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**Re: Comments for the Record  
Draft Permit, Major Permit Modification for a Solid Waste Disposal Facility  
TVA Kingston, Class II Landfill, IDL 73-0211**

Dear Mr. Luke:

Please accept these comments on the Major Permit Modification for the Class II Landfill for the Kingston Fossil Plant, IDL 73-0211, from Southern Alliance for Clean Energy, Southern Environmental Law Center, Tennessee Clean Water Network, Statewide Organizing for Community eMpowerment, the Sierra Club, Environmental Integrity Project and Earthjustice (hereinafter referred to collectively as “the Groups”). We appreciate the opportunity to comment on Tennessee Valley Authority’s (TVA) application to Tennessee Department of Environmental Conservation (TDEC) for a major permit modification for a Class II landfill permit for storage of gypsum waste, fly ash, bottom ash, boiler slag, cinders and clinkers generated by the Kingston plant. We welcome TVA’s conversion from wet placement to a dry stacking waste management at the Kingston facility. While the only way to make coal ash completely safe is to avoid generating it in the first place, dry storage of coal ash can be less harmful to the environment and human health than storage in wet impoundments if the landfill is sited, constructed, and operated to highest industry standards.

**1. Introduction**

Unfortunately, the landfill and proposed major modification do not represent a best-in-class design and contain significant problems, as demonstrated more fully in this comment letter and the attached supporting technical comments. The application for this permit raises a number of significant technical and environmental concerns, including a background of ongoing contamination from the Kingston ash ponds, complex substructural issues, improper variances, an insufficient drop-out mitigation plan and ecological risks to the Clinch River. At the December 9<sup>th</sup> TDEC public hearing around this permit, the Groups learned that TVA has a contingency plan to store this waste off-site if they cannot move forward with the landfill on the proposed site. TDEC should reject the proposed major modification and make TVA find a safer, more stable site for storage of this coal ash waste.

In addition, we are concerned that while this permit has been under review, TDEC has allowed TVA to go forward and begin construction of Phase IB, utilizing the dropout mitigation used for Phase IA, on the basis that such procedure was a “minor modification”.<sup>1</sup> As discussed below, that mitigation is wholly insufficient, and there is a real question as to whether under these circumstances this was a “minor modification” in accordance with the law. There is also a question of the propriety of TDEC’s approval of a substitute liner for Phase IB, again as a minor modification.<sup>2</sup> Irrespective of the legality and propriety of these actions, TVA’s premature construction work should not and cannot justify the issuance of this permit.

Although normally site suitability is not taken into consideration during the permit modification process, in this instance there is significant new information about the site that has come to light since the original permit was granted.<sup>3</sup> A December 2010 dropout, discussed in more detail below, 10 additional sinkholes on-site and a significant amount of selenium contamination in the groundwater have been discovered since the original permit and are clear evidence that the current site is actually unsuitable for a landfill. Because this new information was unknown at the time of the original permit and poses a threat to human health and the environment, TDEC must consider whether or not this site is actually suitable for long-term storage of coal ash waste.

The attached technical findings from Mark A. Quarles, P.G. (Global Environmental, LLC Report), provide details on, among other things, the following deficiencies that TDEC should address:

- The technical components submitted by TVA in support of the permit modification relied on outdated, inaccurate, and insufficient information to support their claim that the site is a suitable disposal facility that meets TDEC’s standards.
- The proposed landfill site clearly exhibits extensive karst geologic features such as sinkholes, cavernous bedrock, and rapid conduit groundwater flow – all features that are not suitable for landfills meant to protect groundwater and surface water.
- TVA’s engineering measures to address the unstable and karst geologic conditions do not meet TDEC’s technical landfill design standards.
- The proposed groundwater monitoring program is deeply flawed because it does not provide for early release detection, does not test for all parameters that are most commonly associated with coal ash, and does not use proper statistical evaluations.
- TVA’s plan to not cover wastes increases the volume of leachate that will be circulated through an improperly designed Phase 1A leachate collection system, increases the weight of the fill, and increases the concentrations of the leachate that will require

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<sup>1</sup> December 4, 2103 letter from Paula Plont to Terry Cheek.

<sup>2</sup> May 15, 2014 Letter from Paula Plont to Sam Hixson. The applicable rule provides: “A minor modification is a change in the plans for a facility which will not alter the expected impact of the facility on the public, public health, or the environment.” Rule 0400-11-01-.02 6 (b) 5.

<sup>3</sup> TDEC Rule 0400-11-01-.02 6 (b) 6, which provides “Facility Siting - Suitability of the facility location will not be reconsidered at the time of permit modification or revocation and reissuance *unless new information or standards indicate that a threat to human health or the environment exists which was unknown at the time of the permit issuance*” emphasis added.

disposal.

- TVA's failure to choose the liner type and specifications that will be used for the entire landfill denies the public a full opportunity to review and comment on the proposed landfill and prevents TDEC from adequately reviewing the technical merits application.

The attached Global Environmental LLC Report is hereby incorporated by reference into this comment letter. In addition, we offer the following comments and suggestions:

**2. The proposed site for the landfill is irreparably unstable and unsuitable for long-term storage of coal ash waste and the Dropout Mitigation Plan set forth in the proposed permit is insufficient.**

- a. The proposed site for the landfill is irreparably unstable and unsuitable for long-term storage of coal ash waste.*

The proposed landfill site clearly exhibits extensive karst geologic features such as sinkholes, cavernous bedrock, and rapid conduit groundwater flow – all features that are not suitable for landfills meant to protect groundwater and surface water. TVA discovered 11 sinkholes after construction of the landfill initially began.<sup>4</sup> In December 2010, a large and sudden sinkhole collapsed within the Phase 1A disposal cell. TVA's own 2005 hydrogeologic study to determine site suitability, discussed in more detail below, failed to identify any of these sinkholes in advance. These discoveries and events alone should constitute sufficient evidence that the proposed site is unsuitable for landfills.

In its analysis to discover the cause of the December 2010 sinkhole, TVA made the following conclusions:<sup>5</sup>

1. The sudden collapse was due to a “small diameter soil conduit extending vertically into bedrock.”
2. Loading may have deformed the fill material and the geosynthetic clay liner over the void resulting in cracking and allowing water to enter the bedrock throat of the void.
3. The void/conduit was present and undetected prior to construction.
4. “It is difficult to predict other locations of voids in this type of geology with any degree of accuracy.”
5. “There is no feasible investigation method that would conclusively identify the locations of all presently undetected voids.”
6. “The original investigation identified conditions indicative of potential voids,” yet that 2005 investigation concluded “only a limited number of actual voids were detected.”

Additionally, TDEC required a dye trace investigation to determine the pathways of

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<sup>4</sup> It should be noted that sinkholes visible on the surface are usually reflective of depressions in the bedrock but not all depressions in the bedrock have resulted in surface expressions.

<sup>5</sup> Root Cause Analysis Report for December 15, 2010 Construction Drop-Out, Geosyntec Consultants, March 2011.

contamination for this sinkhole collapse. After conducting this dye trace investigation, TVA concluded “all groundwater originating on, or flowing beneath, the disposal area ultimately discharges into the Clinch River.”<sup>6</sup> The preferential groundwater migration pathways discovered during the dye trace investigation include conduit bedrock flow along bedding planes, caverns and joints.<sup>7</sup> This analysis also determined that contamination can by-pass downgradient monitoring wells located nearby and eventually deposit directly into the Clinch River. This means that the water quality determined from these monitoring well results may not represent actual concentrations of contaminants that end up in the Clinch River via these migration pathways.

Furthermore, TVA determined that inflow from the river to the groundwater beneath the proposed landfill “may occur into the bedrock flow system along the river margin...during periods of rapid increases in river elevation.”<sup>8</sup> In fact, TVA found that the Clinch River influences groundwater elevations extending up to 1000 feet from the river as well as beneath the landfill. This means that more than half of the proposed landfill has groundwater beneath it that rises and falls in direct response to river levels. TVA found it impossible to identify all of the joints contained in the bedrock located on the landfill site, which could cause sudden collapses of the landfill. TVA did discover that the underlying bedrock contained caverns up to 8 feet tall and over half of the 14 rock core borings drilled on-site had caverns in them. Despite the overwhelming evidence that this site is patently unstable and therefore unsuitable for long-term storage of coal ash waste, TVA continues to falsely assert the viability of this landfill site.

There is significant potential for surface collapse, as demonstrated by the December 2010 collapse, TVA’s identification of potential future collapse locations within the landfill footprint and TVA’s conclusion that other potential future collapse locations cannot be predicted. The groundwater conduit flow system has already contributed to a major surface collapse and has caused significant degradation to the ground water. The location of this landfill over karst terrain has already caused significant degradation to the local ground water resources. For these reasons, TVA has failed to comply with TDEC regulations for facilities over karst terrain.<sup>9</sup>

*b. The Dropout Mitigation Plan set forth in the proposed permit is insufficient.*

TVA’s efforts to address the unstable geologic conditions for this site do not meet TDEC’s technical landfill design standards. The dropout mitigation plan relies on visual observation from the surface during and after construction to identify potential collapse areas located deep in the soil below. For example, the location of the sudden collapse sinkhole reported in December 2010 had been over-excavated 3 feet during landfill construction and “due to the small size of the throat at this dropout, it was previously undetected.”<sup>10</sup> TVA’s plan to only over-excavate and re-compact only the upper-most 5 feet will not correct the deeper soil voids and bedrock conduits, which represent root causes of future, potential collapses. It is likely that a mere 5-foot over-

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<sup>6</sup> Dye Trace Investigation Report, Geosyntec Consultants, July 19, 2011.

<sup>7</sup> *Id.*

<sup>8</sup> *Id.*

<sup>9</sup> Rule 0400-11-01.04 (2) General Facility Standards, (q.) Karst Terrane (sic).

<sup>10</sup> Root Cause Analysis Report for December 15, 2010 Construction Drop-Out, Geosyntec Consultants, March 2011.

excavation, TVA's current plan to overcome the unstable site characteristics would not have prevented the December 2010 collapse and is inadequate for prevention of future collapses.

Additionally, the dropout mitigation plan does nothing to address and prevent the seasonal and flood-stage fluctuations of the groundwater elevations influenced by the Clinch River. Seasonal fluctuations of the groundwater and the associated upward pressure head can result in the formation of an arch from below. This threat is compounded by the fact that half of the proposed landfill has groundwater beneath it that rises and falls in direct response to Clinch River levels. Arches that form in the deep soil from the rise and fall of groundwater can form suddenly, without any visual indication on the surface of the ground or warning that a collapse is imminent.

TVA's only engineering mitigation measures, which include the proposed dropout mitigation plan and a composite liner, rely on no new subsurface investigation data and rely on visual observations made from above during construction. These visual observations are wholly inadequate and do not predict where a future collapse from below might happen. The soil exhibits differential settling because of conduits in the bedrock and voids in the soil, and TVA has concluded that those future settlement areas cannot be pre-identified or predicted.

TVA has filled over known sinkholes and failed to address the hydraulic connection to the rise and fall of water in the Clinch River resulting in remaining unmitigated risks with the proposed landfill. The proposed liner options are not sufficiently strong to prevent liner failure in the event the soil collapses from below, as it did in the reported December 2010 sudden collapse.

As a result, the dropout mitigation plan is inadequate and renders the permit insufficient to protect the surrounding environment from further contamination.

- c. TDEC must consider site suitability given new information about the site that threatens human health and the environment.*

TDEC regulations require reconsideration of site suitability in the event that "new information or standards indicate that a threat to human health or the environment exists which was unknown at the time of the permit issuance."<sup>11</sup> As explained, TVA and TDEC have become aware of numerous problems with stability and water contamination at the landfill site. The catastrophic December 2010 dropout, discussed in more detail below, along with 10 additional sinkholes on-site and a significant amount of selenium contamination in the groundwater have been discovered since the original permit. Because this new information was unknown at the time of the original permit and poses a threat to human health and the environment, TDEC must consider whether or not this site is actually suitable for long-term storage of coal ash waste. After considering the myriad of issues identified at this site, it should be clear that this site is not suitable for long-term storage of coal ash waste and TVA must find a more suitable site for storage of this waste.

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<sup>11</sup> TDEC Rule 0400-11-01-.02 6 (b) 6.

### **3. The technical components submitted by TVA in support of the permit modification rely on outdated, inaccurate and insufficient information.**

In the Operations Manual for the proposed major permit modification, TVA attempts to explain how it will comply with TDEC's technical standards.<sup>12</sup> In this Operations Manual, TVA included virtually no new hydrogeologic investigation data, despite well-documented karst geologic conditions and associated water contamination that have been identified since the initial permit was granted in 2007. Instead, the Operations Manual continues to rely on the original 2005 hydrogeologic investigation for the site.<sup>13</sup> This 2005 analysis came well before the December 2010 sinkhole collapse and before TVA identified up to 10 other probable collapse areas that were identified in Phase 1A.

In its 2014 Operations Manual, TVA incorrectly reports, "there are no natural karst features (i.e., sinkholes, sinking streams, and springs) directly formed in the subsurface" and that "no active karst features were observed during the hydrogeologic study." TVA's site suitability determination for the initial Class II permit – in addition to the 2014 Operations Manual<sup>14</sup> for the proposed permit modification – is based on a conclusion made in 2005 that there were no voids in the soil that would be indicative of a sudden collapse potential.<sup>15</sup> TDEC cannot and should not allow TVA to rely on this outdated and materially inaccurate hydrogeological analysis in its permit application.

Although the TDEC Commissioner's Order<sup>16</sup> in response to the December 2010 sinkhole collapse and release of landfill contents directly into the Clinch River required a plan for a subsurface investigation to determine the cause and nature of the seepage failure, TVA's response essentially included no new subsurface borings or investigative techniques other than the small area in the immediate vicinity of the collapse. As a result, essentially no new information was gathered for any Phase 1 or 2 area proposed as a landfill.

TVA's response to the Commissioner's Order to develop and implement a "plan for determining the structural integrity of the constructed landfill" included no new meaningful investigative procedures to evaluate the *entire landfill*, choosing instead to rely on 2005-era hydrogeologic conclusions, visual inspections of the landfill surface, incremental excavations only at the sinkhole collapse location, and the installation of a few shallow borings in that collapse area.

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<sup>12</sup> Operations Manual Combustion Residuals Disposal Facility, Permit Modification, Peninsula Site, Geosyntec Consultants, June 2014.

<sup>13</sup> Hydrogeologic Evaluation of the Coal-Combustion Byproduct Disposal Facility, Kingston Fossil Plant – Peninsula Site, TVA, December 2005.

<sup>14</sup> Operations Manual Combustion Residuals Disposal Facility, Permit Modification, Peninsula Site, Geosyntec Consultants, June 2014.

<sup>15</sup> The 2005 investigation performed by TVA identified numerous surface sinkholes in the landfill footprint and approximately 15 deep depressions in the bedrock that are indicative of karst solution-enlarged bedrock conditions.

<sup>16</sup> Commissioner's Order, letter to Ms. Anda Ray, TVA from E. Joseph Sanders, TDEC, December 17, 2011.

In summary, the structural integrity analysis concluded:

- a) Instead of evaluating the integrity of the subsurface for potential collapses and liner design, TVA chose instead to refine the site “conceptual model” to include karst features in order to evaluate the structural evaluation of the *liner system* – not the structural integrity of the site itself.
- b) “Because of the hit-and-miss nature of the karst geology, it is believed that additional subsurface investigations would yield information of limited utility”.
- c) “Use of a reinforcing geosynthetic under the landfill liner is costly and does not address the mechanics behind the void formation” and that “it is difficult to predict locations of voids in this type of geology with any degree of accuracy”.
- d) The “most viable and technically robust” way to determine the structural integrity of the site is to “confirm” potential collapse areas during construction through visual inspections, to “rehabilitate” them through over-excavation, and to install a flexible liner system to prevent voids *beneath* the liner from happening.

#### **4. The list of monitoring constituents in the Groundwater Monitoring Plan is insufficient.**

When a subsection of the Groups submitted comments on the Class II landfill proposal for TVA’s Gallatin plant in April of this year, we noted that the list of constituents to be monitored was inadequate in that it did not include the most important coal ash indicator pollutants.<sup>17</sup> The Kingston landfill permit is inadequate for the same reason.<sup>18</sup> We are surprised, because TDEC and TVA have agreed to monitor coal ash indicator pollutants at all coal ash landfills going forward. In the formal response to comments, TDEC said the following:

*Comment #111: TVA concluded in 1987 that boron, lithium, heavy metals, sulfate, and Total Dissolved Solids (TDS) were good indicators of coal combustion waste contaminants in water.*

*Response #111: The list of materials that are monitored at TVA landfills has grown and will include materials found in ash waste at the Gallatin Fossil Plant including those listed above.<sup>19</sup>*

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<sup>17</sup> See Southern Alliance for Clean Energy et al., Comments on the draft Class II Landfill permit for the Gallatin Fossil Plant, IDL 83-0219 (April 14, 2014).

<sup>18</sup> See TDEC, Draft Registration Authorizing Solid Waste Disposal Activities in Tennessee – IDL730000211 – Tennessee Valley Authority Kingston Fossil Plant (lacking site-specific groundwater monitoring requirements); see also Geosyntec, Operations Manual – Coal Combustion Residual Disposal Facility – Permit Modification – Peninsula Site – Kingston Fossil Plant, Appendix G: Groundwater Monitoring Plan at 4 (June 2014) (identifying inorganic constituents for detection monitoring, and omitting boron, lithium, manganese, sulfate, and Total Dissolved Solids).

<sup>19</sup> TDEC, Response to Public Comments Summary – TVA Gallatin Fossil Plant Class II Landfill (IDL830000219), 31 (June 30, 2014).

In some places, TDEC and TVA appear to be following this approach. A draft NPDES permit for the John Sevier plant, for example, includes some details about the ash pond closure plan for the site, and the list of groundwater monitoring constituents includes boron, cobalt, manganese, sulfate, aluminum, and other parameters associated with coal ash.<sup>20</sup>

In the current draft landfill permit for Kingston, however, monitoring of coal ash indicators is not required. TDEC has either made an oversight in drafting the permit, or it has broken its word to the citizens of Tennessee. We hope it is the former, and that the mistake will be quickly remedied. In any case, we feel compelled to reiterate the basis for our comment as it applies to the Kingston permit.

The existence of coal ash indicators is indisputable. The U.S. EPA's proposed regulation for disposal of coal ash sets out pollutants that would serve as early indicators of coal ash pollution during detection monitoring. These include boron, chloride, sulfate, and Total Dissolved Solids (TDS).<sup>21</sup> The proposed EPA rule also includes a larger list of pollutants to be monitored in "assessment monitoring" once the early indicators show a problem; these include aluminum, manganese, molybdenum, and others.<sup>22</sup>

Like EPA, TVA has recognized that aluminum, arsenic, boron, manganese, strontium, sulfate, and TDS are useful coal ash indicators.<sup>23</sup> These pollutants, and in particular boron, manganese, and sulfate, are regularly elevated relative to upgradient or background wells at TVA coal ash disposal sites.<sup>24</sup>

At the Kingston plant, in particular, there is abundant evidence of groundwater showing elevated concentrations of coal ash indicators. The landfill that this permit would allow the expansion of, which has been receiving flue gas desulfurization waste since 2010,<sup>25</sup> caused severe contamination of underlying groundwater in 2010. Table 1 below summarizes data for selenium

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<sup>20</sup> TDEC, DRAFT NPDES permit No. TN0005436 for the John Sevier Fossil Plant (Dec. 14, 2014) (the full list of monitoring parameters is a positive development, but we note that two pollutants are missing from the list – Total Dissolved Solids, which is a traditional coal ash indicator, and molybdenum, which has been associated with coal ash throughout the TVA fleet and has been a particular problem at John Sevier).

<sup>21</sup> See U.S. EPA co-proposed Subtitle D coal ash regulations, 75 Fed. Reg. 35128, 35253 (June 21, 2010).

<sup>22</sup> *Id.* The full list includes aluminum, antimony, arsenic, barium, beryllium, boron, cadmium, chloride, chromium, copper, fluoride, iron, lead, manganese, mercury, molybdenum, pH, selenium, sulfate, thallium, and TDS.

<sup>23</sup> See, e.g., TVA, *Colbert Fossil Plant Groundwater Assessment*, 51 (Oct. 1994) (stating that "pH, sulfate, and TDS are considered to be indicators of coal ash leachate in groundwater" and that aluminum, manganese and iron can be associated with ash leachate); *id.* at 52 (stating that boron, molybdenum, and strontium are often considered to be indicators of ash leachate); TVA, *Groundwater Monitoring Report – Allen Fossil Plant*, at 2 (Aug. 22, 2008) (identifying arsenic, boron, and sulfate as "ash leachate indicators").

<sup>24</sup> See generally Environmental Integrity Project, *TVA's Toxic Legacy: Groundwater Contaminated by Tennessee Valley Authority Coal Ash* (Nov. 2013), available at [http://www.environmentalintegrity.org/news\\_reports/documents/20131107\\_TVAGroundwaterReport\\_FullDraft\\_000.pdf](http://www.environmentalintegrity.org/news_reports/documents/20131107_TVAGroundwaterReport_FullDraft_000.pdf).

<sup>25</sup> See TVA, *Kingston Fossil Plant Gypsum Disposal Facility Groundwater Monitoring Report – June 2010* (July 29, 2010).

and other coal ash indicators, and shows that downgradient concentrations of these indicators have exceeded upgradient concentrations by very large margins: as much as 300-fold in the case of selenium. This was all after a sinkhole formed in the gypsum disposal area. If TVA and TDEC hope to detect such failures in the future, they will have to monitor these pollutants.

Table 1: Groundwater Quality Data from the Kingston Gypsum Disposal Facility  
(Dec. 2010 – Dec. 2013)

Parameter	Upgradient well G1B: Mean and (maximum)	Downgradient well data: Mean and (maximum)					
		G3A	G3B	G4B	G5A	G5B	G6B
Boron (mg/L)	0.04 (0.05)	0.04 (0.05)	0.04 (0.05)	0.08 (0.12)	0.62 (1.41)	1.03 (1.55)	0.04 (0.05)
Selenium (ug/L)	1.3 (2.0)	1.5 (2.0)	1.2 (2.0)	7.0 (29.3)	71.9 (379.0)	126.9 (412)	7.9 (99.3)
Sulfate (mg/L)	2.9 (4.5)	21.8 (29.0)	60.8 (65.4)	67.3 (75.8)	112.8 (246.0)	288.7 (378.0)	6.1 (12.7)
Total Dissolved Solids (mg/L)	228 (255)	206 (229)	280 (320)	516 (604)	507 (841)	995 (1,090)	304 (334)

In addition to gypsum, the expanded landfill will also receive fly ash, bottom ash, and other materials. Groundwater monitoring wells near Kingston’s current ash disposal area have shown elevated concentrations of cobalt, manganese, and sulfate.<sup>26</sup> In order to detect leakage from a disposal area that contains coal ash, TVA must monitor these and other coal ash indicators.

Tennessee regulations explicitly state that TDEC should expand the list of monitoring parameters when TDEC knows that there are indicators of the waste being regulated. According to Tenn. Comp. R. & Regs. 0400-11-01-.04:

The Commissioner may establish an alternative list of inorganic indicator parameters for a SWLF unit, in lieu of some or all of the heavy metals (constituents 1-17 in Appendix I to this rule), *if the alternative parameters provide a reliable indication of inorganic releases from the SWLF unit to the ground water* (emphasis added).<sup>27</sup>

<sup>26</sup> Environmental Integrity Project, *TVA’s Toxic Legacy: Groundwater Contaminated by Tennessee Valley Authority Coal Ash* (Nov. 2013), available at [http://www.environmentalintegrity.org/news\\_reports/documents/20131107\\_TVAGroundwaterReport\\_FullDraft\\_000.pdf](http://www.environmentalintegrity.org/news_reports/documents/20131107_TVAGroundwaterReport_FullDraft_000.pdf).

<sup>27</sup> This Class I landfill rule applies to Class II landfills per Tenn. Comp. R. & Regs. 0400-11-01-.04(7)(b). (“Class II disposal facilities must meet the same ground water protection/monitoring standards for Class I facilities [with listed exceptions]”).

TVA, like EPA, has acknowledged that several pollutants (listed above) “provide a reliable indication of inorganic releases.” TDEC plainly has a legal basis, and a responsibility, to require monitoring of these pollutants.

In addition, according to the groundwater protection and monitoring standard regulations for Class II landfills:

Since the operator of a Class II facility may or may not be required by the Commissioner to conduct sampling and analysis for the constituents listed in Appendix II of this rule, the operator shall develop and submit a ground water quality assessment plan as required in part (a) 6 of this paragraph and shall conduct corrective action as required in part (a) 8 of this paragraph based on sampling and analysis of ground water monitoring parameters specified by the Commissioner to be characteristic of the wastes and/or the constituents listed in Appendix II of this rule. The Commissioner, at his discretion based on statistical increases in sampling parameters, may expand the number of parameters that characterize the waste.<sup>28</sup>

Again, TVA, like EPA, has explicitly acknowledged that several pollutants are “characteristic of the wastes” that would be placed in the proposed landfill. Furthermore, TVA has seen elevated concentrations of these pollutants in groundwater near coal ash disposal areas across their coal fleet. TDEC therefore has a firm legal basis to require monitoring of these pollutants.

A groundwater monitoring plan that doesn’t include the pollutants known to be associated with coal ash will very likely miss early warning signs of contamination, and potentially miss long-term contamination. At a minimum, there is no reason why TDEC would not require TVA to monitor the pollutants that TVA itself has described as coal ash indicators: aluminum, arsenic, boron, manganese, strontium, sulfate, and TDS.<sup>29</sup> TDEC must require TVA to amend its groundwater monitoring plan to include these pollutants.

## **5. The landfill permit is based on an inadequate assessment of potential ecological impacts**

Tennessee’s solid waste laws serve to protect human health and the environment. Specifically, the Solid Waste Disposal Act declares that it exists “to protect the public health, safety and welfare, prevent the spread of disease and creation of nuisances, conserve our natural resources, enhance the beauty and quality of our environment and provide a coordinated statewide solid

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<sup>28</sup> Tenn. Comp. R. & Regs. 0400-11-01-.04(7)(b)(5) (emphasis added).

<sup>29</sup> See, e.g., TVA, *Colbert Fossil Plant Groundwater Assessment*, 51 (Oct. 1994) (stating that “pH, sulfate, and TDS are considered to be indicators of coal ash leachate in groundwater” and that aluminum, manganese and iron can be associated with ash leachate); id. at 52 (stating that boron, molybdenum, and strontium are often considered to be indicators of ash leachate); TVA, *Groundwater Monitoring Report – Allen Fossil Plant*, at 2 (Aug. 22, 2008) (identifying arsenic, boron, and sulfate as “ash leachate indicators”).

waste disposal program.”<sup>30</sup> Tennessee landfill permit regulations implement the purpose of the law:

Each permit shall include such terms and conditions as the Commissioner determines are:  
(i) Necessary to achieve compliance with the Act and regulations, including each of the applicable requirements specified in this Chapter . . . and (ii) Otherwise necessary to protect human health and the environment.<sup>31</sup>

TDEC plainly has a legal obligation to ensure that landfill permits protect the environment. Yet this draft Permit is focused solely on potential human health effects, and ignores potential ecological impacts. There are a number of reasons, discussed below, why TDEC should be concerned about the ecological impact of the proposed landfill. In light of the clear potential impact, TDEC must carefully evaluate the ecological risks that the proposed landfill presents, and amend the permit to minimize or eliminate these risks.

First, the Kingston plant has a history of massive coal ash disposal failures with clear ecological impacts, including the 2008 spill of over 5 million cubic yards of coal ash into the local environment, and the 2010 release of large quantities of selenium, known to be toxic to fish, into the Clinch River. Local ecosystems have been repeatedly impacted by coal ash, and have a much lower capacity to absorb any additional injury.

Second, U.S. EPA modeling of long-term pollution migration from ash ponds and landfills suggests that ecological risks are in many cases greater than human health risks. In the risk assessment supporting its proposed solid waste rule for coal ash, the EPA estimated releases of coal combustion wastes from landfills and surface impoundments, the transport of pollutants in the environment, and risks to human and ecological receptors using several scenarios.<sup>32</sup> For every pollutant other than arsenic, the EPA quantified risk with a hazard quotient (HQ).<sup>33</sup> In general, the pollutant with the highest HQs was boron. In the unlined coal ash impoundment scenario, for example, the 90<sup>th</sup> percentile ecological HQ was 2,375, while the HQ for human health via the drinking water pathway was 7. More broadly, ecological HQs for boron consistently exceeded human health HQs, usually by more than an order of magnitude.<sup>34</sup> A similar pattern was evident for other pollutants. In the EPA’s screening analysis, ecological HQs exceeded human health HQs for boron, cadmium, lead, selenium, cobalt, chromium VI, manganese, and nickel.<sup>35</sup> In EPA’s final analysis, ecological HQs exceeded human health HQs (via drinking water) in one or more scenarios for boron, cadmium, lead, selenium VI, aluminum,

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<sup>30</sup> Tenn. Code Ann. § 68-211-102(a).

<sup>31</sup> Tenn. Comp. R. & Regs. 0400-11-01-.02.

<sup>32</sup> U.S. EPA, Draft *Human and Ecological Risk Assessment of Coal Combustion Wastes* (Apr. 2010)

<sup>33</sup> *Id.* at ES-3.

<sup>34</sup> *Id.* at Chapter 4. For example, 50<sup>th</sup> percentile ecological HQs for unlined landfills and ponds (0.2 and 7.0, respectively) exceeded 50<sup>th</sup> percentile human health risks via the drinking water pathway for unlined landfills and ponds (0.01 and 0.4, respectively) by 20 and 17.5 times. *Id.* at Tables 4-2, 4-4, and 4-21.

<sup>35</sup> *Id.* at Table 3-5.

barium, and cobalt.<sup>36</sup> In short, the EPA risk assessment suggests that the dominant risks from coal ash disposal are likely to be ecological risks.

Finally, there is a large and growing body of scientific research documenting real ecological impacts of coal ash. This research shows increased concentrations of toxic metals in sediment near coal ash wastewater outfalls,<sup>37</sup> increased tissue concentrations of selenium and other pollutants near these outfalls,<sup>38</sup> and adverse effects on fish, macroinvertebrates, and amphibians, including death, deformities, and reproductive failure.<sup>39</sup> All of these effects have been seen in connection with routine releases (surface water discharges and groundwater seepage), not just in connection with large ash spills. These are therefore the kinds of effects that may be occurring near the Kingston plant, and that any discharges from the proposed landfill expansion will contribute to.

TDEC and TVA must ensure that the landfill will not cause or exacerbate environmental damage in the Clinch River. This requires (1) an assessment of existing conditions, including sediment and fish tissue concentrations of coal ash pollutants, and (2) modeling to estimate the loadings of pollutants from leachate to the River, either through landfill leakage or permitted leachate discharges.

**6. TDEC must reject the variances requested by TVA for this permit, as they are improper and would threaten water quality and public health and safety.**

The draft permit contains variances that pose a significant threat to the surrounding surface and groundwater, especially given TDEC's disregard of virtually all of the rules regarding the siting of a Class II landfill. As discussed above, TDEC originally permitted this landfill even though it met the criteria for an unstable area<sup>40</sup>, was in a fault area<sup>41</sup>, was in a seismic impact zone<sup>42</sup> and was within 200 feet of Watts Bar Lake. TDEC should never have granted this permit at such an unsuitable site for a landfill. Yet, TDEC proposes to continue to allow the landfill, despite the significantly harmful consequences of the dropout and in the face of insurmountable evidence of the unsuitability of the site. TDEC further proposes to grant the same variances it granted in the original permit, further reducing the protections to human health and the environment. If TDEC does issue the permit, then the agency should not grant the proposed variances and waivers for

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<sup>36</sup> *Id.* at Tables 4-1, 4-2, 4-3, 4-4, and 4-21.

<sup>37</sup> *See, e.g.*, B.A. Lalaonde et al., Trace Metal Concentrations in Sediments and Fish in the Vicinity of Ash Lagoon Discharges from Coal-Combustion Plants in New Brunswick and Nova Scotia, Canada, 61 Arch. Environ. Contam. Toxicol. 472 (2011).

<sup>38</sup> *See, e.g.*, A.D. Lemly and J.P. Skorupa, Wildlife and the Coal Waste Policy Debate: Proposed Rules for Coal Waste Disposal Ignore Lessons from 45 Years of Wildlife Poisoning, 46 Environ. Sci. Technol. 8585 (2012).

<sup>39</sup> *Id.*

<sup>40</sup> Rule 0400-11-01.04(9)(c) 6; See Operations Manual at 10-11.

<sup>41</sup> Rule 0400-11-01-.04(9) (c) 4. See Operations Manual at 9 (“Although the Kingston fault (a thrust fault) crosses the southeastern margin of the site....”)

<sup>42</sup> Rule 0400-11-01-.04(9) (c) ; See Operations Manual at 9-10 (“The site falls within an area characterized by a maximum horizontal acceleration of 0.2g within 50 years.”) This is twice the limit set by the rule.

the landfill. Where the site is already unstable, the landfill should not be built over wetlands or sinkholes or allowed to be constructed inside of the normally boundary for surface water, and the leachate collection system should be sized according to the Tennessee rules.

Rule 0400-11-1-.04(2)(p) requires that new landfills and lateral expansions shall not be located in wetlands unless it can be demonstrated that no degradation of wetland and aquatic resources will result from such action. The draft permit waives this requirement and allows the filling of a “sinkhole pond” in the “Phase I” area and a channel, which connects this pond to the Watts Bar Lake. The draft permit also waives the rule to allow filling a small stream or wetland at the lower corner of the “Phase II” area. We strongly object to any variances that would allow fill in the impoundment to go over a wetland. There is no way that any assurance can be made that toxic seepage will not contaminate the groundwater if the impoundment is placed over a wetland. We also strongly object to any variance that allows placement of the landfill over a sinkhole. Geologic surveys and assessments must ensure that no sinkholes are present under or near the landfill. Sinkholes present a wholly uncertain geologic stability problem, and any collapse over the lifetime of the landfill could pose significant threat to surface and groundwater nearby.

Rule 0400-11-1-.04(3)(a)(4) states that landfills may not be constructed within 200 feet of the normal boundaries of springs, streams, and lakes. But the draft permit waives this buffer requirement to allow the “starter berm” along the south side of the site to be constructed less than 200 feet from the normal pool of Watts Bar Lake. TDEC must not grant this variance and should require a buffer zone of at least 200 feet from the lake. As the 2010 sinkhole blowout demonstrated, waste can reach the water so quickly that it is not detected and stopped in time to prevent surface water contamination. Further, this landfill full of toxic ash could be flooded when the Clinch River floods.

Rule 0400-11-1-.04(4)(b) requires that the leachate collection system must be designed to maintain a maximum leachate head of one foot over the liner. The draft permit waives this requirement to acknowledge a head of greater than one foot over the liner may occur. Rule 0400-11-01-.04(4)(a)7.(iii)(II) requires leachate collection reservoirs to have capacity to store the volume of leachate generated in 30 days. The draft permit waives this requirement, allowing TVA to construct one permanent tank with the capacity of providing approximately three (3) weeks of storage. We object to these variances. The leachate collection tank should have the capacity required by the Tennessee rules.

## **7. Conclusion**

The history of coal ash contamination at the Kingston site, tracing back to the December 2008 disaster, makes it imperative that TDEC approve the safest and most protective landfill design possible for the continued storage of coal ash waste on-site. The proposed landfill site is patently unsuitable for the storage of long-term coal ash waste due to the prevalence of karst topography, sinkholes, influence of groundwater levels from the seasonal water level changes of the Clinch

River and the known instability of the area as evidence by the December 2010 dropout. The conduit flow beneath the landfill, caused by the influence of the water level of the Clinch River on groundwater below more than half of the landfill, makes it more likely than not that the site will experience another subsurface collapse that will result in further contamination of surrounding water bodies. For the reasons laid out in these comments, TDEC must reject TVA's application in its entirety.

Respectfully submitted on behalf of the Groups by:



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December 30, 2014

Mr. Greg Luke  
Division of Solid Waste Management  
William R. Snodgrass Tennessee Tower  
312 Rosa L. Parks Ave, 14<sup>th</sup> Floor  
Nashville, TN 37243

RE: Comments for the Record  
Draft Permit, Major Permit Modification for a Solid Waste Disposal Facility  
TVA Kingston, Class II Landfill, IDL 73-0211

Dear Mr. Luke:

Global Environmental, LLC has provided these comments on behalf of the Southern Environmental Law Center (SELC), Southern Alliance for Clean Energy, Southern Environmental Law Center, Tennessee Clean Water Network, Statewide Organizing for Community eMpowerment, Sierra Club (both National and the Tennessee Chapter), Environmental Integrity Project, and Earthjustice.

In summary, our review of the proposed major permit modification documents provided in advance of the Public Hearing – in addition to a review of the TDEC file associated with this landfill - indicates that the draft permit does not meet minimum technical standards for land disposal, is not protective of the environment, and does not meet the protective measures necessary for problematic coal combustion wastes. Key summary points that support these conclusions include the following that are elaborated in the attached detailed comments:

- The technical components submitted by TVA in support of the permit modification relied on outdated, inaccurate, and insufficient information to support their claim that the site is a suitable disposal facility that meets TDEC's standards.
- The proposed landfill site clearly exhibits extensive karst geologic features such as sinkholes, cavernous bedrock, and rapid conduit groundwater flow – all features that are not suitable for landfills meant to protect groundwater and surface water.
- TVA's engineering measures to address the unstable and karst geologic conditions do not meet TDEC's technical landfill design standards.
- The proposed groundwater monitoring program is deeply flawed because it does not provide for early release detection, does not test for all parameters that are most commonly associated with coal ash, and does not use proper statistical evaluations.
- TVA's plan to not cover wastes increases the volume of leachate that will be circulated through an improperly designed Phase 1A leachate collection system, increases the weight of the fill, and increases the concentrations of the leachate that will require disposal.
- TVA's failure to choose the liner type and specifications that will be used for the entire landfill denies the public a full opportunity to review and comment on the proposed landfill and prevents TDEC from adequately reviewing the technical merits application.

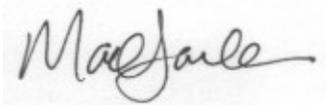
Comments for the Record  
December 30, 2014

These comments are developed based upon my nearly 25 years associated experience permitting and designing landfills in Tennessee and my nearly 60 investigations of coal ash disposal sites in 12 states.

We look forward to receiving detailed responses from TDEC on each an every technical comment attached.

Should you have any comments or questions regarding this matter, please call me at 615-504-0956 or email me at [markquarles@comcast.net](mailto:markquarles@comcast.net).

Sincerely,

A handwritten signature in black ink, appearing to read "Mark Quarles", is centered on the page. The signature is fluid and cursive, with a long horizontal stroke at the end.

Mark A. Quarles, P.G.

Attachment, Technical Findings

## Technical Findings

**The technical components submitted by TVA in support of the permit modification relied on outdated, inaccurate, and insufficient information to support their claim that the site is a suitable disposal facility that meets TDEC's standards.**

1. The Operations Manual<sup>1</sup> for the proposed major permit modification that details their how TVA intends to comply with TDEC's technical standards included virtually no new hydrogeologic investigation data - despite well documented karst geologic conditions and associated water contamination that have been identified since the initial permit was granted in 2007.
2. Instead, the Operations Manual continued to rely on the original 2005 hydrogeologic investigation for the site<sup>2</sup> that was performed before the well-documented December 2010 sinkhole collapse and up to 10 other probable collapse areas that were also identified in Phase 1A.
3. TVA based their hydrogeologic site suitability determination for the initial Class II permit – in addition to the 2014 Operations Manual<sup>3</sup> for the proposed permit modification - on the conclusion made in 2005 that there were no voids in the soil that would be indicative of a sudden collapse potential.
4. TVA continued to report in the 2014 Operations Manual that “there are no natural karst features (i.e., sinkholes, sinking streams, and springs) directly formed in the subsurface” and that “no active karst features were observed during the hydrogeologic study.”
5. The 2005 investigation performed by TVA identified numerous surface sinkholes in the landfill footprint and approximately 15 deep depressions in the bedrock that are indicative of karst solution-enlarged bedrock conditions.
6. Although the Commissioner's Order<sup>4</sup> in response to a reported December 2010 sinkhole collapse and release of landfill contents directly into the Clinch River required a plan for a subsurface investigation to determine the cause and nature of the seepage failure, TVA's response essentially included no new subsurface borings or investigative techniques other than the small area in the immediate vicinity of the collapse. As a result, essentially no new information was gathered for any Phase 1 or 2 area proposed as a landfill.
7. TVA's response to the Commissioner's Order to develop and implement a “plan for determining the structural integrity of the constructed landfill” included no new meaningful investigative procedures to evaluate the *entire landfill* - choosing instead to rely on 2005-era hydrogeologic conclusions, visual inspections of the landfill surface, incremental excavations only at the sinkhole collapse location, and the installation of a few shallow borings in that collapse area. In summary, the structural integrity analysis concluded that:

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<sup>1</sup> Operations Manual Combustion Residuals Disposal Facility, Permit Modification, Peninsula Site, Geosyntec

<sup>2</sup> Hydrogeologic Evaluation of the Coal-Combustion Byproduct Disposal Facility, Kingston Fossil Plant – Peninsula Site, TVA, December 2005.

<sup>3</sup> Operations Manual Combustion Residuals Disposal Facility, Permit Modification, Peninsula Site, Geosyntec Consultants, June 2014.

<sup>4</sup> Commissioner's Order, letter to Ms. Anda Ray, TVA from E. Joseph Sanders, TDEC, December 17, 2011.

- a) Instead of evaluating the integrity of the subsurface for potential collapses and liner design, TVA chose instead to refine the site “conceptual model” to include karst features in order to evaluate the structural evaluation of the *liner system* – not the structural integrity of the site itself.
- b) “Because of the hit-and-miss nature of the karst geology, it is believed that additional subsurface investigations would yield information of limited utility.”
- c) “Use of a reinforcing geosynthetic under the landfill liner is costly and does not address the mechanics behind the void formation” and that “it is difficult to predict locations of voids in this type of geology with any degree of accuracy.”
- d) The “most viable and technically robust” way to determine the structural integrity of the site is to “confirm” potential collapse areas during construction through visual inspections, to “rehabilitate” them through over-excavation, and to install a flexible liner system to prevent voids *beneath* the liner from happening.

**The proposed landfill site clearly exhibits extensive karst geologic features such as sinkholes, cavernous bedrock, and rapid conduit groundwater flow – all features that are not suitable for landfills meant to protect groundwater and surface water.**

8. The occurrence of 10 sinkholes that were not identified until after construction began and then again following the sudden sinkhole collapse reported in December 2010 within the Phase 1A disposal cell, all clearly demonstrate that the entire peninsula site meets the definition of extensively developed “karst terrane.”
9. TVA’s investigation into the root cause<sup>5</sup> of the reported December 2010 sinkhole collapse in Phase 1A concluded:
  - a) The sudden collapse was due to a “small diameter soil conduit extending vertically into bedrock.”
  - b) Loading may have deformed the fill material and the geosynthetic clay liner over the void resulting in cracking and allowing water to enter the bedrock throat of the void.
  - c) The void / conduit was present and undetected prior to construction.
  - d) “It is difficult to predict other locations of voids in this type of geology with any degree of accuracy.”
  - e) “There is no feasible investigation method that would conclusively identify the locations of all presently undetected voids.”
  - f) “The original investigation identified conditions indicative of potential voids,” yet that 2005 investigation concluded “only a limited number of actual voids were detected.”
10. A dye trace investigation required by TDEC and completed by TVA<sup>6</sup> concluded that:
  - a) “All groundwater originating on, or flowing beneath, the disposal area ultimately discharges to the Clinch River.”
  - b) Conduit bedrock flow along bedding planes, caverns, and joints are the preferential groundwater migration pathways, and groundwater in the soil and bedrock both discharge directly into the Clinch River.
  - c) The average groundwater flow velocity was 18 feet per day.

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<sup>5</sup> Root Cause Analysis Report for December 15, 2010 Construction Drop-Out, Geosyntec Consultants, March 2011.

<sup>6</sup> Dye Trace Investigation Report, Geosyntec Consultants, July 19, 2011.

- d) Contamination can by-pass downgradient monitoring wells located nearby and flow directly into the Clinch River along preferential pathways such as bedrock joints and bedding planes. As a result, the water quality in monitoring wells may not represent actual concentrations influent into the Clinch River.
  - e) The water levels in the Clinch River “significantly influence average groundwater levels” beneath the landfill within about “1,000 feet of the Clinch River bank.”
  - f) Inflow from the river and to the groundwater beneath the landfill “may occur into the bedrock flow system along the river margin...during periods of rapid increases in river elevation.”
  - g) The bedrock has numerous joints that are difficult – if not impossible - to identify from the surface, and these joints transport groundwater and can cause sudden collapses.
  - h) The underlying bedrock has caverns up to 8 feet tall and over one-half of the 14 rock core borings drilled on-site had caverns in them.
  - i) Sinkholes visible on the surface are usually reflective of depressions in the bedrock but not all depressions in the bedrock have resulted in surface expressions.
11. The landfill is at continual risk for a sudden collapse of FGD wastes, ash, and leachate into the cavernous subsurface that is hydraulically connected to the Clinch River. A collapse can happen with dry flue gas desulfurization (FGD) waste, dry ash, or leachate from the proposed landfill.
12. TVA’s determination that the Clinch River water elevations rise and fall *towards the landfill* and influence groundwater that extends 1,000 feet horizontally from the river bank means that the river influences the groundwater elevations beneath most of the landfill. Further, the TVA-projected “seasonal high” - that corresponds only to the typical summer pool elevation (741 feet above mean sea level (MSL)<sup>7</sup>) that was used to design the liner and geologic buffer - understates the true “high” whenever the river rises suddenly in response to precipitation events. As such, the liner could be constructed too close to the real seasonal high.

**TVA’s engineering measures to address the unstable and karst geologic conditions do not meet TDEC’s technical landfill design standards.**

13. TVA’s liner design – specifically the depth to which the liner is constructed - does not reflect any precipitation-induced rise of the groundwater that would represent the true seasonal high, conduit flow groundwater elevation (e.g., the 50 or 100-year floods). As such, TVA’s logic to determine the design elevation of the bottom of the liner and the feet of geologic buffer that separate that “seasonal high” is not accurate. Having inadequate separation can result in future collapses of the soil beneath the constructed liner.
14. The dropout mitigation plan relies on visual observation from the surface during and after construction to identify potential collapse areas located deep in the soil below. TVA’s plan to only over-excavate and re-compact the upper-most 5 feet will not correct the root cause of the potential collapse – deeper soil voids and bedrock conduits. As a result, the mitigation plan should be rejected.

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<sup>7</sup> Operations Manual Combustion Residuals Disposal Facility, Permit Modification, Peninsula Site, Geosyntec Consultants, June 2014.

15. The location of the sudden collapse sinkhole reported in December 2010 had already been over-excavated 3 feet during landfill construction and “due to the small size of the throat at this dropout, it was previously undetected.”<sup>8</sup> Arguably, even a 5-foot over-excavation – which is what TVA now plans to overcome the unstable site characteristics - would not have prevented that collapse or future collapses.
16. The dropout mitigation plan does nothing to prevent the seasonal and flood-stage fluctuations of the groundwater elevations influenced by the Clinch River. Seasonal fluctuations of the groundwater and the associated upward pressure head can result in the formation of an arch from below.
17. Arches that form in the deep soil from the rise and fall of groundwater can suddenly form without any visual indication on the ground surface or warning that a collapse is imminent.
18. TVA has not demonstrated that the site meets Rule 0400-11-01.04 (2) General Facility Standards, (q.) Karst Terrane because:
  - a) There is significant potential for surface collapse – as demonstrated from a past collapse, TVA’s identification of 10 potential future collapse locations within the landfill footprint, and TVA’s conclusion that other potential future collapse locations cannot be predicted.
  - b) The ground water flow system is conduit flow – a condition which has already contributed to a major surface collapse and has caused significant degradation to the ground water; and
  - c) The location in the karst terrane has already caused significant degradation to the local ground water resources.
19. TVA has not demonstrated that the site meets Rule 0400-11-01.04 (2) General Facility Standards, (w.) Unstable Areas because their only engineering measures – their proposed drop-out mitigation plan and a composite liner - rely on no new subsurface investigation data and rely on visual observations from *above* during construction to predict where a future collapse from *below* might happen. Clearly, the site is “unstable” because:
  - a) The soil exhibits differential settling because of conduits in the bedrock and voids in the soil, and TVA has concluded that those future settlement areas cannot be pre-identified or predicted.
  - b) The well-developed karst geologic features in the bedrock; TVA’s filling over known sinkholes; and the hydraulic connection to the rise and fall of water in the Clinch River remain unmitigated risks with the proposed landfill.
  - c) The proposed liner options are not sufficiently strong enough to prevent liner failure in the event the soil collapses from below again, as it did in the reported December 2010 sudden collapse.

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<sup>8</sup> Root Cause Analysis Report for December 15, 2010 Construction Drop-Out, Geosyntec Consultants, March 2011.

**The proposed groundwater monitoring program is deeply flawed because it does not provide for early release detection, does not test for all parameters that are most commonly associated with coal ash, and does not use proper statistical evaluations.**

20. TVA has concluded that groundwater in the soil and groundwater in the bedrock both flow into the Clinch River.<sup>9</sup>
21. Research at the TVA Kingston plant has concluded that the localized fish population has been adversely affected by ongoing, legacy releases to the surface water due to selenium “bioaccumulating in the aquatic environment surrounding the Kingston coal plant prior to the ash spill.”<sup>10</sup> Selenium is found in the groundwater beneath the landfill. Selenium has acute and chronic fish toxicities at very low concentrations that are less than what is harmful to humans.
22. TVA has installed four cluster well locations (1 each soil (“A”) and bedrock (“B”), designated as G3A / G3B; G4A / G4B; G5A / G5B; and G6A / G6B) for Phase 1; however, TVA has not been sampling two soil wells (G4A or G6A) during their detection or assessment monitoring programs. Those wells should be sampled during all event.
23. TDEC placed the landfill into the “assessment monitoring” program because of documented exceedences of groundwater protection standards and / or statistical background concentrations of metals. TVA concluded that the constituents and concentrations that warranted assessment monitoring were due to the reported December 2010 sinkhole collapse and its associated contamination of the underlying aquifer<sup>11</sup> - as opposed to widespread liner leakage.
24. TVA concluded that contaminated groundwater beneath the proposed landfill can by-pass monitoring wells that are meant to represent downgradient groundwater quality into the Clinch River. As a result, the concentrations in the wells may not represent the actual concentrations or harm to fish and aquatic life and humans.
25. The reported conduit bedrock flow velocity determined through dye tracing (18 feet per day) does not allow for early release detection prior to contaminated water reaching the receiving stream because the most frequent sampling frequency is every 3 months.
26. Ash produced from the FGD air pollution control equipment and leachate produced from the landfill during precipitation events can be expected to contain concentrated amounts of sulfates and metals.<sup>12</sup>
27. TVA concluded in 1987 that boron, lithium, heavy metals, sulfate, and Total Dissolved Solids (TDS) were good indicators of coal combustion waste contaminants in water.<sup>13</sup>

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<sup>9</sup> Groundwater Monitoring Plan, Coal Combustion Residuals Disposal Facility – Peninsula Site, May 2014, Appendix G, Operations Manual, June 2014.

<sup>10</sup> Preliminary Summary Report from Water, Sediment and Fish samples collected at the TVA Ash Spill by Appalachian State University, Appalachian Voices, Tennessee Aquarium, and Wake Forest University, Carol Babyak and others.

<sup>11</sup> Groundwater Assessment Monitoring Report, June 2014 Sampling, TVA, Smith, August 13, 2014.

<sup>12</sup> Assessment and Recommendations for Improving the Performance of Waste Containment Systems, Bonaparte, Daniel, Koerner for EPA, EPA/600/R-02/099, Page E-40, December 2002.

<sup>13</sup> An Evaluation of the Impacts of the Gallatin Fly Ash Pond to the Groundwater Resources, Tennessee Valley Authority Engineering Laboratory, WR-28-2-39-101, Page 13, August 1989.

28. TVA concluded in 2004<sup>14</sup> that leachate from dried coal ash contains high amounts of ammonia nitrogen (733 mg/L), and FGD leachate contains high amounts of boron (42 mg/L) and chloride (1,300 mg/L) - yet TVA does not routinely sample for those constituents or statistically evaluate their concentrations for compliance purposes.
29. Groundwater in Phases 1 and 2 of the landfill has a negative gradient, pushing groundwater in the soil and upper bedrock deeper into the highly fractured bedrock. In fact, a groundwater “sink” was identified at one location (MW-66A) within the proposed footprint of Phase 2. The groundwater elevation was so dramatically lower than the wells around it, that TVA chose to ignore that result all together when determining the local groundwater flow direction.<sup>15</sup>
30. TVA’s use of 1 bedrock well (well G1B) as the “background” well to which all downgradient soil and bedrock wells are statistically compared for compliance determinations is wrong because:
  - a) The “background” concentrations to which all downgradient soil and bedrock wells are compared to are ongoing data from 2008 to current day – as opposed to using the eight (8) quarters of “baseline” data obtained by TVA from March 2008 to December 2009 prior to placement of any wastes.
  - b) The “background” data period of well G1B includes ongoing years of sampling – even while sluiced FGD wastes were discharged into the landfill. Sluice water can “mound” the groundwater and cause groundwater to flow radially in all directions – making the “upgradient well” possibly “downgradient.” As a result, the groundwater quality in well G1B could have been adversely affected and provide an inaccurate “background” concentration.
  - c) The statistical analyses relies on an interwell comparison of all downgradient wells to the single upgradient bedrock well – as opposed to instead correctly relying on an intrawell comparison of data from the each well.
31. TVA analyzed wells for an expanded, longer-than-normal list of parameters in June 2011. Those results indicate that groundwater contamination is far more widespread than previously acknowledged. The additional parameters included coal ash indicator parameters such as boron, chloride, sulfate, ammonia nitrogen, and nitrate-nitrite. When those results were compared to the upgradient well G1B, the downgradient wells were higher than the interwell background for these parameters:
  1. Boron – wells G3A, G4B, G5A, G5B, and G6B.
  2. Chloride – wells G3A, G3B, G4B, G5A, G5B, and G6B.
  3. Sulfate - wells G3A, G3B, G4B, G5A, G5B, and G6B.
  4. Nitrate-Nitrite – wells G5A and G5B.

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<sup>14</sup> Hydrogeologic Evaluation of Coal-Combustion Byproduct Disposal Facility Expansion, Tennessee Valley Authority, Boggs and Julian, November 2004.

<sup>15</sup> Groundwater Monitoring Plan, Coal Combustion Residuals Disposal Facility – Peninsula Site, May 2014, Appendix G, Operations Manual, June 2014.

**TVA's plan to not cover wastes increases the volume of leachate that will be circulated through an improperly designed Phase 1A leachate collection system, increases the weight of the fill, and increases the concentrations of the leachate that will require disposal.**

32. TVA's plan to use leachate to control fugitive dust recirculates the leachate into the waste and as a result, increases leachate constituent concentrations over time.
33. Recirculation of leachate in Phase 1A increases the leachate loading on a collection system that was not designed consistent with TDEC requirements and has had past operational problems.
34. Recirculation keeps more liquid circulating in the waste and if a leak in the liner occurs, allows more leachate to reach the underlying soil. TVA concluded that saturated sub-soil beneath the liner was a root cause of the Phase 1A liner failure.
35. TVA's plan to not provide any daily or interim cover will increase the amount of leachate because any precipitation that comes into contact with the waste will become leachate, rather than grading and regularly covering the waste to promote drainage away from the waste.
36. The amount of leachate that will be used for dust control and its effect on the free moisture content of the waste was not specified, other than what is needed to achieve optimum moisture content for compaction purposes.
37. Moisture that is added to the fill results in a heavier load on the subsurface soils beneath the liner and results in more leachate that will be transported through the leachate collection system. Increased weight of the waste above increases the collapse potential from below.

**TVA's failure to choose the liner type and specifications that will be used for the entire landfill denies the public a full opportunity to review and comment on the proposed landfill and prevents TDEC from adequately reviewing the technical merits application.**

38. TDEC cannot approve this landfill without first knowing what proven liner components will be used for the entire landfill and how those components are compatible with all proposed waste streams.
39. GSE – a leading synthetic liner manufacturer - recommends that before a geosynthetic clay liner (GCL) is selected, compatibility tests should be performed on the actual site leachate to determine actual compatibility - yet that was not performed for the Kingston plant. TDEC should require that TVA perform a liner compatibility test using actual Kingston FGD and ash leachate.
40. TVA's proposed clay components of the composite liner Option 1 (60-mil HDPE and 2-feet of  $1 \times 10^{-7}$  cm/sec compacted clay) and Option 2 (60 mil HDPE, an unspecified GCL, and 2-feet  $1 \times 10^{-5}$  cm/sec compacted clay) have not been demonstrated to be capable of containing coal ash wastes.
41. Natural and synthetic liner clay components used for coal combustion waste liners require polymer enhancement to prevent breakdown of the clay.
42. High chloride and high calcium content wastes can damage the bentonite layer of the GCL, the compacted clay liner, and the man-made clay geologic buffer. That damage can increase the hydraulic conductivity of the bentonite / clay layers several orders of magnitude because

the clay liner shrinks and cracks. Once the clay liner cracks, pollutants can migrate much more rapidly to the underlying groundwater.

43. Coal combustion wastes – especially FGD wastes – are much higher in ionic strength; are much more damaging to clay and synthetic liners; can “leak” through liners without holes and tears; and have constituents that are much more mobile in groundwater compared to municipal solid wastes.
44. The thin nature of GCL and HDPE liners make them susceptible to accidental punctures and tears. The TDEC-required 60-mil HDPE thickness equates to less than 1/16-inch thick. The typical GCL thickness is only ¼-inch thick.
45. Contaminants in coal combustion wastes are able to permeate the proposed liners even without holes or tears in those liners. Contaminants can permeate through the liner by molecular diffusion,<sup>16</sup> in addition to seepage through holes and tears. Molecular diffusion transport of contaminants with a high chloride content (e.g., coal combustion wastes) occurs through a liner without holes or defects and is a function of the concentration of the waste – the higher the concentration, the more diffusion occurs.
46. Coal combustion waste contaminants are able to permeate composite liners through the expected holes in the uppermost liner. Well-constructed, new geo-composite liners commonly have holes that are defects in the liner. As such, these liners are almost never installed without holes; the typical frequency of holes ranges between 2.5 to 25 holes per hectare (approximately 10 holes per acre); and the typical assumed hole diameter is 11 millimeters.<sup>17</sup> Even for a well-constructed and undamaged 50-acre Phase 1A / 1B Class II landfill, the landfill industry *expected* number of holes that are slightly smaller than a dime is up to 500 - not including man-caused holes and tension tears along welds.

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<sup>16</sup> Benson, Craig, Department of Civil and Environmental Engineering, University of Wisconsin-Madison, *Liners and Covers for Waste Containment*, Proceedings from the 4<sup>th</sup> Kansai International Geotechnical Forum, Japanese Geotechnical Society, Kyoto, Japan, May 2000.

<sup>17</sup> *Id.*, Page 9.