years at several different locations representing dry, medium and wet locations in the UK. The number of failures could then be contextualised by weighting the rainfall scenarios for the % area covered in the UK in an approach similar to that

	Input parameter/ assumption to be refined	Study/ information/ data type	Amount of information required	Additional Notes
				recommended by higher tier drainflow assessments using MACRO – see the HSE website for further details.
14	Reduce drift by integrating drift across the water body.	An additional calculation to account for the reduction in drift across the width of the water body utilising the integration equation (Equation 5 from the FOCUS SW guidance document[2]) used in FOCUS modelling.	No additional information would be required.	An additional calculation would be required to amend the amount of active substance which is loaded in to the water body via drift. This should not be implemented by amending the drift percentage (2.8 % is used as a standard value) input in to the model, as this also affects the amount of active substance which is available to be lost via other processes (e.g. run-off to drains) to the water body. Currently spray drift calculations for all UK specific applications (agricultural field applications as well as hard surface applications) utilise the near bank drift deposition rates as a surrogate for deposition rate across

[2] FOCUS (2001). "FOCUS Surface Water Scenarios in the EU Evaluation Process under 91/414/EEC". Report of the FOCUS Working Group on Surface Water Scenarios, EC Document Reference SANCO/4802/2001-rev.2. 245 pp.

	Input parameter/ assumption to be refined	Study/ information/ data type	Amount of information required	Additional Notes
				the whole water body. Therefore it is considered by HSE that for reasons of consistency, the method of calculation of drift deposition for hard surface applications should not be amended without further consideration of spray drift calculations for agricultural uses.

HardSPEC - Home garden scenario

	Input parameter/ assumption to be refined	Study/ information/ data type	Amount of information required	Additional Notes
1	Refine the percentage of patios in back gardens connected to storm drains.	Survey/ study information to determine actual percentage. The underpinning model assumption would then require amendment.	The amount of information required would depend upon the specific type of information presented; but ultimately would require a significant data set or amount of information in order to amend the current value used.	Currently a value of 10 % is used which is considered to be conservative. However this parameter does not have a big effect on the PEC. Therefore it is considered that a large amount of information or data would be required for only a small refinement.

	Input parameter/ assumption to be refined	Study/ information/ data type	Amount of information required	Additional Notes
2	Number of properties applying during 18 d rain free period.	Survey targeted at an area which represents the realistic worst case described by the catchment scenario (i.e. a suburban catchment dominated by owner-occupied properties). The survey would also need to be targeted to a time around the peak application period (spring/early summer).	The survey would need to include a greater number of properties than the survey already performed which supports the current assumed value. In addition it would be useful to have a multiple number of surveyed locations. While it is difficult to give an exact number of surveyed properties ultimately the greater the number of properties surveyed and the greater the number of the areas surveyed the greater the likelihood that the information provided would be of a sufficient quantity to support an amendment of the assumed value.	Currently 10 % of properties are assumed to apply pesticide during the realistic worst case 18d rain free period. This is derived from a survey of c.150 houses in a suburban catchment in York. In addition it is supported by survey data on the number of properties likely to use herbicides at any time in the year. This value was 30 % - but is a mean value for the total population and has been revised upwards to 50 % to take into account worst case usage areas (see below for full details). The technical report on the development of the home garden scenario[3] and the HardSPEC Guidance document[1], both of which are available on the HSE website, provide further details. Unless a large amount of survey data are available it is considered that there

[3] RAMWELL, C.T., HOLLIS, J.M. & PARRY, H. (2009). *Development of a home and garden scenario for HardSPEC*. The Food and Environment Research Agency. Final report for Defra Project PS2237. 41 pp.

	Input parameter/ assumption to be refined	Study/ information/ data type	Amount of information required	Additional Notes
				is not a good chance of amending the value already assumed. It is further considered that even were enough data to be supplied that the currently assumed values are well supported and that it is unlikely that additional information would significantly affect the value currently assumed.
3	Number of properties (houses) likely to use herbicides. This possible refinement should be considered in association with that discussed at point 2 above (number of properties applying during the 18d rain free period).	Survey targeted at an area which represents the realistic worst case described by the catchment scenario (i.e. a suburban catchment dominated by owner-occupied properties).	The survey would be required to include a significant number of properties. However it is difficult to give an exact number because the value is used as supporting information for the number of properties applying pesticide in the rain free period rather than directly in the model (see notes). An absolute minimum requirement would be to survey a greater number of properties than in the survey used to support this value (e.g. greater than 150). However it is unlikely that amendments to the number of properties applying during the	The value assumed at the moment is set at 50 %. It is based upon a mean value for the total population of 30 % but has been revised upwards to 50 % to take into account worst case usage areas. e.g. areas with a prevalence of owner-occupied properties in a suburban catchment. Ultimately the value is used as evidence to support the selection of the number of properties in the catchment applying pesticide in the rain free period in spring (see Option 2 above) and therefore a significant number of properties would need to be surveyed in order to amend the assumption that 10 % of properties apply herbicide during the rain-free period.

	Input parameter/ assumption to be refined	Study/ information/ data type	Amount of information required	Additional Notes
			rain free period could be made on the basis of this minimum amount of data indicated. However the greater the number of properties, and the greater the number of different areas, surveyed the greater the chance of the value being able to be refined.	It is considered that unless large amounts of survey data can be provided it is unlikely to be a practical way to refine the assessment. If the number of properties applying pesticide should be refined the survey described in Option 2 would be a more appropriate approach.
4	Percent of hard surface area treated.	Survey/ observational study on infestation rates on asphalt in the home garden.	An appropriate number of properties would be required to be surveyed in order to capture a realistic worst case. In addition appropriate locations would be required to be studied. Though the amount of data required would depend upon the relevance of the properties surveyed to the catchment, as a guide it is envisaged that approximately 100 properties would be required to be surveyed where the area studied is analogous to the catchment modelled in the HardSPEC home garden	Currently it is assumed that treated areas of hard surfaces in the home garden scenario are: -10 % concrete -10 % asphalt - 50 % brick For concrete and brick the values currently estimated based upon calculations of surface area of individual blocks, length of cracks between blocks/ bricks, the weed infestation rate of those cracks and the treated area for individual spot spray applications. Therefore for concrete and bricks it is not considered to be a workable refinement.

	Input parameter/ assumption to be refined	Study/ information/ data type	Amount of information required	Additional Notes
			scenario.	The actual percentile of infestation rates to be used would vary depending upon the property types studied, but as a guide if the study was conducted in an area similar to that in the modelled catchment then it is envisage that a 60th percentile infestation could be utilised. For asphalt the treated area is based upon assumptions, therefore there is a greater potential to refine the treated asphalt area. However it is considered unlikely that the value could be refined by an amount which would significantly alter the PECs since asphalt represents the smallest area of surface type in the modelled catchment (at present herbicide is applied to 8.3 m^2 of asphalt as opposed to 77 & 195.5 m^2 of concrete and brick respectively). Therefore it is considered that a large amount of work would be required which would only minimally affect the final outputs of the HardSPEC model home garden scenario.

	Input parameter/ assumption to be refined	Study/ information/ data type	Amount of information required	Additional Notes
5	Amend water body characteristics, e.g. size or volume.			See Option 8 in the Amenity HardSPEC table above.
6	Amend water body dynamics			See Option 10 in the Amenity HardSPEC table above.
7	What happens to drainflow inputs to streams?			See Option 11 in the Amenity HardSPEC table above.

HardSPEC - Railway scenario

	Input parameter/ assumption to be refined	Study/ information/ data type	Amount of information required	Additional Notes
1	Refinement of drift distance based on locality of water body	It is envisaged that a GIS based study would be required to display the range of drift distances in the UK from the track to an adjacent water body. A realistic worst case drift distance could then be identified.	It is considered that the GIS based project would require a significant resource. However for applications via the spray train derivation of the spray train drift inputs to the surface water body should be relatively quick.	It is considered that it is not easy to reduce the drift inputs following application via hand held application because of the elevation of the embankment in the situation modelled. The drift data used as the worst case default is for a drift distance of 1m with no elevation. The actual lateral drift distance is greater in the modelled scenario (2.9 m) and therefore the 1 m

	Input parameter/ assumption to be refined	Study/ information/ data type	Amount of information required	Additional Notes
		For applications via the spray train, inputs to a surface water body could then potentially be derived for the derived single realistic worst case different drift distance using the existing data set which underpins the current model assumption. For hand held application appropriate additional drift data would be likely to be required.	The likelihood that additional drift data would be required for hand held means that a large amount of additional drift data is likely to be required to refine the risk for hand held application.	drift from the available data set was selected as an assumed worst case. The fact that the measured data is for a different situation to that modelled means that it is not plausible to allow refinements from the same data set as drift deposition behaviour may be different in the modelled situation. Overall it is considered that refinements of the drift inputs would require a significant amount of resource, and the resource required is likely to be greater for hand held sprayers than for the spray train application. However, in many instances drift deposition is the route of exposure responsible for maximum PECsw values in the railway surface water scenario, and therefore refinement of spray drift inputs to the surface water body would potentially reduce maximum PECsw values in the railway scenario.
2	Refinement of water body	It is envisaged that a GIS based study would	It is envisaged that the GIS based project would require a	See HardSPEC amenity use scenario Option 8 for further information.

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	dimensions	be required to investigate the range of water body sizes in the railway situation modelled. Realistic worst case water body dimensions could then be identified.	significant resource.	With regard to the dynamics of the water body (see Option 10 in the HardSPEC amenity scenario table); the water body dynamics are not considered to be a plausible refinement in the railway scenario because the surface water body is assumed to be fed by groundwater flow and the water body is therefore assumed to have a lower flow than in the amenity and home garden scenarios.
3	Refinement of spray target area for (i) Radiarc (spray train) and (ii) hand held applications	Information to show the actual effective application rate. The measured amounts applied used in the revised risk assessment should be based upon realistic worst case infestations.	Data should be readily available from spray train operators or from hand held application operators. However the data set could be large in order to identify a realistic worst case.	Some spray train mounted application systems are fitted with “magic eye” technology to reduce the area sprayed. Therefore information should be available from operators from which average, realistic worst case application rates in treated areas for spray train applications could be derived. It should also be borne in mind that if the risk assessment is dependent on assumptions of being applied through such a system, the statutory conditions of use would have to specify that the product could only be applied through

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				such a system. Records should also be kept for hand-held railway applications, and therefore it should be possible to calculate a realistic worst case amount applied / area. However, it should be noted that any such refinements are only appropriate for contact herbicides. The refinement is not appropriate for residual herbicides which must be applied over the full area to be effective.
4	Attenuation of loads leached out the railway formation during transport in the unsaturated zone.	a) - Information on the likely organic carbon content of railway embankments and derivation of a likely percentage attenuation based on compound Koc. This could be based on literature review in the first instance.	a) - It is considered that a large amount of information would be required, since the refinement is likely to need support by a study consisting of a robust data set to derive an organic carbon content of the embankment. It is likely that a practical study would subsequently be required.	a) - It is likely refinement of the leaching would be difficult to implement within the model based on information on the likely organic carbon content of a railway embankment alone. This is because the model is not a FOCUS type model and therefore derivation of a percentage attenuation for a studied compound would probably be required outside of the model. It is considered that this would be difficult without reference to practical or study information.

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		It is likely that this would then need to be supported by a study targeted at a realistic worst case situation. b) - A case could be made based on degradation rate of the active substance and the transport time assumed in the model.	b) - For the case linking a compound's degradation rate to the transport time assumed in the model information on the degradation rate of the compound may only be required together with appropriate argumentation.	Overall it is considered that this modification would require a large amount of resource and/ or would be difficult to implement. b) - A case based upon the attenuation and degradation would be based on DT50 and transport time assumed in model. Such a case is only likely to be appropriate for rapidly degrading compounds. It should be noted that PECsw resulting from leaching through the railway embankment are always smaller than those resulting from run-off down the embankment sides. As a result users are advised to focus on generating data and arguments for a reasonable run-off attenuation factor rather than a leaching attenuation factors in the first instance.
5	Run-off attenuation factor	Can be amended based on a reasoned argument. Such	It is difficult to indicate how much information/ data would be required to support a	It is noted that the input to the surface water body due to run-off provides higher maximum PECsw values than

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		argumentation may be based on attenuation derived from other studies which may be applicable. However any such argumentation would be required to address the problem that the situation is very specific because of the extreme slope. Therefore specifically conducted studies to derive an attenuation factor may be required. Any such study would be required to address the realistic worst case situation with regard to slope and vegetation type and density. One possible option may be to design a bespoke laboratory study based	reasoned argument based upon literature and/ or other existing data as the amount of information required would depend upon its relevance to the specific situation being modelled and its quality. It is anticipated that any practical study would require an appropriate number of replicates to be scientifically valid.	are obtained from leaching through the embankment. Currently the run-off attenuation factor is set to a default of 1 meaning that there is no attenuation of loads during transport down the railway embankment. This is a clear worst case and therefore refinement is plausible. However there may be difficulties in deriving an appropriate attenuation factor for a given compound because of the steep slope of the embankment in the railway scenario. If this issue cannot be addressed by reasoned argument and existing data then an appropriately targeted study would be required which would be expected to require significant resource. It should also be noted that there are no study protocols or guidelines available for such a study. Overall it is considered difficult to derive a specific value for an attenuation factor, but it may be possible to provide some qualitative argumentation where PECs are just above an ecotoxicological

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		on an impermeable slope with the surface flora/ debris present to obtain laboratory derived values for attenuation.		threshold.