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Comments on TVA Fly Ash EE/CA Work Plan for Non-Time Critical Removal Action

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Introduction

This document provides communities affected by the Tennessee Valley Authority (TVA) Kingston Fly Ash Release with a summary of the technical issues associated with the TVA Fly Ash Engineering Evaluation/Cost Analysis (EE/CA) Work Plan for Non-Time Critical Removal Action (“the Work Plan”) and potential issues of community concern. A supplementary fact sheet providing a broader overview of these issues is available through the contacts listed on the last page of this document.

Document Summary

The Work Plan considers three different options for cleaning up the embayment and the dredge cell where coal ash is presently held. All three options would restore the embayment to conditions existing before the coal ash spill (pre-spill conditions). Any other options would likely include restoring the embayment as well, for legal reasons.

1. Option 1 would remove 2.4 million cubic yards of ash from the embayment and the ash from the test embankment within the dredge cell (0.3 million cubic yards). This ash would be taken off site for disposal. The embayment would be converted to an aquatic environment. Then a dike would be built to keep ash in the dredge cell from entering the embayment, and the dredge cell would be graded for drainage. The height of the closed cell would be approximately 780-790 feet above sea level. This option would only take 50 percent of the ash off site, leaving the other 50 percent on site in the dredge cell.

2. Option 2 involves removing the ash and taking all of it off site for disposal, rather than leaving some behind in the dredge cell. This option involves excavating the embayment, which would remove 2.4 million cubic yards of ash, then removing 0.3 million cubic yards from the test embankment and 3.6 million cubic yards of ash from the dredge cell. The 3.6 million cubic yards from the dredge cell is purported to be enough to “limit long-term reliance on a dike between the cell and the embayment, yet would leave enough ash to provide buttressing for the remaining dikes” (page 36 of the Work Plan). After removing the ash, which totals 6.3 million cubic yards, and disposing

of it off site, the dredge cell would be graded to a gradual slope to approximately 765-775 feet above sea level at the highest point. The embayment would be restored to an aquatic environment.

3. Option 3 would leave all of the ash that is removed from the embayment (2.4 million cubic yards) and store it permanently on site in the dredge cell. The material placed in the cell for the test embankment would remain in the cell and TVA would install a dike that would keep ash from entering the embayment just as in option 1. The dredge cell, also like option 1, would be graded for drainage and would reach a height of 790-800 feet above sea level. Like Options 1 and 2, the embayment would be restored to an aquatic environment.

The three options are quite different in approach and in final outcome. The Work Plan could present more combinations of removal and storage, but it is not clear what advantage would be gained by additional options. The current options include maximum on-site storage and maximum removal, with just one option that is a combination of the two other approaches. Other possible treatments would just be variations of these three options. Other technologies for how to contain any coal ash left on site could apply to greater or lesser volumes of coal ash, depending on the removal/storage ratio. These three options seem to represent a reasonable range and all three have the possibility of achieving the cleanup goals.

There is not a “No Action Alternative” planned or described in the Work Plan, an unusual absence. All work plans for Remedial Investigation/Feasibility Study (RI/FS) reports or EE/CA reports usually include the “No Action Alternative” according to CERCLA and EPA guidance and practice. CERCLA stands for Comprehensive Environmental Compensation and Liability Act and embodies a set of laws that provides guidance on remediating hazardous waste sites. The “No Action Alternative” is meant to serve more than one practical purpose. First, the harm from leaving the contamination in place and untouched is explained and, to the extent possible, quantified in the description. Second, a quantitative estimate of risk would include the specific risks from leaving the contamination untreated. Third, other alternative cleanup options can be compared to “No Action” in order to better put the improvements or cleanups in perspective.

The range of clean up options in an EE/CA (or RI/FS) is meant to explain the best and least that can be done to clean up a site and present a reasonable range of choices. The reasonable range of choices, however, must always meet the legal requirements to protect public health and the environment. Thus, options often include different combinations of technologies, but the combined effect is supposed to be protective of health and the environment. If an option, such as the “No Action Alternative” does not meet the requirements of protecting health and the environment, then that alternative is dropped from further consideration.

I. General comments

1. Definition of hazardous waste: There is a difference between the legal definition of a constituent as hazardous waste and the scientific definition of a constituent as toxic. This document does not take into account the fact that although the heavy metals found at high concentrations at the TVA site may not qualify as hazardous waste under the federal definition, they can still be toxic to humans and wildlife, pending exposure pathways, receptor characteristics and other biological factors. For a detailed analysis of this language issue in the Work Plan's discussion of hazardous waste definition, please see specific comment 18.
2. Single name for project: The U.S. Environmental Protection Agency (EPA) and TVA have used at least three different names for the accident site in written material. TVA's EE/CA Work Plan uses the name Kingston Fly Ash Recovery Project. TVA's Community Involvement Plan calls it the TVA Fossil Plant Release Site. The EPA Web site calls it TVA Kingston Fly Ash Release. Choosing an official name for the site so that one name is used uniformly over the course of the cleanup would avoid public confusion and distinguish the cleanup site from the active fossil plant.
3. Amount of ash removed: The time critical removal action is supposed to be treating the majority of ash in the river and the ash east of Dike 2 before the onset of the non-time critical removal action (the subject of this Work Plan), but there is no mention of the exact volume, or even a ballpark figure, of ash that is supposed to be removed during the time critical. That number or estimate could be included in the EE/CA Work Plan to give relevance and meaning to the numbers estimated for Range of Alternatives developed for the non-time critical removal action. The Work Plan could include the specific numerical goals for ash removal during the time-critical removal action and provide more information on the volume of ash that will remain at the site after the time-critical removal, as well as how the Range of Alternatives will treat the specific amount remaining.
4. User-friendliness: The Work Plan is highly technical and likely difficult for the public to fully understand. It relies on the reader's initiative to seek out the tables, reports and legislation that form the basis of the document's information. For example, the list of contaminants of potential ecological concern is not given in the body of the document. The information presented in the Work Plan also uses language that is not familiar to a lay audience. Section 7 is a good example of how language can be simplified to present a clear picture of the issues at the site, but it is the only section in the Work Plan written in this concise, non-expert language. There are also typographical errors scattered throughout the document.
5. Using all available data: When developing the separate EE/CA Work Plan for the rivers section, this Work Plan calls for using data that have already been collected on the Emory, Clinch and Tennessee Rivers as part of the investigation and time critical removal action. This approach is a customary one that is intended to be efficient in using time and resources. Data on the rivers gathered

by other reputable sources after the spill may also contribute to a more informed understanding of the extent of site-derived contamination and the conditions in the rivers. The Clinch River, for one, is well known for having the most diverse assemblage of freshwater mussels in the world. As a result of the mussel diversity, scientists and resource managers have a large amount of data on conditions in at least some parts of the rivers. These other data will likely prove useful for understanding the ecological conditions. The other sources of data could be obtained and examined, and then a decision made as to how they can best guide the cleanup efforts alongside the data gathered by TVA, EPA and Tennessee Department of Environment and Conservation (TDEC).

6. Specificity: The Work Plan tends to generalize, using vague descriptions like “low” and “trace,” rather than giving the exact concentrations of contaminants. Being specific does not hinder the document and, in fact, gives a less biased, clearer representation of information.
7. Visual aids: The document repeatedly refers to various sections of the Emory, Clinch and Tennessee rivers, delineated by river mile. It is unlikely that knowledge of each specific river mile is common to the public, and a map labeling the specific location river miles would be helpful for increasing understanding of the site plans. It would also benefit readers to have a map to show the extent of the ash upstream and downstream, as well as to give a frame of reference when discussing specific sections of the impacted rivers.
8. Incomplete information on site characteristics: The Work Plan does not mention whether or not there is a liner in the dredge cell. This information is important so that the remedial alternative is selected based upon the best available information and effectively prevents recontamination in the future.
9. Historical contamination: The Work Plan mentions that the Clinch and Emory rivers were listed on the national 303(d) impaired waters list prior to the contamination from the spill. However, the document is silent on how TVA plans to address historical contamination released from fly ash settling ponds to the receiving waters in past decades, as documented by the EPA’s Toxic Release Inventory. The Work Plan could be more specific in addressing how the cleanup will incorporate both the accidental and historical releases of toxins from the fly ash into the Emory.
10. Explanation of cleanup progress: The Work Plan introduction does not present information on the cleanup decisions and progress that have led to the non-time critical removal actions. An explanation of the difference between the two types of removal actions would be helpful.
11. Clear understanding of site language: Figures 1 and 2 provide excellent, detailed and well-marked depictions of the dredge cell and immediately affected areas

that are of importance when discussing the cleanup. These characteristics are important to consider when creating figures for future documents.

12. Incongruence in map and text: Figure 4 provides information that does not seem to agree with the text in Section 3.1. For more information on how this information could be clarified, please see specific comment 8.
13. Use of appropriate EPA guidance: The exposure scenarios for children in contact with contaminated soil and water are not based on EPA's *Child-Specific Exposure Factors Handbook* (2008). EPA recommends using this handbook as a primary source of information for risk assessment. The values listed in the handbook are specific to children and consider the differences between children and adults in order to be as receptor-specific as possible. The Work Plan does not discuss how the exposure parameters for this site were derived, and it remains unclear whether children were considered using this most recent EPA guidance for that age category.
14. Spatial extent of site: It would benefit readers if the document clarified what spatial area the official site includes and then referred to that area as "the site" throughout the rest of the document. Instead, the document uses "KIF [Kingston Fossil Plant] and the area affected by the ash release," which is vague. The full spatial extent of the site would include as far up and down the rivers as ash is detected. In other words, until samples return clean, without any trace of ash, that area should be considered part of the cleanup site.
15. Cumulative risk: The Work Plan does not mention evaluating long-term risks from multiple chemicals and other harmful conditions that exist in the area, for people or ecological resources. This type of risk is referred to as cumulative risk and EPA has developed an approach for addressing this issue. Will cumulative risks be considered in the full evaluation?
16. Construction risks: The Work Plan does not mention if TVA will consider the various conditions and changes that will be imposed on the community by construction work in each remedial alternative. These conditions may include increased train and truck traffic, dust and runoff. Presumably a table could show the types of risks for each alternative, with the risks from each cleanup option along with the risks from contamination left in place.
17. Limitations of risk assessments: For every risk assessment there are standard limitations on its ability to precisely calculate risk. These limitations can result in an overestimation or underestimation of risk. Some of the variables that are not incorporated into a risk assessment are: the combined effects of multiple chemicals, novel responses to exposure, toxicity data for some chemicals and a uniform exposure pathway from site to site.

II. Specific comments

EE/CA Work Plan

1. Executive summary, page vi: The question “In what condition should the rivers be left?” seems too broad to address the issues associated with residual ash in the Emory, Clinch and Tennessee Rivers. The scope of the river action could explicitly mention all aspects of the rivers, including recreation, ecology, fishing, and health implications and how these will influence the restoration. The same is true for the question “In what condition should the embayment be left?” The language used in this section does not give a clear understanding of the role these areas play within the broader scope of community and environment.
2. Executive summary, Sampling and Monitoring Activities, page vii: The acronym TDEC is used for the first time here, but it is not spelled out. The document would be clearer if it consistently spelled out every acronym the first time it is used.
3. Executive summary, Ecological Risk Assessment, page viii: The language in this section leads the reader to expect an actual list of the constituents of potential concern, using the names of each constituent. Instead, what follows is a list of the number of inorganic constituents detected in ash as soil, as sediment, and in surface water. There is no reference in this section that would direct a reader to the full list. The section could be edited to be more explicit.
4. Executive summary, Range of Alternatives, page ix: The Range of Alternatives does not include a “No Action Alternative.” It is standard cleanup procedure to provide a full range of cleanup alternatives, from the “No Action,” which involves doing nothing to alter the current conditions of the site, to an alternative that spares no expense to fully restore the site to as close to its original conditions as possible.
5. Introduction, page 3: The scope of the work is described oddly in the four questions pertaining to the cleanup. The fourth question, “In what condition should the river be left?” makes a presumption that the regulatory agencies are leaving open the option that the river will not be restored to the pre-spill conditions or better. If the question is really how to improve the conditions of the river, then such a question could be explicitly stated, rather than imply that the river may not be restored. A suggested change to the language is “*To what condition should the rivers be restored?*” This wording indicates that the cleanup will proactively change the condition of the rivers for the better.
6. Introduction, third full paragraph, page 3: The language could be changed to include re-vegetation with *native* species, rather than “selected” as the Work Plan is currently written. It is important to restore this site to its original conditions, using plants that naturally occur in the area in order to encourage the ecosystem to recover to the fullest extent possible.

7. Introduction, fourth full paragraph, page 3: There is a typo in this paragraph. “effortsUltimately” should be edited to “efforts. Ultimately.”
8. Section 3.1 Site/Ash Conditions, page 4, and Figure 4: The text of the Work Plan states that no coal ash was found in the Little Emory River. The text on Figure 4 also states that no coal ash was found in the areas sampled in the Little Emory River. However, according to the Figure 4 legend, green dots symbolize that ash was found. There are five green dots in the mouth of the Little Emory River on Figure 4. It is unclear whether this is a mistake or if ash was found at these sampling locations, as the dots indicate. The map and/or text in Section 3.1 should be changed to properly reflect the results of the sampling.
9. Section 3.2 River Conditions, page 5: TRM and ERM are spelled out in the second paragraph, but both acronyms were already used, without being spelled out, on page 4.
10. Section 3.2 River Conditions, page 5: The abbreviation for cubic feet per second (cfs) is used for the first time in the document without giving the full name. After several uses throughout the document, cfs is spelled out on page 55 for the first time. The document’s readability would be improved by consistently spelling out acronyms and abbreviations the first time they are used in the document.
11. Section 3.2.4 Water Quality, page 6: This section states that there “may” be elevated levels of metals in the Emory River. It is unclear whether data exists with this information. For clarity, the document could state how this information is relevant to the cleanup by giving definite background data on water quality.
12. Section 3.3 Ground water Conditions, page 7: Rather than using the phrase “KIF and the area affected by the ash release,” the language could be adjusted to use “The Site.”
13. Section 3.3 Ground water Conditions, pages 7-8: Figure 5, used to depict the rock formations that influence ground water, does not give a clear understanding of the hydrology near the site. Specifically, the Work Plan states that ash does not threaten the ground water due to the hydrogeology, but it concurrently states that ground water “within the site locality” is recharged by infiltration during precipitation events. Rainwater will continue to infiltrate the terrain, regardless of whether it is soil or ash. In this case, rainwater can filter through the ash that remains on the ground at the site into the rock formations below and eventually to either the river or ground water. A figure in addition to Figure 5 could provide directional arrows or a layered depiction of how precipitation reaches the ground water or discharges to the river. This figure would serve to assure the community that leachate is being appropriately considered and monitored to prevent ground water contamination. In addition, acid rain conditions will increase the leaching of metals into waters (surface and ground), presumably raising the risks from ash to ground water in the area.

14. Section 3.3 Ground water conditions, page 8: There is a typo in the third full paragraph. “Affect” should be “effect.”
15. Section 3.4 Ecological Conditions, page 8: This section omits discussion of the aquatic environment and ecosystem. It is also silent on mammals that are native to the area. The relationship of vegetation and terrestrial species is integrally linked to the aquatic plants and animal species, which is relevant to the discussion of ecology at the site.
16. Section 3.4 Ecological Conditions, first full paragraph, page 9: The first sentence indicates that fauna have been described earlier in this section. However, the preceding discussion only mentions various types of plants, not animals. It is possible that the author confused flora and fauna. If this is the case, “fauna” should be replaced with “flora” in this paragraph.
17. Section 4 Sampling and Monitoring Activities, page 10: This text is the first time that the name “Kingston Fly Ash Recovery Project” has been used. It is unclear whether this is the official name of the cleanup project, what the project entails, or generally to what it is referring. The Work Plan could include a paragraph in the “Background” section that would introduce this name and its relevance to the cleanup.
18. Section 4.1 Soil and Ash Sampling Results, first full paragraph, page 11: This explanation of why coal ash is not classified as a hazardous material under federal law either does not make the point clearly or is incorrect. Rewriting this section of the Work Plan would make it more accurate. Coal ash is classified according to the legal definition under the Bevill Amendment. It is also important to mention that the legal definition of hazardous is different than the scientific description of toxicity. The scientific definition of toxic (capable of causing injury or death) depends on the site specific concentrations, exposure pathways and durations, and a range of other biological factors. The legal definition of hazardous is derived not only from scientific evidence, but also from political factors, and therefore the list of hazardous wastes may not include all wastes that are toxic to humans and the environment. This paragraph states that “In all instances, the concentrations of the TCLP metals, including arsenic, found in samples from the KIF release site were below the threshold values that would categorize the ash as hazardous waste material under 40 CFR Part 261.” EPA uses the TCLP to determine how much of the contaminants will leach out of the ash and compares that number to a federal standard, but this method is never mentioned and the data from this testing are not made available in this document. Moreover, there is a distinct set of standards used to determine the threat posed to human health and ecological quality, which is not clarified in the Work Plan. The document gives the impression that because the ash does not qualify for disposal in a hazardous waste landfill, there is no threat to human health or wildlife. Using the data provided in Table 8, we prepared a comparison

of the maximum detected concentrations of metals at the TVA site to the federal threshold values listed under CERCLA (see Table 1 below). These maximum concentrations will be used for the risk assessments that will determine the threats to human and ecological health posed by the site, according to the document.

Table 1.

Contaminant/Constituent in ash	Federal hazardous waste parameters* (mg/L)	Maximum detected concentration at TVA site (mg/L)
Arsenic	5.0	166
Barium	100	1410
Chromium	5.0	68
Lead	5.0	60.5
Mercury	0.2	0.2
Selenium	1.0	17.8

*If any of the constituents present in waste fall within one of the four characteristics of hazardous waste according to RCRA and are present in concentrations above the parameter, that waste is considered hazardous. Coal waste is exempted from this classification system.

19. Section 4.1 Soil and Ash Sampling Results, second full paragraph, page 11:
This section makes a vague statement that TDEC has posted “relevant information” on its Web site, but it does not give the Web site or any name for the data that would encourage a reader to search for it. If these data are important to the EE/CA Work Plan, TVA could include it as an appendix to encourage proactive reading, as opposed to sending readers away from the document looking for information that was excluded.

20. Section 4.1 Soil and Ash Sampling Results, second full paragraph, page 11: The language of this paragraph states that arsenic presents a potential health hazard, which is in direct contrast to the statements made in the first full paragraph above it. The Work Plan should clarify whether or not the sampling data indicate that arsenic is above the screening levels that would qualify it as a human health hazard.

21. Section 4.4 Ground water Sampling Results, second and third full paragraphs, page 13: This paragraph, rather than simply listing the 17 organic constituents that are included in Appendix I of the TDEC state rule, only references Appendix I. The paragraph could be amended to provide the full list of constituents in the body of the text, or a second option would be to create a list of these constituents and provide it in an appendix to the Work Plan. Including information in technical documents, rather than sending readers away from the document to look for it, gives a better sense of the information that the document relies on and engages the reader beyond surface level.

22. Section 4.5 Ecological Sampling Results, entire section, page 14: This section does not give any reference to when or where these results will be published and

how they will be used in the scope of designing and implementing the cleanup. In addition, this section only mentions the physical impact of the coal ash spill, but it could include a holistic presentation by giving the chemical impact as well.

23. Section 4.5 Ecological Sampling Results, third full paragraph, page 14: The information given in this section would be categorized under the chemical effects of the coal ash spill, not physical. The reproductive, neurological, and developmental impacts on fish in the rivers are all influenced by the specific constituents present in the river as a result of the spill at a more complex level than simply their physical presence.
24. Section 4.6 Air Sampling Results, first full paragraph, page 14: The third sentence beginning with “The hand-held...” and ending at “2.5 microns” is a run-on sentence. There should be a period, instead of a comma, after “(PM10).” In addition, this sentence gives the abbreviation for 10 microns, but does not give the abbreviation for 2.5 microns. For consistency, this sentence should provide the abbreviation for both.
25. Section 5 Human Health Risk Assessment, bulleted list, page 15: The document could be clearer by indicating that the list of EPA guidance documents is not exhaustive, rather than using the word “may,” which implies that certain documents will be selected from this list and that other documents absent from the list will not be considered. One specific reason this amendment is important is that the list does not include the *Child-Specific Exposure Factors Handbook* (2008), which serves as the primary guide on risk assessment for children and should be an integral part to the risk assessment portion of this cleanup.
26. Section 5.1 Data Evaluation, second bullet, page 16: This entire sentence is a run-on. There should be a period between “evaluated” and “sediment.”
27. Section 5.1.2 Identification of Site Related Contaminants, Determination and Use of Background Concentrations, page 18: It is unclear which data will be used, and from which agency, to serve as the reference for the background concentrations of soil in the Roane County Region.
28. Section 5.1.2 Identification of Site Related Contaminants, Determination and Use of Background Concentrations, second full paragraph, page 19: The document would be clearer if the specific sampling depths for each location were listed, instead of saying “several.”
29. Section 5.2.1 Soil/Ash, page 23: It is unclear whether there is currently public access to the site.
30. Section 5.2.3 Surface Water, Recreator (fisher) paragraph, page 25: There is a typo in this paragraph. The word “isfrom” in the fourth sentence should be separated into two words.

31. Section 5.2.5 Quantification of Exposure, first and second paragraphs, page 26: There is an entire body of scientific evidence indicating that 10 mg/L is not a low enough threshold to protect children from the effects of lead. In order to be as conservative as possible and to protect the community's youth, TVA could revise this section to indicate that they will use the IEUBK model at a threshold below 10 mg/L.
32. Section 6.1 Conclusions of the SLERA, first paragraph, page 33: It is unclear what "steps" are being referenced, what step 1 is, or where one could find these steps.

Appendix A Ecological Conceptual Site Model

1. A.1. Sources, first sentence, page 45: There is a typo in this sentence. It is unclear whether it should be "a constituent" or "constituents."
2. A.1.1 Primary Source, page 45: This is a great introductory, background paragraph that would have served well in the introduction to the entire document. It gives important background information that is relevant to a clear understanding of the cleanup.
3. A.5.4 Benthic Invertebrate Communities, page 48: This section does not mention specific benthic invertebrates that are known to reside in the Emory, Clinch and Tennessee Rivers. This omission is important because of the variety of special and endangered species of freshwater mussels that are federally protected.
4. A.5.6 Amphibians and A 5.7 Reptiles, page 49: Neither of these sections reference the different species found at this site. To be consistent with the other Ecological Receptor sections, these sections could be amended to specifically reference the animals that fall into these categories.

Appendix B Screening-Level Ecological Risk Assessment

1. First paragraph, page 53: There appears to be a typo in this paragraph. There is a large space before the last sentence.
2. Second paragraph, page 54: The information in this paragraph would be useful in the risk assessment section of the document to provide background information.
3. B.1.1 Screening-Level Problem Formulation, Identification of Constituents Detected in relevant Media, page 56: There is a typo in this sentence. There is a series of spaces and a period before the last sentence.

Risk Assessment limitations:

Risk assessment is a good method, but it is not perfect for determining the likelihood, nature and extent of harm from environmental conditions both for human health and ecological endpoints. Risk assessments can make reasonable estimates for some conditions, especially for the risks from single chemicals to average people. Risk assessment is less effective for ecosystems, multiple chemicals and chemicals for which there are limited toxicological data.

All risk assessments are supposed to estimate the probability, nature, extent and magnitude of harm from stresses. They are typically used to assess chemical exposures for people and experimental animals. The basic method for all risk assessments is common to human health and ecological analysis and includes an exposure analysis, a hazard analysis, a dose-response estimation and a risk characterization. Ecological risk assessment adds an additional initial step of problem formulation that serves to focus and define the assessment.

Human and ecological risks assessments differ in some important aspects:

- 1) Human health risk assessments consider individuals and not communities.
- 2) Ecological risk assessments evaluate populations and not individuals, except for rare and endangered species.
- 3) Much less is known about the ways that animals and plants respond to environmental stressors.
- 4) Ecological risk assessments should consider how assemblages of animals and plants and not just single species are affected.
- 5) Ecological risk assessments always begin with a Problem Formulation that narrows the scope because it is not possible to assess all species and all potential effects.

Risk assessments depend on a base of knowledge regarding the conditions of the risk situation. These conditions will determine the source of stress, the exposure pathways and the people and non-human species affected. The conditions also include the condition or status of the communities exposed to stresses.

Risks are difficult to assess for multiple chemical exposures, as is the case at the TVA Coal Ash Spill. The most common method for handling multiple chemicals is simply summing the individual calculated risks. This approach does not take into account interactions among chemicals that cause responses greater than can be predicted by adding them together nor can risk assessment predict novel responses that are only observed with multiple chemical exposures.

Oftentimes, the limitation for estimating human health risks is the fact that most toxicological information is based on experimental animals that have significant biological differences from humans. These differences are taken into account via uncertainty factors. Uncertainties regarding the exposed people are also considered.

Risk assessments are supposed to consider the most sensitive and vulnerable members of a community or population. Children or young animals, fetuses and the chronically ill are all more sensitive or vulnerable and will suffer more severe harm than the average adult. Chronic illnesses such as cardiovascular disease and respiratory problems (asthma, COPD) also result in greater sensitivity to many environmental stressors, especially airborne ones.

Risk assessments have only recently begun to address how human communities respond to stressors. Literature from the social science field indicates that communities already under stress are more vulnerable to subsequent stress. These stressors can stem from high unemployment rates, poor health care and school systems, high disease burdens and other social factors. Communities that are already under stress from these types of conditions will experience more severe effects and recover poorly from major stress from natural or human disasters. This type of risk assessment is referred to as a cumulative risk assessment and EPA has completed at least two substantial documents on conducting cumulative risk assessment.

The risk assessments for the TVA Fly Ash Release will be shaped by a number of these social and ecological conditions that apply to the specific situations in Roane County.

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