Life Cycle Stage 3: Risk assessment

Remediation PFAS Guidance

Goal: to identify and quantify the potential risks PFAS pose to human health and the environment at contaminated sites.

This section is designed to assist parties in properly applying risk-based guidance for evaluating the human health and environmental risk caused by exposure to PFAS-contaminated media. In a risk-based approach, remedial actions are driven by evaluating the contaminated media, exposure pathways, and impacts to current and future receptors. The results from the Initial Site Review and Site Investigation stage provide information about the presence of PFAS. The absence or presence of PFAS is confirmed through sample collection and analysis. The potential risk is assessed by evaluating several metrics, including but not limited to, site characteristics, exposure pathways to receptors, and analytical data.

Note

Responsible and voluntary parties are responsible for conducting risk assessments with MPCA guidance and oversight.

It is imperative that users of this guidance understand the exposure scenarios and other assumptions used in developing the risk-based values (RBVs) referenced in this section and have sufficient knowledge of the site to which the values are being applied. A risk characterization will be meaningful only when the RBVs are properly applied, and uncertainties are clearly identified. Individual RBVs may not be adequately protective in situations where multiple contaminants are present (refer to the "Additivity for mixtures assessment" section for more information).

For the purposes of this guidance, the risk assessment process will require a comparison of analytical results to RBVs. When RBVs are not available, the party conducting the risk assessment should work in close coordination with MPCA remediation staff and risk assessors to determine a path forward. This may include strategies such as the use of ambient background values if available, surrogate values, relative potency approaches, etc. A site-specific risk assessment and more active involvement by MPCA remediation staff and risk assessors will be needed in the following cases:

- Risk-based and/or ambient background values are not readily available.
- Risk-based and/or ambient background values are exceeded, and a more thorough evaluation is needed.
- Complex exposure pathways need to be evaluated (e.g., migration of PFAS into food products).

The risk assessment stage typically follows a site investigation. However, RBVs may be used at numerous stages of a site investigation – for initial screening of the first set of samples and during any subsequent investigations that may need to be completed. Risk assessment is also applicable during the disposal phase, when investigation derived waste (IDW) needs to be characterized to determine appropriate management options.

Risk is determined by combining hazard and exposure, i.e., the inherent danger of a chemical or mixture of chemicals and the likelihood that they will come into contact with or impact a human or environmental receptor. For the purposes of this guidance:

- Hazard is defined as the presence of PFAS at a site.
- Exposure is defined by an exposure pathway (existing or future) leading to a receptor having potential contact with the identified contamination.

Risk assessments often make use of RBVs derived by regulatory agencies. An RBV represents an estimate of the contaminant concentration that is not likely to result in an appreciable risk of deleterious effects during a

specific exposure duration, usually a lifetime. These values can take into account default or site-specific exposure assumptions. When there is more than one contaminant and/or multiple exposure pathways present, cumulative risk should be considered. For sites with multiple contaminants and a single exposure pathway, RBVs can be used to assess one type of cumulative risk – additive risk. Additive risk is calculated by summing the target cancer risk for carcinogenic contaminants and individual hazard quotients to calculate a hazard index for noncarcinogens with similar health endpoints.

The receptor evaluation conducted during the Site Investigation stage will provide information on human and ecological/environmental receptors within a specific radius from the site that need to be part of the risk assessment. RBVs are typically developed by receptor and environmental media type. Table 3-1 provides a summary of the media and receptor types that are typically evaluated during the risk assessment stage.

Table 3-1: Receptors and media to evaluate during risk assessment

	Environmental Media to Evaluate				
Receptor	**Soil**	**Sediment**	**Surface Water[1]**	**Groundwater**	**Soil vapor**
Ecological	X	X	X	N/A	N/A
Human	X	X	X	X	X

1 – PFAS containing foam may be present on surface water; more information is available in the risk-based values section
N/A = not applicable

There may be additional exposure pathways that need to be evaluated and a site-specific risk assessment would be required in these cases. A site-specific risk assessment requires close coordination between MPCA remediation staff, MPCA risk assessors, and the party conducting the risk assessment. A site-specific risk assessment is, for example, required when evaluating complex exposure pathways (e.g., migration of PFAS into food products). Complex exposure pathways are best evaluated through a forward risk calculation method, which more easily allows for the calculation of aggregate (single contaminant aggregated through multiple exposure pathways) and cumulative risk (multiple contaminants through multiple exposure pathways) (ITRC 2015, USEPA 2003). For more information on the forward risk calculation method refer to the Interstate Technology and Regulatory Council (ITRC 2015).

Risk assessments should include an uncertainty analysis with a brief discussion of the possible sources of uncertainty that could affect the conclusions of the assessment. To the extent that it is known, the uncertainty analysis should describe whether the uncertainty is due to:

- Incomplete knowledge of the site (e.g., unidentified hot spot) or receptors,
- Incomplete data from the scientific literature or other information sources (e.g., lack of toxicity information for some contaminants), or
- From the effects of natural, unquantified variability (e.g., natural fluctuation in moisture content of soil).

The discussion should also indicate whether the uncertainty has a biased impact on the risk characterization results (e.g., leading to an over- or under-estimation of risk) and, if possible, the magnitude of the effect.

3.1 Risk-based values

Table 3-2 provides a summary of PFAS RBVs currently available in Minnesota for assessing risks to human and ecological health. Human health vapor intrusion screening values have not been developed for the PFAS listed in Table 3-2 as the volatility of these PFAS is considered low at environmentally relevant pH conditions.

It is important that users of the RBVs listed in Table 3-2 understand their applicability, the exposure assumptions that were used to derive the values and the uncertainties present. The technical support/guidance documents available for each set of values should be reviewed prior to using the values during risk assessments (Table 3-2).

Each set of human health RBVs is derived using target or acceptable risk levels. In Minnesota, these are defined as follows:

- **For carcinogenic chemicals** the acceptable risk level is a total or cumulative excess lifetime cancer risk (ELCR) not to exceed 1 in 100,000 (i.e., 1 x 10^{-5}) for chronic exposure. In other words, the acceptable risk

level is a maximum of one additional case of cancer per 100,000 chronically exposed individuals above background cancer rates in the general population. If there are multiple carcinogens present, the cumulative cancer risk is determined by summing the ELCRs of individual contaminants with a carcinogenic endpoint.

- **For noncarcinogenic chemicals** the acceptable risk level is a noncancer chronic risk not to exceed a hazard quotient (HQ) of 1 per contaminant and a hazard index (HI) of 1 for multiple contaminants with similar health endpoints. The HQ is determined by dividing the site contaminant exposure concentration by the contaminant RBV. The HI is determined by adding the HQs for contaminants that share a similar toxicological endpoint.
- More information about calculating HI and cumulative ELCR is provided under the "Additivity for mixtures assessment" section.

To evaluate ecological receptors, RBVs may be derived in a variety of ways depending on the environmental media and organisms being evaluated and may include values for wildlife (avian or mammalian), plants (terrestrial or aquatic), aquatic organisms (invertebrates, fish), etc. As specified in Table 3-2, some PFAS ecological RBVs are available but should be chosen in coordination with MPCA remediation staff and eco risk assessor.

Note

RBVs should not be interpreted as default cleanup values. In establishing remedial/cleanup goals, risk managers need to consider additional lines of evidence. Refer to the Remediation life cycle stage.

Due to the unique properties of PFAS, there may be additional situations that warrant evaluation, such as the presence of foam on surface waterbodies. There are no RBVs to evaluate human or ecological contact with foam. Because there is considerable uncertainty in evaluating PFAS foam exposures quantitatively, the MPCA strongly supports the MDH's ongoing messaging to the public to avoid any contact with foam. Foams are typically not stable and can intermittently form and dissipate. Both natural organic and PFAS-containing foams pose risks to people and pets from ingestion. Signage is recommended in areas that are swimmable or have public access beaches and are known to have PFAS-containing foam or support conditions for foam formation. In some cases, wildlife may be exposed to PFAS through surface water foams. This exposure could be from direct ingestion of the foam or from ingesting other animals (like insects) that interact with foam or the high-concentration surface water microlayer (air-water boundary).

PFAS are also subject to long-range environmental transport and readily migrate between environmental media. Several migration pathways are discussed in the Site Investigation – Fate and Transport section. These migration pathways can all contribute to widespread PFAS contamination, which in addition to impacting human and ecological receptors through direct exposures to the contaminated media, can lead to impacts through food chain exposures such as through human/animal consumption of plant/animal products. For example, animals consuming contaminated water or ingesting contaminated soil or plant matter may lead to PFAS building up in their tissues. In addition to a potential direct risk to the animal, this also represents another exposure pathway for humans who consume animal products such as meat, milk, offal, eggs, and fish. Other potential migration pathways may need to be considered and evaluated on a site-specific basis.

Table 3-2: Summary of available PFAS Risk Based Values

			Human Health			Ecological
Per- and polyfluoroalkyl substances	**PFAS**	**Surface Water and Fish Tissue [1]**	**Groundwater [2]**	**Soil [3]**	**Soil leaching pathway [4]**	**All relevant pathways**
Perfluorobutanoic acid / perfluorobutanoate	PFBA	Site-specific WQC available	MDH short-term, subchronic and chronic value available	MPCA SRVs available	SLVs for PFAS were not derived. Refer to the MPCA soil leaching values guidance document for more information.	Some screening values are available – work with MPCA remediation staff and eco risk assessor.
Perfluorobutane sulfonic acid / Perfluorobutane sulfonate	PFBS	Site-specific WQC available	MDH short-term, subchronic, and chronic value available	MPCA SRVs available		
Perfluorohexane sulfonic acid / Perfluorohexane sulfonate	PFHxS	Site-specific WQC available	MDH short-term, subchronic and chronic value available	MPCA SRVs available		
Perfluorohexanoic acid / Perfluorohexanoate	PFHxA	Site-specific WQC available	MDH short-term, subchronic and chronic value available	MPCA SRVs available		
Perfluorooctanoic acid / Perfluorooctanoate	PFOA	Site-specific WQC available	MDH short-term, subchronic, chronic, and cancer value available	MPCA SRVs available		
Perfluorooctane sulfonic acid / Perfluorooctane sulfonate	PFOS	Site-specific WQC available	MDH short-term, subchronic, chronic, and cancer value available	MPCA SRVs available		
Hexafluoropropylene Oxide Dimer Acid	HFPO-DA	Not available	USEPA drinking water health advisory	MPCA SRVs available		
Additional Information		Available on site-specific WQC webpage	MDH values available through the MDH Water Guidance Values table USEPA PFAS drinking water health advisories fact sheet	Available in the SRV spreadsheet Sediment RBVs are derived on a site-specific basis		
Other PFAS or exposure pathways	Work with MPCA remediation staff and risk assessors					

1 – Refer to the MPCA WQS website, Minn R. 7050, and Minn R. 7052 for more information on water quality standards and site-specific criteria. Site-specific WQC are applicable to specific waterbodies, refer to Appendix B on the site-specific WQC webpage for a list of waterbodies where WQC apply.
2 – Refer to the MDH 2008/2009 SONAR which explains the current methodology used to derive groundwater values. The USEPA has developed drinking water health advisories for four PFAS including PFOS, PFOA, GenX, and PFBS. MDH values may be used preferentially if available.
3 – Refer to the MPCA SRV technical support document and background threshold value evaluation document for more information.
4 – Refer to the MPCA soil leaching value (SLV) guidance document for more information

3.2 Risk evaluation

Potential risks to human and ecological receptors should be estimated by comparing site sample concentrations to the applicable RBVs and/or ambient background values, if available and applicable. Refer to the "Ambient background concentration" section for more information on ambient background.

In general, if the contaminant concentration is equal to or less than the RBV (i.e., individual HQ or HI ≤ 1 and individual or cumulative ELCR ≤ 1×10^{-5}), the contaminant does not present an unacceptable human health or ecological risk. If, however, the RBVs are exceeded this indicates that there may be potential for risk and further evaluation is warranted. Initial data collections/site investigation may not always be done in a way that best lends itself to risk assessment (for example, too few samples may have been collected). Therefore, further evaluation often means additional sample collection to better characterize the extent of contamination and risk. Some RBVs, such as the MPCA SRVs, can be adjusted during these later stages of site investigation if the initial values have been exceeded and site-specific information is available for refinements. Other values, such as the MDH groundwater values, are typically not adjusted and an exceedance may mean that response actions, such as replacement or treatment of a drinking water supply, are warranted.

For PFAS that bioaccumulate in fish tissue, such as PFOS, fish consumption can be a significant source of exposure. When evaluating PFAS impacted surface water, fish sampling may be needed in addition to water sampling. If a water quality standard, water quality criterion, or other screening level designed to protect fish consumers is exceeded in water, fish sampling is recommended to determine if the compound is bioaccumulating in edible fish at a level that may pose a risk to human health.

During risk evaluation, it is important that exposure areas and representative exposure point concentrations (EPCs) are appropriately defined and used. An exposure area is the location of potential contact between a human or ecological receptor and a release of contaminants. An exposure area is defined relative to a given pathway and exposure route, and may correspond to a single location, especially in the case of water wells or surface water, an entire site, or some portion of the site. An exposure area may or may not correspond to the extent of contamination at the site, a source area proper, or a source area with an associated plume. An exposure area may extend beyond property lines.

Based on the pattern of contamination (e.g., location and magnitude of hot spots) and current and planned site activity, it is necessary to determine whether the site conditions or the focus of investigation requires definition of multiple exposure areas and grouping of associated data to estimate the EPC to be used in the evaluation. It may be necessary to group data by depth or location or as a function of time. EPCs can represent both single analytical results, such as a maximum contaminant concentration, or a calculated value based on grouped results, such as by calculating a 95% upper confidence limit (UCL) of the mean of multiple samples. Many of the RBV technical support/guidance documents specify how site data are to be handled prior to comparison to RBVs. This information should be reviewed prior to establishing EPCs. Refer to Table 3-2 for links to relevant documents.

To that end, it is important that the data collected have been collected in a manner consistent with the risk assessment being performed and the RBVs being used. The following data issues are frequently encountered:

- Non-detect results,
- Estimated results, often denoted with a "J" data qualifier, and
- Detection and reporting limits higher than RBVs.

Note

Submission of all collected data is required. Include all compounds and QAQC for method analyte list.

If analytically feasible, detection and reporting limits should always be below the RBVs used in the risk assessment to ensure that non-detects do not exceed RBVs. If RBVs are below reporting limits, site staff should request the laboratory to report estimated results (e.g., "J" qualified results) that are typically defined as being between the method detection limit and the limit of quantitation (also called a reporting limit). If sufficiently low detection limits cannot be achieved, this should be discussed in the uncertainty analysis. Estimated results (e.g., "J" qualified results) can be used as any other detected result in the risk assessment. Estimated results should always be appropriately qualified/flagged in laboratory reports and

data summaries. J-flag data will be treated in the same way as non-J-flagged data for individual analytes and will be entered into the additivity calculator as with other results.

The Kaplan Meier (KM) method available through USEPA's ProUCL software is recommended for evaluating non-detect data when appropriate (i.e., assuming appropriate data quality and the method is appropriate for the dataset in question). For example, the SRV technical support document recommends the KM method for calculating a 95% UCL of the mean for censored datasets with non-detect frequency of less than or equal to 80 percent if it's needed for a specific exposure area. Non-detect results should not be used in additivity calculations. If non-detect results have the potential to impact the additivity calculation this should be discussed in the uncertainty analysis.

3.2.1 PFAS precursors

Due to the uncertainty surrounding PFAS precursors, it is recommended that any precursors identified at a site are screened using RBVs for their terminal products, if available. This would be considered most health protective given how much is unknown about precursor degradation. Refer to the footnote for a list of resources that can help with identifying PFAS precursors and terminal products.[1]

3.2.2 Stepwise process

Follow the steps below during risk evaluation. Refer to Figure 3-1 outlining the major decision points.

Depending on the individuals or communities impacted it may be important to account for variations in cultural practices. For example, certain communities might be eating more fish/game that could be contaminated with PFAS than others or engaging in cultural practices that use resources in ways that could increase exposure. This information should be identified during the data and information gathering stage (Step 1). If the individuals or communities being evaluated are likely to have greater exposure to PFAS than what is represented by the default exposure assumptions used in developing RBVs, then a site-specific risk assessment may be needed (Step 9). Consult with MPCA if this is the case.

Step 1. Gather data and all relevant information needed for the assessment. This includes but is not limited to:

- Site information/characteristics
- Analytical data/results
- Conceptual site model outlining the exposure pathways and current and/or future potentially impacted receptors
- Applicable RBVs[2]

Step 2. Confirm that all data have been properly QA/QC'ed and that enough samples have been collected for the assessment. This will depend on the RBVs being used.

Step 3. Determine the EPCs. This may be a maximum contaminant concentration, or a calculated value based on grouped data such as a 95% UCL of the mean.

Step 4. Compare the EPCs to the applicable RBVs[2] from Table 3-2 and calculate HQs and ELCRs.

> **Step 4a.** When more than one contaminant is detected and additivity needs to be considered at the screening level (e.g., for groundwater and surface water), perform additivity calculations (i.e., calculate

[1] Information from Environment and Climate Change Canada for PFOS and precursors: https://www.canada.ca/en/environment-climate-change/services/canadian-environmental-protection-act-registry/publications/ecological-screening-report-sulfonate/appendix-1.html
PFOA and precursors (Table 3-2): https://ec.gc.ca/ese-ees/default.asp?lang=En&n=370AB133-1

Information from Germany's REACH restriction proposal for PFHxA (see Final BD annex, section B.4.1.2): https://echa.europa.eu/registry-of-restriction-intentions/-/dislist/details/0b0236e18323a25d

Information from the Stockholm Convention on PFHxS and PFBS precursors:
http://chm.pops.int/Portals/0/download.aspx?d=UNEP-POPS-POPRC13FU-REF-PFHxS-20171027.En.pdf

[2] Applicable RBVs are selected based on the presence of an exposure pathway to a current or future receptor – human or ecological. For example, if receptors may come into contact with contaminated groundwater and soil, then groundwater and soil RBVs need to be used to evaluate risk.

an HI for noncarcinogens and a cumulative ELCR for carcinogens). Refer to the "Additivity for mixtures assessment" section for more information.

Step 5. If RBVs are not exceeded (i.e., HQ or HI ≤ 1 and individual or cumulative ELCR ≤ 1×10^{-5}) then the risk is below RBVs/unacceptable thresholds and further investigation/evaluation is typically not warranted. If RBVs are exceeded (i.e., HQ or HI > 1 and individual or cumulative ELCR > 1×10^{-5}) then assume there is potential for risk and further evaluation may be needed. Proceed to Step 5a and 6.

Step 5a. Consider if remedial actions can be taken to address the potential risk. Refer to the Remediation Stage for options.

Step 6. Determine if and to what extent additional site investigation is needed. Conduct additional sampling and collect more data as appropriate.

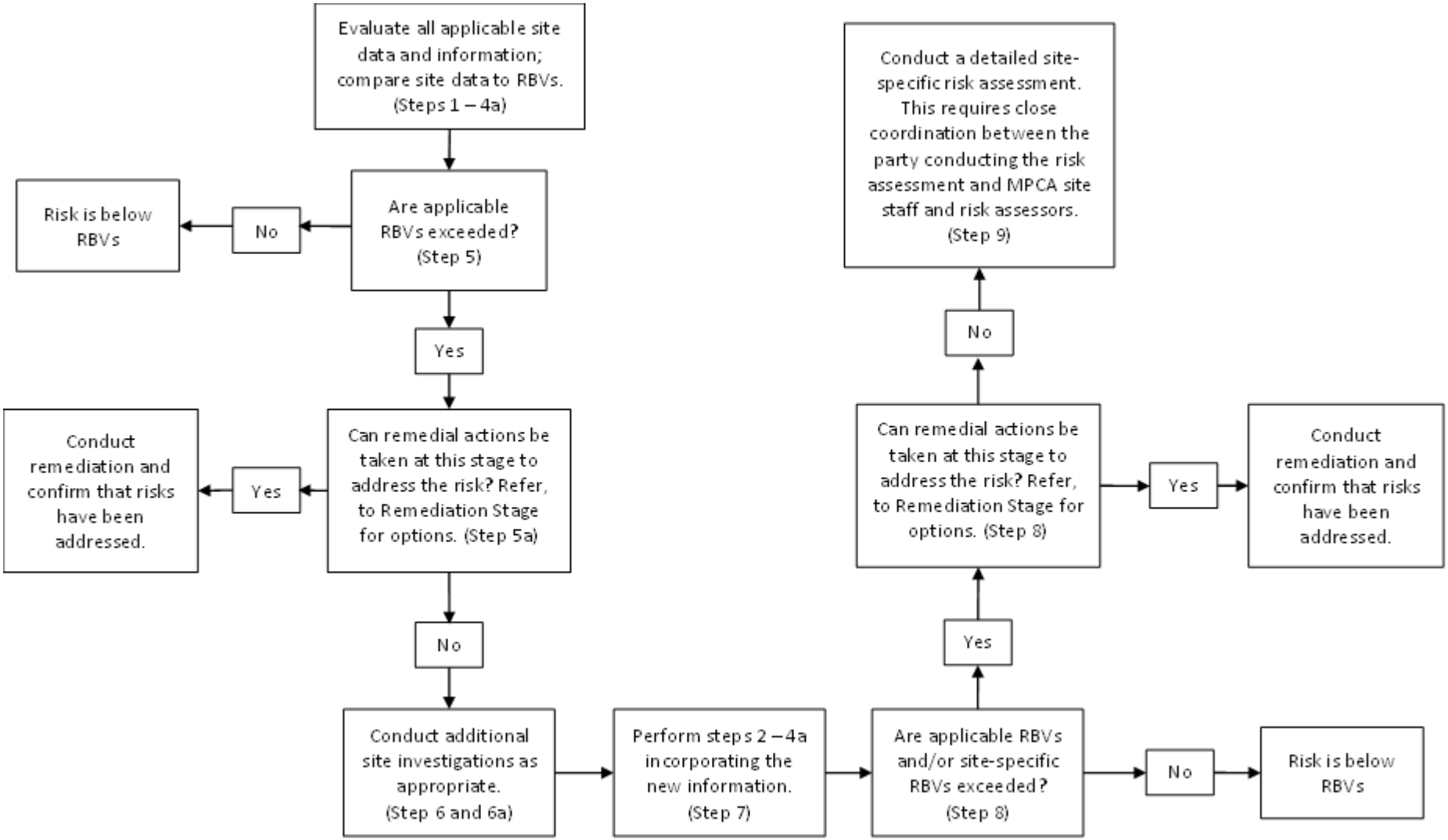
Step 6a. Determine if site-specific adjustments can be made to the RBVs being used. For soil, site-specific information can be used to refine the RBVs if appropriate.

Step 7. Perform steps 2, 3, 4, and 4a incorporating the new information – data from additional sampling events and/or site-specific information used to adjust RBVs.

Step 8. If RBVs are still exceeded, determine what remedial actions can be taken to address the potential risk. Refer to the Remediation Stage for options. If remedial actions cannot be selected yet due to insufficient information or determinations of risk, proceed to Step 9.

Step 9. Conduct a detailed site-specific risk assessment. Work with MPCA remediation staff and risk assessors on next steps. A site-specific risk assessment at this stage may need to incorporate complex exposure pathways. A forward risk assessment should be conducted to properly aggregate all applicable exposure pathways (ITRC 2015).

Figure 3-1: Flowchart of decision points during risk evaluation



3.3 Additivity for mixtures assessment

Contaminants in combination (i.e., more than one contaminant present in a particular medium) may cause adverse effects that would not be predicted by evaluating each contaminant separately. Therefore, when multiple contaminants are detected at a site, additive risk (a type of cumulative risk) may need to be evaluated. The USEPA uses additive risk as a reasonable approach to mixtures assessment given what is unknown about how chemicals interact in the body (e.g., there may be synergistic, antagonistic, or additive effects). Additivity is evaluated by an HI for noncarcinogens and a cumulative ELCR for carcinogens. The HI is expressed as the sum of the ratios of the measured concentration of each contaminant to its respective RBV. If the calculated HI for a particular endpoint exceeds 1, this may indicate that there is potential for risk and further evaluation is warranted. Similarly, cumulative ELCR is expressed as the sum of the individual contaminant ELCRs.

Other mixtures assessments, such as a PFAS relative potency factors (RPF) method, may be developed in the future by USEPA or other regulatory agencies. MPCA may adopt a federally or state developed RPF method in the future.

3.3.1 Groundwater

The methods used to derive MDH groundwater/drinking water values specify that additive risk is to be evaluated (Minn. R. 4717.7870). Most RBVs have health endpoint(s) associated with various exposure durations. These endpoints are organs (e.g., liver, kidney), organ systems (e.g., reproductive), or other health outcomes (e.g., developmental effects) that have the potential to be adversely impacted by the contaminant. To calculate additivity for groundwater exposure, the MDH developed and maintains an additivity calculator that is available through their website. For simplicity, MDH refers to both cancer and noncancer additive risk as a health risk index.

Additivity should be assessed for all contaminants that are detected, not just for contaminants that are close to exceeding an RBV and not just for PFAS. There may be situations where no single contaminant approaches an RBV but when all detected contaminants are assessed for additive risk the risk index may exceed 1, which would indicate that there is potential for risk.

3.3.2 Surface water

Similarly, the methods used to derive MPCA surface water quality standards or criteria include additive risk considerations (Minn. R. 7050.0222, subp. 7, item D). The health endpoints associated with the PFAS site-specific WQC as well as an explanation of the additivity calculation is provided in these technical support documents:

- PFOS WQC technical support document
- PFOA, PFHxS, PFHxA, PFBA, and PFBS WQC technical support document

The PFAS WQC are site-specific and only apply to the waterbodies listed in the appendices to these technical support documents:

- PFOS Appendix B: Application to specific waterbodies
- PFOA, PFHxS, PFHxA, PFBA, and PFBS Appendix B: Application to specific waterbodies

The appendices can be updated to include additional waterbodies. If there is a surface waterbody that needs to be evaluated for PFAS contamination, but it is not listed in the above linked appendices, remediation staff should contact WQS unit staff so they can assess whether the WQC can be applied to the waterbody in question and update the appendices if deemed appropriate.

3.3.3 Soil

As a matter of policy, SRVs are developed using a relative source contribution (RSC) factor of 0.2 and are considered to be reasonably protective of additive effects at the screening level for most sites. The RSC applied to SRVs is a modifying factor that adjusts the HQ downward. Adjusting the HQ downward as a way of accounting for potential additive effects at the screening level is also recommended by the USEPA (USEPA 2022). For soil,

additivity is assessed on a site-specific, as-needed basis. A modified SRV spreadsheet allowing for the calculation of additivity is available and can be requested from MPCA.

3.4 Risk-based values from other sources and data poor PFAS

To evaluate human health risk, MPCA preferentially recommends RBVs, and toxicity values developed by Minnesota state agencies (e.g., MDH or MPCA values). However, there is not enough toxicity information for the majority of PFAS to derive RBVs; therefore, Minnesota-derived values may not be available for all PFAS of interest. When RBVs are not available for certain PFAS, the PFAS contaminants should be clearly identified (name, detection frequency and magnitude) and discussed in the uncertainty portion of the risk assessment. RBVs may be available from other sources, such as the federal government, that may be used in certain situations. For example, if a site cleanup is being led by the USEPA, preference may be given to values developed by the USEPA.

When Minnesota RBVs are not available and values are available from other sources, such as the federal government or other state governments, it may be appropriate to determine the toxicity values used in developing those RBVs. MPCA and MDH can review the toxicity information used in developing other RBVs and determine if a Minnesota RBV can be derived. Toxicity values are commonly developed by the USEPA, Agency for Toxic Substances and Disease Registry (ATSDR), California EPA (CalEPA), Environment and Climate Change Canada, and the European Chemicals Agency's REACH program.

If no toxicity information is available for a PFAS of interest, other approaches will need to be considered. MDH is already exploring surrogate and other approaches for characterizing toxicity for PFAS with no or limited toxicological information. As toxicity values become available for additional PFAS from MDH or other sources (USEPA, ATSDR, CalEPA, etc.), MPCA will evaluate, and if appropriate, incorporate this information and develop human health RBVs for use during site investigations and risk assessments. Additionally, parties conducting the risk assessment should suggest approaches for selecting toxicity values if no value is available for the PFAS of interest and should work closely with MPCA remediation staff and risk assessors. The following are options, in order of preference:

- Surrogate toxicity values
  - This is a common practice when dealing with data-poor contaminants. MDH has used the surrogate approach in the past (circa 2006) when not enough toxicity information was available at the time to derive groundwater RBVs for certain PFAS such as PFBA and PFHxS. Chemical-specific RBVs were derived once toxicity data became available.
- RPF approach
- Surrogate toxicity values may also be used for a group of data-poor PFAS by selecting one PFAS with existing toxicity information as a group representative. Grouping may be considered based on similar toxicities and potencies, and/or based on structural and physicochemical similarities.

Additionally, the following resources may help with identifying relevant information for data-poor PFAS:

- USEPA CompTox Chemicals Dashboard
  - Includes information on physicochemical properties, environmental fate and transport, exposure, usage, in vivo toxicity, and in vitro bioassays.
- PFAS-TOX Database
  - Database of relevant toxicity studies for "less well studied" PFAS (excluding PFOS and PFOA which have been studied extensively).

To evaluate ecological risk, MPCA often recommends federal or other state RBVs as deemed appropriate. The availability of RBVs is likely to grow in the future. As outlined in Table 3-2, there are some screening values available, but they should be selected in consultation with MPCA remediation staff and eco risk assessor.

3.5 Ambient background concentrations

Background concentration refers to the concentration of a chemical that is ubiquitous and consistently present in the environment and would be present even if the release did not exist. PFAS are subject to long-range transport and are often detected in areas far away from point sources. The MPCA has prepared a technical memo describing ambient background PFAS concentrations in various media (MPCA 2024). This memo is informational only and should not be used to set cleanup levels at remediation sites. Ambient background can be defined as the concentration of a contaminant in water, soil or other media that is the sum of the naturally occurring background concentration (if applicable) and the contaminant levels that have been introduced by general anthropogenic activity (not specifically related to the release in question). Given that PFAS are manmade, there is no natural background for these contaminants, therefore, they can only be classified to have anthropogenic background.

When more information about the toxicity of a contaminant becomes available, it is often necessary to update or recalculate existing RBVs. This often means that RBVs become more stringent/protective especially if it is found that the contaminant is toxic at lower levels than previously understood. For soil, only the PFOA SRV may currently fall below ambient background in some parts of the state, but it is possible that other SRVs may fall below PFAS ambient background concentrations in the future. Site-specific background should be determined at sites where ambient background concentrations may need to be used during risk assessments.

Note that it must be assumed that detected PFAS are present above ambient background concentrations unless it can be otherwise demonstrated. Generally, it is necessary to collect samples from appropriate off-site locations and apply statistical methods (if applicable) to determine whether site PFAS concentrations are consistent with or above ambient background concentrations. Published ambient background levels may not be representative of Minnesota conditions and may not be comparable to the data obtained at the site (e.g., different soil type, variations in sampling and analytical techniques, etc.). Thus, the assessor should not use any list of published ambient background levels which has not been specifically recommended or approved by the MPCA.

Ambient background samples should be collected in locations that are unlikely to have been affected by point sources. The sampling location should be based upon similarity of the site conditions to the reference/background area conditions. A reference area should have similar physical, chemical, geological, biological, and ecological characteristics and land use as the site being evaluated. Enough samples must be taken to allow a meaningful comparison of ambient background concentrations to site concentrations. This will depend on the environmental media being evaluated. Determination of site-specific PFAS ambient background should be done in close coordination with MPCA.

For soil, the following resources may be useful for determining ambient background concentrations:

- USEPA guidance for developing soil background concentrations for Superfund sites
  - While the document was developed for Superfund, the guidance is a useful resource for any site where background concentrations may need to be determined.
- ITRC information on establishing soil background for risk assessments

Additional resources related to ambient background concentrations include:

- USEPA Frequently Asked Questions About the Development and Use of Background Concentrations at Superfund Sites: Part One, General Concepts
- USEPA Establishing Background Levels
- USEPA Role of Background in the CERCLA Cleanup Program

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