



**Expert Opinion, Rebuttal Report of Mark A. Quarles, P.G.**

**July 2021**

**Sierra Club, Environmental Law and Policy Center, Prairie Rivers Network, and  
Citizens Against Ruining the Environment v. Midwest Generation, LLC**

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## 1.0 INTRODUCTION

This section of the report includes the purpose and scope of my rebuttal and opinions of the Illinois Pollution Control Board ("Board").

### 1.1 Purpose and Scope

BBJ Group, LLC (BBJ) was retained by the "Complainants" (Sierra Club, Environmental Law and Policy Center, Prairie Rivers Network, and Citizens Against Ruining the Environment) to evaluate relevant portions of the current record to assist them in determining necessary steps to select an appropriate groundwater remedy based upon regulatory standards established by the Illinois Environmental Protection Agency ("IEPA") and the Board. The Complainants filed a seven-count complaint in 2012 against Midwest Generation, LLC ("MWG") at four coal-fired power plants: Joliet 29 Station ("Joliet"), Powerton Station ("Powerton"), Will County Station ("Will County"), and Waukegan Station ("Waukegan").

In development of my first expert report (*Expert Opinion of Mark A. Quarles, P.G.*, January 2021), I requested and reviewed reports and analyses provided by the Complainants for the four power plants in Illinois from the administrative record, based upon my input of what types of documents would provide the most useful information. Of those documents, the Board's June 29, 2019 Interim Opinion and Order of the Board (Opinion) regarding operations, storage, fill, and disposal areas, and groundwater contamination and reports that discussed the geologic and hydrogeologic conditions, was the most useful for my analysis. Further, I gathered additional background information developed by MWG and provided to the public on its publicly available website (<https://www.nrg.com/legal/coal-combustion-residuals.html>) required by the U.S. Environmental Protection Agency ("US EPA") and its Coal Combustion Residuals Rule ("CCR Rule").

The Respondents responded to my expert report with their analysis in the *Expert Report on Relief and Remedy* by Weaver Consultants Group ("WCG", April 22, 2021). That report was co-written by Douglas G. Dorgan, Jr., L.P.G. and Michael B. Maxwell, L.P.G. The report included WCG's description of background information of the four power plants; its rebuttal opinions on my analyses included in my first expert report; its understanding of the CCR Rule; and its opinion on appropriate future actions associated with a remedy for contamination identified by the Complainants and confirmed by the Board.

This expert report provides my technical and regulatory rebuttals to WCG's analyses. My individual conclusions are in Section 2 for brevity and clarity, and my global report conclusions are included in Section 3. The documents that I relied upon to formulate my opinions are cited in this report and are listed in Section 4, References. The page numbers to those citations throughout this report are based upon the *PDF page number(s) in each document* [emphasis added].

## **1.2 Board Opinion and Conclusions**

The complaint alleged groundwater contamination and open dumping in violation of the Illinois Environmental Protection Act ("Act") and Board regulations. Both the Complainants and MWG agreed that contaminants found in the groundwater at all four stations are known constituents associated with coal combustion wastes ("CCWs") or CCRs. (Opinion at 78). The Board defines CCWs as "any fly ash, bottom ash, slag, or flue gas or fluid bed boiler desulfurization by-products generated as a result of the combustion of...coal, or... coal in combination with [other material]." (Opinion at 14). CCWs and CCRs are commonly called "coal ash."

The Board concluded in its Opinion that "Environmental Groups met their burden in establishing that it is more probable than not that MWG violated the Act and Board regulations as alleged in the amended complaint." (Opinion at 1). My report cites to the Opinion numerous times because the Opinion and its findings provide a factual foundation for the basis of pollution liability. The Board concluded in its Opinion that the current record was insufficient "to determine the appropriate relief in this proceeding", and that additional hearings were necessary to determine the appropriate relief. (Opinion at 2).

The purpose of the relief is to determine an appropriate remedy to comply with the Act. Given the Board's decision that MWG has not yet thoroughly examined the active and historical disposal and fill areas at each power plant (Opinion at 79), the next step is for MWG to complete a nature and extent investigation at each of the four stations. Those investigations must be sufficient to support a remedy to comply with the Act. Significant Board conclusions related to past actions by MWG and those that are necessary in the future regarding sources of contamination and selecting a remedy include:

- None of the fill areas of the historic coal ash storage areas has any permits at all"; "none of them "confine the refuse" to ensure that no nuisances or hazards to public health or safety exists because, other than ash ponds, none of the other areas separate the coal ash from the ground or surface water infiltration and leaking into the groundwater." (Opinion at 90 and 91).
- MWG "allowed the waste to be consolidated on the site" in "fill areas and historic storage sites that have no liners, covers, or any other protection from the surface of groundwaters", and "the record shows no actions by MWG to remove the coal ash from those areas or prevent leaking of contaminants from those areas in any other way." (Opinion at 91).
- Groundwater contamination persists even after MWG concluded corrective actions required by its Compliance Commitment Agreements (CCAs) and Groundwater Management Zones (GMZs). (Opinion at 79). Also, the CCAs at all four stations that required on-going monitoring and inspections were "intended to avoid and detect any further contamination, or monitor the effectiveness of a corrective action, rather than remedy any contamination or remove the contaminant source." (Opinion at 82).
- MWG is liable for exceedences of a Part 620 standards at Waukegan because no GMZ exists, and MWG is also responsible for exceedences prior to establishing GMZs in 2013 at Joliet, Powerton, and Will County. (Opinion at 80). Also, a GMZ is not a permanent solution. (Opinion at 80).

- Although MWG was aware of contamination, MWG did not: (i) undertake any further actions to stop or even identify the specific source(s) and had not taken actions to further investigate historic disposal areas, (ii) install additional groundwater monitoring wells, or (iii) complete further inspections of the ash ponds or the land around the ash ponds in areas that showed persistent groundwater exceedances. (Opinion at 79).
- Environmental Land Use Controls (ELUCs) at Powerton, Waukegan, and Will County restricted the use of the area for the future (e.g., installing potable water wells). (Opinion at 79). Further, ELUCs established by MWG at Powerton and Will County are not considered to be “corrective actions” because they were designed to protect against exposure to contaminated groundwater, rather than to remedy the contamination. (Opinion at 83).
- MWG did not “take active actions” to ensure that the contamination does not spread beyond MWG property. (Opinion at 79).
- There is no evidence to expect that groundwater quality at Joliet, Powerton, or Will County will naturally return to IEPA Class I Groundwater Quality Standards. (Opinion at 83).
- There is insufficient information for the Board to determine the appropriate relief. (Opinion at 92).

## 2.0 TECHNICAL AND REGULATORY REBUTTAL ANALYSES

This section of the report includes my responses, rebuttals, and conclusions to claims made by WCG in its report.

### 2.1 Qualifications of Respondent Experts

This subsection of the report describes the qualifications of the respondent experts.

#### 2.1.1 Douglas G. Dorgan, L.P.G

The WCG report described Mr. Dorgan's 35 years of experience performing remedial investigations, planning, design, and construction associated with "a wide range of industrial, commercial, and institutional properties." (WCG at 8). The only CCR-related experience that he cited in the expert opinion report was his experience supervising closure of CCR Rule regulated ash ponds – without specifying what that supervision entailed, if that experience included any investigative or corrective actions, how many power plants were involved, or how many ash ponds were involved. (WCG at 6-7). His resume did not include any CCR related experience or representative projects, nor did it include any project(s) where he served as an expert witness for any CCR related matter. (WCG at 77-79).

In short, Mr. Dorgan has minimal CCR related expertise that qualify him to be an expert in CCR matters related to designing groundwater monitoring systems, investigating the nature and extent of CCR contamination, or initiating CCR groundwater corrective actions.

#### 2.1.2 Michael B. Maxwell, L.P.G.

The WCG report described Mr. Maxwell's 24 years of experience "providing services related to site investigation, remedial investigation, planning, design, and construction for a wide range of industrial, commercial, and institutional properties." The only CCR-related experience he cited in the expert opinion report was his "various different projects involving regulatory compliance / permitting, investigation, and remediation of coal ash surface impoundments, and coal ash fill disposal sites." (WCG at 8). Each of Mr. Maxwell's stated CCR experience projects involved his direct oversight of groundwater monitoring programs and analyses. His resume expanded on that CCR-related experience by describing the following three projects:

- An unspecified industrial waste (coal ash) disposal facility in northwest Indiana that is a Superfund site under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA). He managed groundwater monitoring activities, an undefined "closure", and wetland investigations. (WCG at 80).
- An undefined power plant in Indiana. He "assisted in the design and installation of the initial groundwater monitoring system, including preparation of the Groundwater Sampling and Analysis Plan, oversaw the collection of the initial eight rounds of background data, as well as the statistical evaluation of the groundwater monitoring data" under the requirements of the CCR Rule. That groundwater monitoring data "was intended to support the preparation and regulatory approval of Closure Plans for both facilities." (WCG at 81).

- Two unspecified former coal ash impoundment sites in northern New Jersey. He “managed the review of Groundwater Monitoring Reports” where the surface impoundments were closed by removal (i.e., wastes were apparently excavated and hauled away). (WCG at 81).

To evaluate Mr. Maxwell’s stated CCR expertise, I searched publicly available utility websites in Indiana (required by the CCR Rule) to gather more information related to Mr. Maxwell’s expertise. My search determined Mr. Maxwell’s involvement with the Indianapolis Power & Light Company (“IPL”), Harding Street Generating Station located in Indianapolis, Indiana (<http://ccr-hardingstreet.com/Home/default.aspx>) – suggesting that this site is the undefined power plant in Indiana mentioned in his report. WCG prepared the Sampling and Analysis Plan “with consideration for the requirements” of the CCR Rule and Indiana Department of Environmental Management (“IDEM”) for groundwater monitoring. (Sargent & Lundy 2016 at 50). Mr. Maxwell certified that the groundwater monitoring system was designed and constructed to comply with the CCR Rule (Sargent & Lundy 2016 at 55) and certified the Sampling and Analysis Plan.

My review of the Harding Street site, through documents obtained from the publicly available website, indicated that:

- Mr. Maxwell designed and installed a nested, cluster well system where multi-depth wells were installed to measure constituent concentrations in different depths of the aquifer. (Sargent & Lundy 2016 at 62). The nested wells monitor groundwater concentrations at two to three depths per well location. Sampling of the new wells began in April 2016.
- The groundwater monitoring system designed and installed by Mr. Maxwell was rejected by IDEM. In 2018, IDEM “raised a concern that the upgradient wells were not suitable locations for determining background water quality unaffected by the ash pond system.” IDEM recommended that the facility investigate other areas for background well(s). Three additional background wells were installed, and the prior upgradient wells certified by WCG became “downgradient” monitoring wells. (ATC 2019 at 2, 3, and 4).
- The new groundwater monitoring system – with the new background wells – was certified by another consulting firm, ATC Group Services (ATC) in March 2019. (ATC 2019 at 1). Mr. Maxwell’s *upgradient* wells were determined to be *hydraulically downgradient* [emphasis added] of the impoundment, meaning that groundwater from beneath the disposal unit(s) flowed towards the wells.
- The new ATC-certified monitoring system and statistical analyses determined that statistically significant increases (SSIs) of boron, calcium, chloride, fluoride, and pH occurred in groundwater at downgradient wells, indicating contamination of groundwater from the unlined impoundment(s) in downgradient wells. (ATC 2019 at 4).
- Groundwater contamination from the site has migrated off-site. (IPL 2020 at 1). Further, assessment monitoring in 2018 determined that concentrations of arsenic, lithium, and molybdenum exceeded groundwater protection standards. (Haley Aldrich 2019 at 7 and 8).

- In response to the contamination, IPL initiated a nature and extent investigation and developed a Corrective Measures Assessment report that created a Conceptual Site Model (CSM) and evaluated seven potential groundwater corrective action options. (Haley Aldrich 2019 at 17 through 30).

In summary, Maxwell has very limited CCR related experience: four projects in 24 years of environmental consulting. That small number of projects does not support his or MWG's claim that he is an "expert" in the CCR Rule; designing, installing, and sampling CCR disposal unit groundwater monitoring systems; investigating the nature and extent of CCR contamination; or designing and implementing groundwater corrective actions to achieve groundwater protection standards required by the CCR Rule.

Mr. Maxwell's role as a testifying expert in this case is especially concerning given that one of his demonstrative example projects was rejected by IDEM and another consulting firm. As previously discussed, Mr. Maxwell claimed in his resume that his work was "intended" to support closure of a surface impoundment at the Indiana facility. That intended purpose was never realized because the groundwater monitoring system and his determination for upgradient and downgradient well designations were rejected and disapproved by the regulatory agency.

## 2.2 "Issues" with My Prior Expert Report

WCG concluded that it had four main "issues" with my prior expert report, where it determined that I relied too heavily on the 2019 Board Opinion and that I either "incorrectly" applied a regulatory standard or that I failed to consider specific data or factors. (WCG at 26-27). I disagree with those conclusions.

First, WCG believed that my prior expert report relied too heavily on the Board's Opinion and resulted in a report that presented "little independent analysis." (WCG at 26). The historical aspects of waste disposal have already been covered by MWG and Complainant experts during the liability phase of this case. My first expert report discussed the facts associated with each site that would affect the ability to establish a remedy, and the Board's opinion was the best summary of that history. As a result, I relied on the Board's Opinion. Consider that the Board has already established MWG's liability when it concluded in its Opinion that:

- "Environmental Groups met their burden in establishing that it is more probable than not that MWG violated the Act and Board regulations as alleged in the amended complaint." (Opinion at 1).
- "It is immaterial whether any specific ash pond or any specific historic ash fill area can be pinpointed as a source to find MWG liable." (Opinion at 79).
- "Contaminants are leaking from MWG's property and that MWG's active coal ash ponds or historical coal ash storage sites of fill areas are the source of that contamination." (Opinion at 79).
- "MWG knew that contaminants that include coal ash constituents are leaking from its property but did not fully investigate specific sources or prevent further release." (Opinion at 79).

*Maxwell  
Consulting  
Group*

- The “Board concludes that MWG caused or allowed open dumping of the coal ash at its Station.” (Opinion at 87).

While my first expert report relied heavily on the Board’s Opinion, it also included substantial independent analyses of numerous technical and regulatory considerations, contrary to WCG’s claim. Those analyses were included in Sections 3.0, 4.0, and 5.0 (and subsections) in my prior report. My analyses included for example, the types and extent of investigations performed by or on behalf of MWG; Alternative Source Determinations (ASDs); recent and historical leakages from disposal units; CCR Rule and Illinois-specific requirements to characterize the nature and extent of contamination; groundwater migration pathways; and groundwater monitoring system sampling and statistical analyses, among others. As a result, there is no evidence to support WCG’s claim that my report did not include substantial independent analyses.

Next, WCG claimed that I incorrectly applied the requirements of the CCR Rule to “the entirety of the Stations, including both the Federal CCR regulated units and the historical fill areas.” (WCG at 26). In short, I am aware that the CCR Rule does not include design, closure, or operational standards for historical fill areas. My prior report discussed that the Board concluded that both active and historical disposal areas are sources of groundwater contamination and that Title 35, Environmental Protection, Part 620 Groundwater Quality standards apply to both areas. Although historical disposal areas may not be covered by the CCR Rule, they are not exempt from the requirements to protect water quality.

WCG implied that I should have mentioned or included proposed Illinois CCR Regulations (35 ILL. ADM. Code 845) in my prior analysis. I did not include the proposed rules because 1) the rules had not been finalized and were therefore not enforceable and 2) the proposed Illinois rules must be at least as stringent as the Federal CCR Rule, which I cited extensively in my prior expert report.

WCG also claimed in its report that I should have considered the entire record in my first expert report. (WCG at 26). Also, as discussed in Section 1.1, my report relied on the Opinion and its findings to provide a factual foundation for the basis of pollution liability. My first report did not need to review the entire record because the Board had already reviewed the historical record when it concluded that it was more probable than not that MWG violated the Act and Board regulations. I therefore disagree that I should have reviewed the entire record prior to development of my first expert report. In development of this rebuttal expert report, I reviewed data and analyses that WCG claims to be recent and extensive. (WCG at 26).

Next, WCG claimed that I performed no independent analysis to “demonstrate that there are or will be source areas at the Stations.” (WCG at 27). WCG is attempting in its report to re-litigate the Board’s prior decision on sources of contamination. As previously discussed, the Board already concluded in its Opinion in the liability phase of this case that there are active or historical sources of contamination and that it is “immaterial” which source(s) has caused the contamination. (Opinion at 79)

WCG also claimed that I indicated that the surface impoundments at each station are intended for “permanent disposal of coal ash”, without providing specific examples where I made that claim in my report. (WCG at 26). In response to that comment, I acknowledge that the active impoundments at

the stations are not meant for permanent disposal, meaning the CCRs are periodically removed (e.g., by dredging).

WCG also claimed that I failed to consider the extensive environmental data collected by MWG that is relevant to deciding the appropriate remedy at each of the stations. (WCG at 26-27). First, the Board already decided that MWG was liable for groundwater contamination associated with active and historical disposal areas. Further, my analyses in my prior report determined that even more data were needed to evaluate and select a potential remedy.

This report further discusses the need for collecting additional station-specific data because the historical data presented by WCG in its report do not represent an accurate or thorough evaluation of site-specific conditions necessary to evaluate and select a remedy.

### **2.3 Regulatory Framework**

This subsection of the report discusses the regulatory framework for the sites.

#### **2.3.1 US EPA and Illinois CCR Rules**

WCG concluded that both US EPA CCR Rule and Illinois CCR regulations apply to the existing and inactive surface impoundments at the four stations. (WCG at 10-12 and 28). WCG concluded that historic and unconsolidated CCR fill areas “are not unregulated” and that both the Act and the Board have other regulations that apply to those areas. (WCG at 28). While the historic fill areas are not “regulated” by the CCR Rule or the Illinois CCR regulations, groundwater protection has always been required by the Act.

The WCG report specifically identifies what it and MWG believe to be regulated disposal units according to the US EPA CCR Rule (referred to by WCG as “Federal” Rules) and the Illinois CCR regulations. WCG and MWG take that determination several steps further, concluding that:

- “There should be a distinction made between areas of the Stations that are subject to the Federal CCR Rules (40 CFR 257) and/or the IL CCR Surface Impoundment regulations (35 Ill. Adm. Code 845) and those areas of the Stations which are not subject to those regulations.” (WCG at 26).
- “CCR has been found at various locations at the four Stations; however, based on MWG assessments, all of the CCR does not necessarily fall under the same regulations” and “Federal and IL CCR Rules apply to each of the four Stations” and specifically, those rules apply to both existing and inactive surface impoundments. (WCG at 28).

WCG did not provide its own opinion on the regulatory status of all of the disposal units and historical disposal areas at each facility, choosing instead to rely on MWG’s claims. WCG did, however, conclude that “when the vast quantity of available data collected at the Stations and available in the regulatory record associated with the Federal CCR Rules is considered, the data and information indicate that sufficient investigation of historical fill areas identified at the Stations has already occurred.” (WCG at

38). WCG concluded that a risk-based approach to groundwater corrective action is its preferred route for the historical disposal areas (WCG at 58-60).

WCG stated that "MWG has concluded that there are no areas at these Stations that fall within the definition of CCR landfill." (WCG at 11). Although according to WCG no currently active landfills or fill areas meet the CCR Rule definition as a "landfill", ENSR identified two historical ash landfills at Joliet. (ENSR 1998 Joliet at 11, 12, and 26). For more information about those two ash landfills, see Section 2.4.3 of this report.

In summary, investigations and remedial actions at each station are foremost regulated by the Illinois Environmental Protection Act – a statute that requires groundwater protection from pollutants that originate from any source. The CCR Rule and Illinois CCR regulations secondarily establish investigative and remedial standards for currently active CCR areas. The Board determined in the liability phase that it is immaterial what source(s) caused groundwater contamination. (Opinion at 79). Knowledge gained by completing a thorough nature and extent investigation at each station is "material" to adequately select a groundwater remedy.

### **2.3.2 Nature and Extent Foundation**

WCG criticized me for not identifying a specific remedy for each of the stations. (WCG at 27). That criticism is not warranted. First, selection of a remedy is a process that begins by first defining the nature and extent of contamination. That information is the foundational information that supports development of remedial alternatives analysis by MWG. MWG has not yet defined the nature and extent of contamination at each station and therefore, neither MWG nor WCG are capable of selecting an appropriate remedy without first understanding the nature and extent of contamination. Selecting a remedy without such information, risks implementing a remedy that is inappropriate to achieve the required groundwater protection standards and to cure the violations.

As discussed in my prior expert report (see Sections 3.4 and 5.2), I concluded that MWG should first complete comprehensive investigations at each station to define the nature and extent of all CCR related contamination and discussed the typical investigative components and goals of such investigations. Nature and extent investigations are the foundation of evaluating and selecting a remedial approach, and MWG bears the responsibility to properly evaluate site conditions and to select a remedial approach.

WCG also criticized me for not evaluating specific factors used by the Board when selecting a remedy and specifically criticized me for not considering the "technical practicability or economic reasonableness of a remedy, the suitability of the stations to the area at which they are located, and any due diligence to comply, including entry into and compliance with the CCAs." (WCG at 27). It is not possible to discuss the technical practicability and economic reasonableness for remedies without first completing a nature and extent investigation at each station and then evaluating potential remedial options to be considered. The foundation of those decisions is a thorough nature and extent investigation, which MWG has yet to perform at each station.

I continue to support my opinion in my prior expert report that MWG should complete a comprehensive nature and extent investigation to support future remedial actions. The CCR Rule, the

Illinois CCR regulations, and the Illinois Site Remediation Program all require that a nature and extent investigation be performed to collect data sufficient to evaluate and select a remedial action. (40 CFR §§ 257.95(g)(1), 257.97(d)(1); 35 Ill. Admin. Code §§ 845.650(d)(1), 845.670(f)(1); 415 ILCS § 5/58.6(b)(1)).

### 2.3.3 Groundwater Remedial Standard

Regarding groundwater contamination, the Board has already concluded in the liability phase of the case that active or historical CCR disposal and fill areas at each station have contributed to groundwater contamination. (Opinion at 79). WCG and MWG's proposed "risk-based" approach did not address the violations identified by the Board, including violations of Section 12(a) of the Act by virtue of exceeding Part 620 groundwater standards, violations of Section 12(a) by virtue of exceeding 90<sup>th</sup> percentile boron and sulfate concentrations, violations of Section 12(d) at Powerton, and violations of Section 21(a) of the Act at all four stations. (Opinion at 2).

In contrast to WCG's efforts in its report to differentiate contamination from active or historical areas, the Board concluded that *"it is immaterial whether any specific ash pond of any specific historical ash fill area can be pinpointed as a source to find MWG liable [emphasis added]."* (Opinion at 79). Also, the Board concluded that CCRs that are scattered at each station are more likely to be contributing to groundwater quality exceedences in monitoring wells. (Opinion at 28, 41, 56, 57, 68, and 92). When discussing groundwater quality at Joliet, Powerton, and Will County, the Board concluded that there is no evidence to expect that groundwater quality at those stations will naturally return to Class I groundwater quality standards. (Opinion at 83). Similarly in my opinion, there is no credible reason to believe that groundwater will naturally improve to Class I standards at Waukegan.

The Board was explicit in its Opinion that MWG was liable for exceedences of Class I Groundwater Protection Standards established in Part 620. In addition, both the CCR Rule and the Illinois CCR regulations require groundwater to be remediated to specific numeric (e.g., Maximum Contaminant Levels, MCLs) or to background groundwater quality not affected by CCR operations. (35 Ill. Admin. Code § 845.600; 40 CFR §§ 257.95(h); 257.97(b)(2)). Neither of those rules allow a risk-based remediation approach using monitored natural attenuation, unless it can be demonstrated that the groundwater protection standards will be met with that approach.

WCG and MWG's preferred risk-based approach of monitored natural attenuation is not likely to meet Part 620 numeric groundwater protection standards at the stations. I agree with the Board's conclusion that groundwater will not naturally improve to meet standards. Also, a risk-based approach will not remedy the violations for open dumping – a practice that the Board concluded did not prevent the leaking of contaminants into groundwater. (Opinion at 92). I also agree with the Board's conclusion that CCRs placed in historical fill areas will continue to leach to groundwater, if not removed or properly remediated.

### 2.3.4 GMZs, CCAs, and ELUCs

The Board concluded in its Opinion that GMZs, CCA, and ELUCs are not likely to improve groundwater quality to meet Part 620 groundwater standards. (Opinion at 83). I agree with that conclusion.

As previously discussed in Section 1.2 of this report, the Board concluded that 1) there is groundwater contamination at each station; 2) the likely causes of that contamination are historic fill areas, active impoundments, or inactive impoundments; 3) there is no evidence to expect that groundwater quality at Joliet, Powerton, or Will County stations will “naturally” return to Class I groundwater quality; 4) groundwater contamination persists even after MWG concluded corrective actions required by its CCAs and GMZs; and 5) the CCAs used by MWG are intended to avoid and detect any further contamination, or monitor the effectiveness of a corrective action, rather than remedy any contamination or remove the contaminant source.

Despite the Board’s conclusions above, WCG concluded that no further investigative or remedial actions are needed. Instead, WCG concluded that past use of GMZs, CCAs, and ELUCs are reasons to *continue with them* [emphasis added] as a groundwater remedial action in the future. (WCG at 52, 55, and 56).

My analysis of WCG and MWG’s proposed continued use of GMZs, CCAs, and ELUCs determined that groundwater improvement to Part 620 standards is not likely, consistent with the Board’s prior finding that groundwater improvement to Part 620 groundwater standards is not likely.

### 2.3.5 Closure-in-Place Presumptive Remedy

WCG proposed to construct a low permeability cover system (“cap”) over the Former Slag/Fly Ash Storage Area (“FS/FAS Area”) at Waukegan as a “presumptive remedy” to improve groundwater quality. (WCG at 57). The area is located west of the West Ash Pond. By name, the “Former Slag/Fly Ash Storage Area” contains both fly ash and slag. WCG claimed the area has an “absence of risk”; the cap will “enhance the natural attenuation remedy”; the cap will reduce the time needed to reach Part 620 groundwater standards; and the cap will “restore” groundwater quality to those standards. (WCG at 57). There is no credible evidence to support those claims.

The electrical power industry has recognized that closure-in-place of surface impoundments without fully dewatering CCRs will not improve groundwater and in fact, a cover system might increase constituent concentrations. WCG’s plan to construct a cap over saturated CCRs at the FS/FAS Area at Waukegan might *increase* [emphasis added] groundwater contaminant concentrations, rather than improving conditions stated by WCG. The Electric Power Research Institute (EPRI) published an investigative report of its findings in 2001, concluding the following conditions that do not support WCG’s claim that a cap is an appropriate groundwater remedy (EPRI 2001 at 8):

- The key factor for achieving groundwater concentration reduction was dewatering the ash prior to constructing a cover system.
- Groundwater quality did not improve, regardless of constructing a cap, when CCRs remained below the uppermost aquifer water. Dewatering and closure were not effective because leaching continued from the saturated ash.
- Groundwater constituent concentrations *increased* [emphasis added] when saturated CCRs remained, because the contact time of groundwater moving through the saturated ash increased

when the hydraulic gradient of the standing water in the impoundment was removed. A cap would have had little or no effect on this process.

WCG's explanation of what a presumptive remedy is mentioned that a cover system is a remedy for a surface impoundment, but "usually after removal of liquids." As a follow-up to that explanation, I reviewed both the CCR Rule and Illinois CCR regulations to determine the conditions that must be present to meet the closure-in-place performance standards of leaving CCRs in-place with an engineered cover system.

The US EPA recognized the importance of separating CCRs from groundwater when it established two closure options for CCR ponds or impoundments: closure-in-place or closure-by-removal. The Illinois CCR regulations mirror those two closure options. According to those rules (CCR Rule, Part 257.102 and Illinois Regulations, Section 845.750 a)1) and 2)), a cover system for closure-in-place must ensure at a minimum, that the impoundment is closed in a manner that:

- "Control, minimize or eliminate, to the maximum extent feasible, post-closure infiltration of liquids into the waste and releases of CCR, leachate, or contaminated run-off to the ground or surface waters or to the atmosphere,"
- "Preclude the probability of future impoundment of water, sediment, or slurry."

The requirement to "control, minimize or eliminate" releases to groundwater in a closure-in-place scenario cannot be achieved if the CCRs remain saturated from seepage from standing water in the ponds or from contact with the uppermost aquifer. Although standing water may not exist on the ground surface from a legacy pond, saturation can exist in the CCRs that remain belowground. If water remains in either case, contaminants can continue to leach to groundwater.

I disagree with WCG's conclusions that the cap will enhance the natural attenuation process and improve groundwater quality to Part 620 standards. In fact, the cap might make quality even worse. I agree with WCG's conclusion that construction of a cap is sometimes "technically practical" and "economically reasonable" (WCG at 58); however, I disagree that its WCG-stated use for Waukegan is likely to improve groundwater quality. WCG's plan to construct a cap over the FS/FAS Area would not meet the CCR Rule or Illinois CCR regulations for closure, if the disposal area were an active pond.

The Board concluded that saturated CCRs exist in the FS/FAS Area at Waukegan. WCG explained that the risks of a release from a landfill are "significantly lower than CCR surface impoundments or active CCR landfills" and that the primary reason for that reduced risk is the reported absence of a "constant head of water on top of the CCR materials, as is the case with surface impoundments and active landfills." (WCG at 38-39). That constant head of water pressure increases the water contamination risk from both active ponds and historical fill where ash remains saturated, as noted by WCG when it concluded that the weight and pressure of water in surface impoundments is "more likely to result in releases to the environment." (WCG at 39). WCG also concluded that the lower risk of landfills is supported by a "substantial amount of data historically collected at each of the four Stations", without specifying what that "substantial amount" of data was. (WCG at 39). Similar to standing water in impoundments that cause leachate to be "pushed" downward, saturated pore water in historical fill areas (e.g., Waukegan) can also create additional weight, and that pressure is likely to increase

releases to groundwater. Without such data that should have been discussed in its report, WCG cannot claim that that landfills at the stations are less likely to contaminate groundwater.

Use of the cap at this FS/FAS Area at Waukegan is the *only* [emphasis added] disposal area at *any of the four* [emphasis added] stations that WCG concluded needed any remedial action other than monitored natural attenuation, GMZs, or ELUCs. Notably, WCG did not discuss any remedy or investigation at the two ash landfills at Joliet that have never been investigated with borings or wells.

WCG did not define what a “presumptive remedy” is other than describing the low permeability cap as “a technology that regulators believe, based upon prior experience, will be the most appropriate remedy for a specified type of site.” (WCG at 57). WCG also concluded that “capping is a proven remedial technology that has been used for decades and is particularly prevalent as a means of closing solid and hazardous waste landfills, and surface impoundments (usually after removal of liquids) under RCRA.” (WCG at 57). Further, WCG concluded that a cap would reduce infiltration and mitigate potential leaching from ash materials to groundwater. (WCG at 57). WCG stated that the cap should be designed by an Illinois-licensed Professional Engineer. (WCG at 58).

Although not defined by WCG, WCG’s use of the term “presumptive remedy” seems to be related to WCG’s statement that it is “a means of closing solid and hazardous waste landfills, and surface impoundments (usually after removal of liquids) under RCRA.” (WCG at 57). According to US EPA (US EPA 1993 at 1), a presumptive remedy for a municipal solid waste landfill, as an example, is described as:

*Presumptive remedies are preferred technologies for common categories of sites, based on historical patterns of remedy selection and EPA’s scientific and engineering evaluation of performance data on technology implementation. The objective of the presumptive remedies initiative is to use the program’s past experience to streamline site investigation and speed up selection of cleanup actions. Over time presumptive remedies are expected to ensure consistency in remedy selection and reduce the cost and time required to clean up similar types of sites. Presumptive remedies are expected to be used at all appropriate sites except under unusual site-specific circumstances.*

First, CCRs at the FS/FAS Area are saturated belowground. The Board determined in the liability phase of this case that CCRs were buried in this area as deep as 22 feet below ground surface, and that some of that coal ash was saturated in groundwater. (Opinion at 67). Given that CCRs are submerged in groundwater, the cap will not prevent lateral inflow of groundwater into the wastes. Even if MWG constructs a cap over the FS/FAS Area, leaching to groundwater will continue because CCRs will remain saturated and / or in contact with groundwater. Those same saturated conditions at Waukegan might also exist at other historic fill areas at other stations, including the two ash landfills at Joliet, for example.

I investigated US EPA guidance on the proper use of a presumptive remedy for a landfill, as an example. Although the FS/FAS Area is not a “landfill”, the US EPA guidance is relevant because it discusses how such a remedy should or should not be used. In short, WCG’s recommended use as a method to improve groundwater quality by reducing leaching and promoting monitored natural attenuation is *not consistent* [emphasis added] with US EPA requirements. “Containment” can be a

remedy for landfills to prevent direct contact with wastes, to minimize infiltration into the wastes, to control surface water runoff, and to control and treat landfill gas. (US EPA 1993 at 6).

The US EPA considers remediating groundwater at a landfill to be a non-presumptive remedy – meaning that other remedial alternatives should be chosen for long-term groundwater restoration. (US EPA 1993 at 2). WCG plans to neither collect nor treat the groundwater at Waukegan, other than relying on monitored natural attenuation and reducing infiltration to improve groundwater quality.

Notable is that WCG stated that the cap should be designed by an Illinois-licensed Professional Engineer. Neither Mr. Dorgan nor Mr. Maxwell are licensed engineers capable of designing and certifying the cover system to meet WCG's stated purpose. Also notable in the WCG conclusions is their acceptance that MWG is required to "restore" groundwater to Class I, numeric groundwater quality standards. (WCG at 57). There is no indication that monitored natural attenuation with the cover system will "restore" the groundwater to Class I standards, consistent with the Board's prior conclusion. (Opinion at 83).

In summary, WCG's plan to construct a cover system and to leave saturated CCRs in-place at Waukegan, cannot be expected to restore groundwater quality or to improve conditions to meet Part 620 standards. In fact, groundwater quality might get worse. Water would remain impounded belowground in the saturated CCRs. WCG's plan would *not* [emphasis added] meet the minimum CCR Rule or Illinois CCR regulation performance standards as closure – much less a groundwater remedy – because CCRs would remain saturated after the cover system is constructed, unless all of the CCRs are completely dewatered and excavated with adequate separation from the uppermost aquifer.

### **2.3.6 Risk-Based Closure and Monitored Natural Attenuation**

WCG concluded that the data support "monitored natural attenuation" as an "appropriate remedy" at Joliet, Powerton, and Will County and that a low permeability cap over the FS/FAS Area at Waukegan is the "presumptive remedy" that will enhance natural attenuation of constituents. (WCG at 49, and 56-57). I continue to agree with the Board's prior conclusion that groundwater quality will not improve with the prior status quo of not initiating any "active" remedial technique.

Although WCG did not determine how many years or decades groundwater contamination will continue at each station, it concluded that remediation may require multiple, undefined decades to complete. (WCG at 55). WCG did not recommend any remedial action that requires more investigation nor any corrective action where contaminants are removed or actively treated (e.g., excavation or closure-by-removal, hydraulic containment, groundwater pumping and ex-situ treatment, in-situ groundwater treatment). Further, WCG did not perform any alternatives analysis that compared timeframes of meeting groundwater quality standards.

Instead of initiating active remedial measures, MWG plans to continue GMZs and ELUCs that "can be implemented in lieu of active remediation, when exposures can be controlled." (WCG at 56). WCG also concluded that "risk-based remediation" with GMZs and ELUCs is "particularly beneficial" where sites are industrial in nature, site access can be controlled, and "there are no off-site complete or potentially complete exposure pathways that would result in unacceptable impact to human health or the environment at the Stations." (WCG at 56).

Given WCG's conclusion that a risk-based, monitored natural attenuation is appropriate at each of the stations, I researched use of that approach with CCR Rule and Illinois CCR regulations. In short, the regulations *do not allow monitored natural attenuation* [emphasis added] as a groundwater remedy or consider the farthest downgradient wells as regulatory points of compliance, based upon the following:

- Neither the Federal CCR Rule nor the Illinois CCR regulations allow a risk-based remedial approach. Instead, both regulations (35 Ill. Admin. Code §§ 845.600, 845.660(a)(1); 40 CFR §§ 257.97 (b)(2)) require that MWG remediate to numeric standards for inorganic constituents, unless background concentrations are higher.
- Neither the Federal CCR Rule nor the Illinois CCR regulations consider the point of compliance to be the most downgradient monitoring wells, the property line, or receiving stream, as implied by WCG. Instead, numeric groundwater protection standards must be met at the "waste boundary." (35 Ill. Admin. Code §§ 845.600, 845.660(a)(1); 40 CFR § 257.91). Both regulations define the "waste boundary" as "a vertical surface located at the hydraulically downgradient limit of the CCR surface impoundment. The vertical surface extends down into the uppermost aquifer." (35 Ill. Admin. Code § 845.120; 40 CFR § 257.53). As a result, groundwater protection standards must be met near the source(s) of the contamination – not far downgradient as discussed by WCG.

In summary, WCG's planned risk-based approach and monitored natural attenuation to "restore" groundwater quality is not supported by facts. Also, monitored natural attenuation will not remedy all of the violations identified by the Board. (Opinion at 2). Further, WCG's risk-based approach does not meet the minimum requirements for selecting monitored natural attenuation as the final groundwater remedy at each station because of the following:

- MWG has still not defined the nature and extent of contamination at each station, as required by the CCR Rule, Illinois CCR regulations, or the Site Remediation Program (Section 740.420).
- MWG still has not yet performed an in-depth alternatives analysis sufficient to evaluate multiple groundwater remedial options.
- Risk-based closures are not allowed by the CCR Rule or the Illinois CCR regulations.
- MWG will remain liable for exceedences of Part 620 standards prior to establishing GMZs in 2013 at Joliet, Powerton, and Will County and would remain liable at Waukegan even if a new GMZ is created. Also, as the Board concluded, a GMZ is not a permanent solution. (Opinion at 80).
- There continues to be no evidence to expect that groundwater quality at any station will naturally return to Class I Groundwater Quality Standards with the proposed risk-based approach.
- MWG would continue to rely on CCAs that the Board concluded was "intended to avoid and detect any further contamination, or monitor the effectiveness of a corrective action, rather than remedy any contamination or remove the contaminant source." (Opinion at 82).

### 2.3.7 Beneficial Use of CCRs

WCG did not identify in its report, any area(s) at any of the four stations where MWG specifically applied for and received regulatory approval for any beneficial reuse, nor did it specifically mention how or if CCRs had been beneficially used on-site at any station. (WCG at 13).

The Board concluded in its Opinion that the placement and uses of CCRs at the four stations do not meet the definition of a “beneficial use” and that the CCRs in areas outside of ash ponds are discarded “waste”. (Opinion at 89). WCG discussed use of various leaching tests that MWG has used to support beneficial use determinations, but did not demonstrate that MWG had applied for and received approval for a beneficial use at any station. Further, WCG did not discuss Illinois-specific requirements for beneficial use.

As previously discussed, CCRs that remain on-site at each station constitute a waste, consistent with the Board’s opinion. WCG discussed the useability of beneficial use leaching methods and generally not US EPA-approved CCR leaching tests, to support its belief that the nature and extent of contamination due to waste disposal has been sufficiently defined at each station. I disagree with WCG’s conclusion that the nature and extent of contamination has been defined, based upon my analyses in Section 2.4.1 of this report.

WCG did not demonstrate that the historic fill areas at any station meet the definition of a beneficial use according to the CCR Rule. For MWG to legally beneficially use CCRs according to the CCR Rule (Part 257.53, Definitions), MWG’s placement of CCRs must meet *each of four conditions* [emphasis added] and especially requires MWG to demonstrate that environmental releases to groundwater, surface water, soil and air will not exceed regulatory standards. The four criteria specified in the CCR Rule (Part 257.53) include:

1. The CCR must provide a functional benefit;
2. The CCR must substitute for the use of a virgin material, conserving natural resources that would otherwise need to be obtained through practices, such as extraction;
3. The use of the CCR must meet relevant product specifications, regulatory standards, or design standards when available, and when such standards are not available, the CCR is not used in excess quantities; and
4. When unencapsulated use of CCR involving placement on the land of 12,400 tons or more in non-roadway applications, the user must demonstrate and keep records, and provide such documentation upon request, that environmental releases to groundwater, surface water, soil and air are comparable to or lower than those from analogous products made without CCR, or that environmental releases to groundwater, surface water, soil and air will be at or below relevant regulatory and health-based benchmarks for human and ecological receptors during use.

WCG also did not demonstrate that CCRs in historic fill areas at each station meet Illinois specific requirement for the proper beneficial use of CCRs, even though there are regulatory requirements in 415 ILCS 5/3.135. The regulation defines nine acceptable uses of coal combustion by-products that

qualify as a beneficial use. Among numerous other standards included in that Illinois regulation, a coal combustion by-product cannot exceed an Illinois Class I groundwater quality standard for any metal constituent when tested by the ASTM D-3987-95 leaching test method. Although WCG mentioned MWG's use of the Neutral Leaching Extraction Test ("NLET"), Toxicity Characteristic Leaching Procedure ("TCLP"), and Synthetic Precipitation Leaching Procedure ("SPLP") tests when describing its prior testing programs, WCG did not determine if those leaching tests are the same method required by 415 ILCS 5/3.135. (WCG at 38, 40-41, 47). Leaching tests are discussed in more detail in Section 2.4.1.

In summary, the CCRs that remain in historic fill areas at each station are a waste. Further, there is no indication that MWG applied for or received approval for a beneficial use that would meet the CCR Rule or Illinois-specific requirements. MWG's analytical methods used to predict waste leachability were inappropriate.

## **2.4 Extent and Adequacy of Prior Investigations**

This subsection of the report discusses the extent and adequacy of prior investigations at the stations.

### **2.4.1 General Use of Leaching Tests by MWG**

Leaching tests are meant to be a *predictor* [emphasis added] of actual leaching conditions that might exist. The best demonstration of CCR impact on groundwater comes from actual groundwater samples, and samples collected from numerous wells at each station have demonstrated that CCR constituents have contaminated groundwater. Although MWG completed leaching tests from select unmonitored areas at each station, the best investigation that MWG should have performed would have been to install groundwater monitoring wells and to sample for CCR constituents. Leaching potential can change over time and can vary depending on site-specific conditions, such as depth below the standing water in a pond and depth below ground surface in the aquifer.

As discussed in Section 2.3.7, MWG completed leaching tests for beneficial use determinations, but those tests are not US EPA-approved to determine CCR leachability. WCG concluded that leaching data collected from CCR surface impoundment samples and soil obtained from historical fill areas indicates that "not all coal ash is necessarily a source that will contribute to groundwater contamination." (WCG at 27). Further, WCG concluded that the historical testing program "are sufficient to adequately characterize the historical coal ash fill areas at the Joliet 29 Station for the purposes of assessing a remedial approach" and "the historical data...are sufficient to adequately characterize the historical coal ash fill areas" at the Powerton, Will County, and Waukegan. (WCG at 42, 44, 45, and 47). I disagree with those WCG's conclusions regarding the usefulness of the leaching data to determine that no nature and extent investigation is needed. I also disagree with WCG that leaching data are sufficient to select monitored natural attenuation as its recommended remedial action, or any other remedial action. MWG should have instead completed comprehensive investigations using the Leaching Environmental Assessment Framework ("LEAF") test method of subsurface samples as a component of a nature and extent investigation.

WCG discussed MWG's use of the NLET to also "characterize the potential for the coal ash to result in impacts to groundwater" from both surface impoundments and historical fill areas. (WCG at 13). WCG

discussed MWG's reliance on the NLET to "support beneficial use demonstrations" but did not provide its independent analysis on the adequacy of those tests for MWG's intended purpose. (WCG at 13). Similarly, WCG concluded that the NLET data "indicates that the coal ash sampled from the Federal CCR surface impoundments exhibits concentrations of metals less than the Class I Groundwater Quality Standards", implying the adequacy of the prior testing program. (WCG at 38; see also 40, 41, 43, 44, and 45). As such, WCG believes that no additional leaching tests are needed at any of the four stations to further characterize the potential for groundwater contamination. I disagree with that conclusion and MWG's use of the NLET test to make groundwater leachability predictions for long-term groundwater protection and remedial design purposes. MWG should have instead used the LEAF test as a groundwater quality predictor at each station. WCG described the NLET testing programs (WCG report Section 4.1.3) where MWG analyzed individual composite samples from Powerton (2007), Will County (2010), and Waukegan (2004) and compared the results to Illinois Class I Groundwater Quality Standards (35 Ill. Adm. Code 620.410). (WCG at 38). Each of the four samples collected from three stations "did not exhibit any metals concentrations above the Class I Groundwater Quality Standards." (WCG at 38). MWG's use of a single composite sample from multiple borings into CCRs at Powerton, Will County, and Waukegan cannot be used to support any groundwater leaching determination. A single composite sample would not adequately characterize the likely variable wastes by CCR type, plant processes, or age. As a result, the sampling programs at Powerton, Will County, and Waukegan did not properly characterize the wastes.

WCG discussed MWG's investigation of the Northwest Fill Area at the Joliet station "to determine whether a CCB classification was feasible", using both NLET and TCLP tests on that a single composite sample. (WCG at 40). WCG determined that the subsurface materials were generally homogenous, consisting of interlayered fly ash and bottom ash/slag. A total of 20 samples were collected from 20 borings across a 13.2-acre area, resulting in *only one* composited [emphasis added] sample for such a large area. (WCG at 40). Individual discrete boring samples would have instead been capable of finding "hot spots" and a spatial range of contaminant concentrations, while the single composite sample used by MWG would have resulted in a diluted sample from multiple areas. As a result, the single test collected at Joliet was incapable of characterizing the wastes in that area.

MWG used the LEAF test sporadically and more recently in 2018 to support its opinion that existing groundwater contamination was not due to sources regulated by Federal and Illinois CCR Rules. MWG also used that test recently while completing ASDs for Powerton, Will County, and Waukegan stations to determine, in its opinion, that currently active surface impoundments are not responsible for groundwater contamination, but instead due to other unnamed sources. (WCG at 35-37). MWG collected CCR and water samples from active impoundments for LEAF analyses. I agree that the LEAF test is a more appropriate method to predict leachability of constituents from CCRs. The LEAF test analyzes leachability at multiple pHs that are possible in the subsurface, due to changes in geochemical conditions over time and at different depths in the subsurface.

Given that MWG relied on the NLET test to determine leachability potential to groundwater based upon a beneficial use analysis by MWG, I evaluated MWG's use of that test for its stated purpose. In summary, MWG's use and WCG's endorsement of the previously used leaching tests were incorrect for the following reasons:

- The NLET test is not designed or meant to determine field leaching conditions. The Illinois beneficial use standards in 415 ILCS 5 / 3.135 require the use of ASTM D3987-85 (a test method current as of 1985) and a comparison of the leached constituent concentrations to Class I Groundwater Protection Standards. It is unclear if the NLET procedure is the same procedure as the ASTM test. Regardless, MWG and WCG's use of the test as an indicator of field condition groundwater quality is explicitly incorrect. According to the ASTM standard for the test (ASTM 1985 at 1):
  - *"This test method is not intended to provide an extract that is representative of the actual leachate produced from a solid waste in the field or to produce extracts to be used as the sole basis of engineering design."*
  - *"This test method is not intended to simulate site-specific leaching conditions. It has not been demonstrated to simulate actual disposal site leaching conditions."*
  - *"This test is intended to be a rapid means for obtaining an extract of solid waste" and the "extract may be used to estimate the release of certain constituents of a solid waste under laboratory conditions prescribed in this procedure."*
- The US EPA determined that the LEAF test method and actual pore water samples from CCRs in field conditions are the two most appropriate, robust, and technically defensible methods to predict constituent leaching potential to groundwater. (Federal Register 2015 at 141). MWG apparently recognized this fact when it used the LEAF test more recently to blame groundwater on sources other than active and inactive impoundments in the ASDs for some stations, rather than the NLET and TCLP tests that it used in the past.
- MWG's testing program focused primarily on sampling bottom ash and was not a comprehensive assessment of all types of coal ash that might be present at a station, specifically excluding current and historical fly ash and other types of CCRs. The IEPA recognizes that "coal ash can vary depending on the source of the coal, the processing of coal, the burning of the coal and the method of the collection of the ash." (IEPA 2010 at 1). This IEPA conclusion is consistent with my 13 years of performing CCR related investigations. As such, the LEAF analyses used by MWG were only performed to evaluate very limited samples of CCRs produced in current coal burning operations.

In summary regarding leaching tests that MWG used as beneficial use determinations, WCG did not provide its opinion on the adequacy of MWG's use of those tests as a groundwater quality predictor, nor the adequacy of the types, frequency of samples, and locations of the CCRs that were sampled. In my opinion, MWG incorrectly used those tests to determine possible impacts to groundwater, and WCG failed to understand how or why those tests were inappropriate, demonstrating their lack of expertise in CCR related matters.

## 2.4.2 Investigative Comments Common to Multiple Stations

### ***Coal Sources and Contaminant Variability***

WCG concluded that the current source of coal for power operations at each station is subbituminous coal sourced from Wyoming's Powder River Basin. (WCG at 14, 16, 20, and 23). WCG did not determine where historical sources of coal originated. As previously discussed, CCRs can vary in constituent content based upon numerous factors specific to that original coal, types of pollution control equipment, and the type of coal ash (e.g., fly ash versus bottom ash). MWG's very limited sampling programs, as discussed in Section 2.4.1, would have only determined leaching conditions for that single sample and likely not have been representative of site-wide conditions – even if MWG had used the correct leaching method.

Other than the three borings installed at Waukegan where samples were collected belowground in the historical FA Area, the LEAF tests performed more recently on behalf of MWG would have only included tests on Powder River Basin coal-related CCRs from currently active impoundments, and not any other coal sources used over the decades of burning coal at each station that might be present elsewhere at the stations.

There is no indication that MWG nor its current or prior consultants considered these coal-specific and site-specific factors in its waste sampling program to determine leaching conditions or its arguments that no further testing is needed to characterize the wastes at each station. As a result, WCG's conclusion that the "historical data as described above are sufficient to adequately characterize the historical coal ash fill areas" at the four stations is not based upon credible science. (WCG at 42, 44, 45, and 47).

### ***Phase I and II Environmental Site Assessments***

Phase II Environmental Site Assessments (ESAs) are usually performed after completion of a Phase I ESA. Both are usually performed prior to buying or selling a property. A Phase II ESA is only completed if the historical records and site inspection performed during the Phase I ESA resulted in the need for an intrusive investigation (e.g., soil borings, surface samples, groundwater wells). Neither is meant to define the nature and extent of contamination. Given the very limited scale and scope of those reports, neither WCG nor MWG can rely on those documents to support the opinion that an in-depth analysis is not needed at any station.

Phase I ESAs rely significantly information disclosed verbally by a property owner, historical regulatory databases, visual conditions observed during a site walk, a review of historical ownership records, and aerial photographs. WCG explained that Phase II ESAs were performed at each station in 1998. (WCG at 39, 43, 44, and 46). According to the Phase II ESAs, each Phase II report was prepared after completion of a Phase I ESA report that was prepared according to ASTM standard E1527-97. A Phase I ESA is performed to identify "recognized environmental conditions", otherwise known as "RECs". A "REC" might be for example, a historical waste disposal area, stained soils around a petroleum storage tank, as examples. If a REC is identified, a Phase II ESA is performed. As ENSR concluded in the Phase II ESAs for each station, "the Phase II ESA alone is *not an exhaustive investigation* [emphasis added]

which can be used to determine the extent of contamination, nor the cost of any suggested remediation.” (ENSR 1998 at 7, each station).

As described above, the Phase II ESAs provide minimal value to the remedy phase of this case – other than identifying historical disposal and fill areas and indicating that MWG was aware that these historical disposal areas existed at least as early as 1998. The Phase II ESAs were not meant to define the nature and extent of contamination.

### ***Liner Replacements and Contaminant***

As discussed in my prior expert report, the Board concluded that historical liners “can and do crack” and that it is “more likely than not that the ash ponds did leak contaminants into groundwater.” Although MWG replaced liners at Joliet (2008), Powerton (2010, 2013), Waukegan (2003 and 2004), and Will County (2009), those impoundments that remained active could have leaked and caused groundwater contamination that is currently present. (WCG at 14, 16-17, 21, and 24)

Leakage to shallow groundwater can be expected with damage and cracks in a liner. (Opinion at 26, 40, 55, 66). Neither MWG nor WCG stated in their analyses that they considered the possibility that currently identified contaminated groundwater could be due to leakage from currently active and inactive impoundments that has co-mingled plume with leakage prior to liner reconstruction and from contamination associated with historical fill. Prior relatively recent leakage from cracked or damaged liners could have contributed to current groundwater contamination.

### ***Nature and Extent Investigations***

WCG concluded that no additional investigations are required at the Federal and State-regulated surface impoundments to determine the nature and extent of contamination at each of the four stations. (WCG at 52-54). Similarly, and as previously discussed, WCG concluded that no such investigations are warranted for historical disposal areas. (WCG at 32-33). As discussed in Section 2.3.2 of this report, a nature and extent investigation is the foundation for evaluating remedial alternatives. I disagree with WCG that no additional investigations are needed at each station to evaluate and select a groundwater remedy. In fact, the sparse investigations performed at each site and described by WCG support the need for more in-depth analyses by MWG, as discussed in Sections 2.4.3, 2.4.4, 2.4.5, and 2.4.6 of this report.

In support of its belief that no additional investigations are needed at each station, WCG more specifically concluded that:

- The Federal and State CCR surface impoundments “do not need to be investigated further because the existing Federal / State CCR Rules already sufficiently address any required investigation.” (WCG at 32). I disagree with that conclusion. Both the Federal CCR Rule and the Illinois CCR Regulations require that MWG investigate the nature and extent of contamination (40 CFR §§ 257.95(g)(1), 257.97(d)(1); 35 Ill. Admin. Code §§ 845.650(d)(1), 845.670(f)(1) ).

- “The record indicates that the Federal CCR surface impoundments are operated pursuant to the Federal CCR Rules, which are deemed sufficiently protective of human health and the environment.” (WCG at 32).
- “A rigorous groundwater monitoring program is being implemented at each of the Stations”; “the groundwater monitoring program is largely based upon the RCRA Subtitle D groundwater monitoring program”; the program includes “detection” or “assessment” groundwater monitoring; and “the groundwater concentrations are compared to statistically derived background concentrations to evaluate whether the regulated units are adversely impacting groundwater.” (WCG at 32). I disagree with those conclusions. As my previous expert report concluded regarding the use of improperly located or constructed background wells, any such use by WCG might not trigger the need for a more detailed investigation or corrective action under either the CCR Rule or Illinois CCR regulations.

### ***Background Groundwater Quality***

A correct and accurate determination of true background groundwater is essential, as IDEM recognized when it rejected Mr. Maxwell’s monitoring system for one of his cited CCR experience projects. As discussed in my prior report, background wells that were drilled adjacent to formerly unlined disposal areas or into CCRs should not be considered “background” to which downgradient wells are then compared. I continue to support that conclusion. MWG’s background or “upgradient” groundwater quality determinations are questionable because sometimes the highest concentrations of constituents were reported in hydraulically upgradient wells. Plus, some of those wells were drilled into CCRs.

I disagree with WCG’s conclusion that I “incorrectly opined” that the “existing background groundwater data are not sufficient for evaluating whether the regulated CCR units have impacted groundwater quality.” (WCG at 32). I also disagree with WCG’s conclusion that “the existing background groundwater data utilized to evaluate whether the Federal CCR Surface Impoundments are adversely impacting groundwater are appropriate for satisfying the regulatory requirements in the Federal CCR Rules and determining background concentrations at the Stations.” (WCG at 32). WCG carefully worded those conclusions to specifically apply to “regulated CCR units” and “Federal CCR Surface Impoundments.” More simply, WCG is attempting to blame the groundwater contamination on what it apparently believes are “unregulated” sources such as historical fill areas and ash used to construct active disposal areas – in an apparent attempt to avoid more stringent, numeric groundwater clean-up standards under the CCR Rule and Illinois CCR regulations. As the Board concluded in its Opinion, it is immaterial in the liability phase of this case what type of CCR or source area has caused groundwater contamination. However, for purposes of a remedy, it is “material” to define all sources of contamination to establish a remedy.

### ***Sources of Groundwater Contamination***

As discussed above, MWG and WCG have concluded that the contamination is not due to current or “regulated” disposal areas but instead due to un-named sources. Regardless, the CCRs that are present at the site and have resulted in groundwater contamination originating from coal burning processes. MWG is responsible for meeting Part 620 groundwater protection standards according to

the Board – regardless of source. The Board affirmed that conclusion when it concluded in its Opinion that it is “immaterial” whether a source is from an active or historic source area. The historical fill areas contain a wider range of CCRs – including bottom ash, fly ash, cinders, and slag – compared to the current impoundments that collect bottom ash. Further, those historical areas likely include CCRs that originated from multiple sources of coal and from different air pollution control technologies. As a result, investigations are needed to define the nature and extent of all source areas.

MWG completed ASDs at Powerton, Waukegan, and Will County and concluded that groundwater contamination was not due to currently “regulated” impoundments, but rather another un-named source(s). (WCG at 34-37). If WCG was correct that the active disposal areas are not the source(s) of groundwater contamination, historical sources that MWG has not yet defined are the likely sources.

When discussing why it believed that existing groundwater data do not implicate the current disposal areas, again WCG carefully worded their argument to blame other un-named contaminant sources, by concluding:

- “Upgradient wells identified by KPRG in the monitoring programs for the Stations are not affected by the regulated units because the wells are upgradient based on groundwater elevation contour maps.” (WCG at 33). However, that conclusion assumes that the ponds never leaked, and that groundwater never flowed radially from the leaky pond – towards the area that WCG now considers upgradient. As previously discussed, the Board concluded that the currently active impoundments had liners that were known or suspected to have leaked prior to being replaced. Leaking liners could have created radial groundwater flow conditions where current “upgradient” wells would have been hydraulically downgradient from impoundments.
- “There is no evidence of mounding from the units”. (WCG at 33). My prior report contradicts that conclusion, providing an example analysis that I performed for Powerton (see Section 3.2, prior report). Also, WCG concluded that “groundwater elevation contour maps produced annually, most recently for data collected in 2020 and 2021, in accordance with the CCR monitoring at each Station do not indicate groundwater mounding in proximity of the regulated units.” (WCG at 33). In my opinion, unlined impoundments with standing free water in them and saturated CCRs beneath that standing water would have produced higher leakage rates with mounding and radial flow conditions. WCG concluded that standing water creates higher contamination conditions, consistent with my opinion. (WCG at 38-39). Mounding would have been likely during the time when prior liners from the current disposal areas were known or suspected of leaking, and the mounded conditions can continue for years, even after a new liner has been constructed.
- “The units are lined, and those liners are functioning as designed to control infiltration from the surface impoundments.” (WCG at 33). In response to that conclusion, active ponds could have leaked prior to liner replacement and could be currently leaking. Also, WCG did not provide proof that the current liners are not leaking, just that they were designed to “control infiltration.” As the Board already concluded, liners sometimes leak. (Opinion at 26, 40, 55 and 66).
- “Based on the lack of groundwater mounding observed at the Stations, the upgradient wells represent the character of groundwater flowing from areas upgradient of the CCR surface impoundments and that the identified upgradient groundwater quality is the correct basis for

comparison to the groundwater quality after it has passed beneath the CCR Surface Impoundments.” (WCG at 33). In my opinion, WCG’s conclusion that the upgradient wells represent the “character of groundwater flowing from areas upgradient of the CCR impoundments” ignores the fact that current impoundments were known or suspected of leaking historically; leaking impoundments would have created radial flow into what WCG now determines to be “upgradient”; some upgradient wells were drilled into CCRs in prior footprints of existing impoundments and historical disposal areas; and residual contamination can remain in the upgradient well areas.

- “The scope of the ASDs associated with the Powerton, Will Co., and Waukegan Stations is appropriate and complies with the Federal CCR Rules and likely also the Illinois CCR Rules.” (WCG at 54). In response to that comment, WCG did not opine that the ASDs meet the Illinois requirements, only stating that compliance is “likely.”
- “The Federal CCR Rules and the Illinois CCR Rules require the owner/operator to evaluate whether the *regulated unit(s)* [emphasis added] are adversely impacting groundwater, but neither require an exhaustive site-wide study to identify a specific alternate source.” (WCG at 54). In response to that conclusion, both regulations require that MWG define the “nature and extent” of contamination, regardless of whether the investigation is “exhaustive” in WCG’s opinion. Also, a nature and extend investigation is the foundation of an alternatives analysis that is needed to evaluate and select a remedial alternative.

#### ***Use of LEAF Analytical Results***

As discussed in Section 2.4.1, the best demonstration that leaching has not contaminated groundwater is to install groundwater wells in potential source areas. Regarding MWG’s use of the LEAF for the ASDs, the US EPA determined that the LEAF method is the best predictor for leachability because it tests for constituents over multiple ranges of pH. I agree with the US EPA that the LEAF method is the best predictive leaching test, and I agree with MWG’s recent use of the LEAF method to estimate leaching potential. The LEAF test is the best analytical laboratory test to predict leachability over a wide range of pHs that would be expected at each station. However, I disagree with how MWG used the LEAF test to formulate its conclusions.

Metal solubility from a solid waste (e.g., fly ash, bottom ash, slag, cinders) is largely determined by pH for some metals (e.g., arsenic), while less important for others (e.g., boron and calcium). As previously discussed, the US EPA determined that the best test to determine metals solubility of ash is to collect pore water samples directly from the CCR in an impoundment, rather than predicting leachability with laboratory tests.

Common to recent ASD demonstrations was MWG’s use of the LEAF method. WCG explained that each of the samples underwent leaching over a range of 8 pH values and under “natural pH” conditions, which is the actual pH of the sample itself. WCG concluded that “the natural pH results are believed to be the most applicable to field conditions because the natural pH represents the best approximation of field conditions.” (WCG at 35, 36, and 37). I disagree that the “natural pH” condition is the most representative predictor of leachability. In my opinion, conditions of pH change by such factors as depth below ground, source coal, waste type and age, and sulfate content. A correct use of

the LEAF data would be for MWG to use the results of multiple pH leaching ranges (of the eight) and to evaluate specific pH conditions by depth at each pond or historic fill area – rather than MWG using just one pH result (natural pH).

WCG's conclusion that the "natural" pH represents the "most applicable to field conditions" fails to understand that the best measure is actual pore water samples from multiple depths from an impoundment, and not a laboratory test. Second, WCG's fails to understand that if an impoundment leaks, that leachate and water can and likely will change geochemically once it reaches the underlying soil and aquifer. Slight changes in pH for example, can increase the mobility of some constituents. Plus, those geochemical conditions can and likely will change over time, making constituents more mobile.

### **Groundwater Elevations for Aquifer Separation**

WCG determined the "average" and "highest recorded" groundwater elevations reported for each station for all wells in a comparison to known impoundment bottom elevations, in an apparent attempt to demonstrate separation from the bottom of the ponds and the uppermost aquifer. (WCG at 14, 16, and 21-22). Those elevations are only approximate because no wells at any station measure groundwater elevations directly beneath a pond or fill area. While such an analysis is useful to determine the amount of separation between the wastes and the uppermost aquifer, it is also important to understand that MWG obtained groundwater elevations from wells located around the *perimeter* of impoundments and not *beneath* [emphasis added] the impoundments. As a result, WCG's analyses cannot be definitive for all ash ponds at each station to determine true groundwater elevations beneath the liners.

### **2.4.3 Joliet Specific Comments**

WCG illustrated historical soil borings, groundwater monitoring wells, sediment, and surface sample locations that were reportedly collected for environmental analysis, in support of its conclusion that no more investigations are needed. (WCG at 66). Contrary to that conclusion, the locations of those sampling points and the description of why samples were collected demonstrate that the nature and extent of contamination has not been defined. That diagram illustrates that:

- No samples have been collected from the two ash landfills that WCG identified in its report ("Southwest Historical Fill Area" and the "Northeast Historical Fill Area"). (WCG at 62 and 66). Those two disposal areas represent significant historical waste disposal areas that were identified by ENSR in 1998 – yet MWG has still not defined the nature and extent of contamination in those areas.
- The only historic area with a high density of samples collected was from the Northwest Historic Fill Area. (WCG at 66). Virtually all of those sample locations were, however, only collected for beneficial use leaching tests. As a result, the nature and extent of contamination in this area is still not defined.
- Phase II ESA soil and sediment samples were sporadically located with few other borings around them. (WCG at 66).

WCG stated that “in addition to coal ash surface impoundments, according to the case record, three other areas at Joliet 29 Station are suspected to contain historical coal ash” and “some” of these areas have been historically investigated. WCG also concluded that MWG excavated wastes from “some of these areas” and hauled that waste to an “appropriately permitted landfill.” (WCG at 15). Notable in that discussion is that WCG did not explain why “some” – but not all – areas were investigated and why wastes from “some of these areas” were excavated and transported to a permitted landfill, while other wastes remained in-tact. MWG’s choice to excavate CCRs from a small area does not explain why it chose to not remove CCRs elsewhere at the station.

WCG summarized the results of a 2004 and 2005 investigation over the 13.2-acre Northwest Fill area, and that investigation included 15 borings (approximately one boring per acre). Notable in that investigation, three borings did not contain CCRs, but off-set borings close to those three borings did encounter CCRs. (WCG at 40). This randomness of CCR occurrence in those borings, as demonstrated by an actual investigation into areas presumed to contain CCRs, demonstrates the importance of completing a comprehensive nature and extent investigation to locate and characterize wastes. MWG will not know where the CCRs exist without performing a comprehensive investigation. Also, notable is that the investigation is the disparity of only one boring per acre (43,560 square feet) for the Northwest Fill Area, compared to the four borings per acre for the FS/FAS Area at Waukegan (see Section 2.4.5).

WCG also summarized the results of CCR and soil characterization in 2005 for the eventual excavation and transport of “52 loads of soil / CCR weighing 1,062.88 tons” to an off-site landfill as an unspecified “remedial action”. (WCG at 41). WCG did not explain the purpose of that remedial action or why that area was targeted. Further WCG did not explain why other CCRs from other areas at the station were not also excavated and transported to a landfill. CCRs that were not excavated have the same long-term potential to contaminate groundwater.

WCG summarized the results of a 2020 investigation around monitoring well MW-09, which according to WCG “has historically exhibited fluctuating concentrations of TDS and sulfate in the groundwater exceeding the 35 Ill. Adm. Code 620 Class 1 Groundwater Quality Standards.” (WCG at 41). A total of 18 soil borings were advanced in the vicinity of MW-09, compared to only one boring per acre collected at the Northwest Area containing historical fill. (WCG at 41). WCG concluded that the water quality exceedences and acidic pH at the well were due to oxidation of a naturally occurring, localized pocket of residual sulfide minerals due to oxidation from the underlying bedrock – and not due to “station operations” or leakage from a CCR pond. (WCG at 42). Contrary to that conclusion, in my experience, localized occurrences of acidic (low pH) groundwater, high sulfate and / or sulfide concentrations in groundwater, and high concentrations of Total Dissolved Solids (TDS) in groundwater are very commonly associated with groundwater contaminated due to a release of constituents from CCRs.

In summary, I disagree with WCG’s conclusion that the “historical data as described above are sufficient to adequately characterize the historical coal ash fill areas at the Joliet 29 Station for the purposes of assessing a remedial approach”. (WCG at 42), based upon my prior comments associated with the NLET analyses, the above investigation summaries, the absence of any investigations at two ash landfills, the randomness of their excavation and remedial actions, and their randomness of collecting analytical data from all areas.

#### 2.4.4 Powerton Specific Comments

WCG illustrated historical soil borings, groundwater monitoring wells, test pit, sediment, and surface sample locations that were reportedly collected for environmental analysis, in support of its conclusion that no more investigations are needed. (WCG at 67). Contrary to that conclusion, the locations of those sampling points and the description of why samples were collected demonstrate that the nature and extent of contamination has not been defined. That diagram illustrates that:

- The only historic area with a high density of samples collected was in the Former Ash Basin, adjacent to the Ash Surge Basin. All of those samples were collected, however, only for beneficial use leaching tests. As a result, the nature and extent of that contamination and leaching potential has still not yet been defined.
- Phase II ESA soil and sediment samples were sporadically located with few other borings around them. Those sporadic locations demonstrate that the investigation was not meant to define the nature and extent of contamination in the specific areas or station wide.
- No samples have been collected from the additional, unrecognized historical ash management area ("Suspect Disposal Area") identified in my prior expert report (Section 2.2) and located south of the East Yard Runoff Basin (not illustrated on the WCG figure, see Figure 4, my prior expert report). That area represents a potential large source of contaminants that MWG has not yet investigated.
- No samples have been collected from the Suspect Disposal Area located between the intake and discharge canals (not illustrated on the WCG figure, but see Figure 4, my prior expert report). That area represents a potential large source of contaminants, and those areas are adjacent to the canals that are hydraulically connected to the Illinois River.

WCG commented that I did not "present the basis for the conclusion that there are additional, unrecognized historical ash management areas" in my previous expert report, referring to my identification of a suspected CCR disposal area located between the intake and discharge channels, as illustrated in Figure 4 of my prior expert report. (WCG at 20). That claim is incorrect. As I stated in that report, I based that claim upon my review of a 1961 aerial photograph that was included in Figure 4. WCG stated that it "was unable to independently substantiate Quarles' characterization of these two suspected disposal areas." (WCG at 20). WCG's explanation did not explain if they even attempted to independently substantiate my claim. As a result, those two areas remain a previously unidentified and suspected disposal area.

WCG disagreed with my interpretation of groundwater flow directions in my previous expert report (Section 3.2) where I opined that there was evidence of groundwater mounding and radial flow beneath the Ash Surge Basin and Ash Bypass Basin. (WCG at 33). I continue to support my prior conclusion that I correctly evaluated groundwater flow conditions at the Ash Surge Basin and Bypass Basin. To support their opinion, WCG concluded that I inappropriately combined groundwater elevation data from "monitoring wells screened in two different saturated zones into one contour map." (WCG at 33). That conclusion apparently relates to Figure 9 of my prior expert report, which

illustrates radial flow from the Ash Surge Basin and MWG-reported groundwater elevations within approximately one foot of the bottom of the impoundment. WCG also stated that my diagram “is inconsistent with industry standard of practice and results in his inaccurate conclusion that there is mounding under the Ash Surge Basin and the Bypass Basin.” (WCG at 34). WCG presented technical facts that it believed supported their conclusions:

- Wells that I used in my analysis were “screened in two different saturated zones.” (WCG at 33).
- Although there are two distinct “units” of groundwater, WCG concluded that the two units are “hydraulically connected.” (WCG at 34).
- Six wells (MW-6, MW-8, MW-12, MW-14, MW-15, and MW-17) were screened “within a confining clay/silt unit and the overlying gravel, sand, and cinders unit.” (WCG at 34).
- Twelve other wells are screened “within the deeper unit consisting of mostly gravel and sand”, and one well (MW-18) is screened across “both deep and shallow sand units separated by a confining clay unit.” (WCG at 34).

WCG admitted that the two upper “units” of groundwater are *hydraulically connected* [emphasis added]. This conclusion supports my prior analysis that groundwater elevations from both “units” *should be combined* [emphasis added] to form a single diagram, consistent with competent industry and hydrogeologic professional practices. WCG’s claim that I incorrectly used groundwater elevations from two different zones to create a potentiometric surface diagram demonstrates their lack of expertise in hydrogeology and the CCR Rule. A correct diagram *should include* [emphasis added] all interconnected aquifer wells to form a single diagram because the upper and lower units are hydraulically connected.

According to both the CCR Rule and Illinois CCR regulations (35 Ill. Admin. Code § 845.120; 40 CFR § 257.53): the *Uppermost aquifer means the geologic formation nearest the natural ground surface that is an aquifer, as well as lower aquifers that are hydraulically interconnected with this aquifer within the facility’s property boundary. Upper limit is measured at a point nearest to the natural ground surface to which the aquifer rises during the wet season.* The key portion of this definition that rebuts WCG’s claim that my prior groundwater flow diagram was incorrect is the “as well as lower aquifers that are hydraulically connected” portion. The uppermost aquifer at Powerton is both the shallow and interconnected deeper zones as a single uppermost aquifer where groundwater elevations from both connected zones should be combined to form a single groundwater flow diagram.

My prior report (Section 3.2) concluded that the bottom of the Ash Surge Basin is within approximately one foot of the uppermost aquifer beneath that impoundment. WCG did not rebut that conclusion in its report. If WCG agrees with my conclusion, it therefore disagrees with the 2019 conclusion made by Geosyntec when it certified that both the Ash Surge Basin and the Ash Bypass Basin met the required five-foot minimum distance as required by the CCR Rule. (Geosyntec 2019 at 1).

In summary, WCG’s summary of prior investigations demonstrates the need for additional investigations in areas already investigated and the need for new investigations where there have been none. Further, my analysis of uppermost aquifer groundwater conditions and WCG’s comments

regarding my interpretation, demonstrate that WCG lacks a clear understanding of hydrogeologic and CCR Rule fundamentals that are necessary for an expert opinion.

#### **2.4.5 Waukegan Specific Comments**

WCG concluded that the historical data presented in its report “are sufficient to adequately characterize the historical coal ash fill area at the Waukegan station.” (WCG at 47). I disagree with that conclusion.

WCG illustrated historical soil borings, groundwater monitoring wells, sediment, and surface sample locations that were reportedly collected for environmental analysis, in support of its conclusion that no more investigations are needed. (WCG at 69). Contrary to that conclusion, the locations of those sampling points and the description of why samples were collected, demonstrate that the nature and extent of contamination has not been defined. That diagram illustrates that:

- The only historic area with a high density of samples collected was from the FS/FAS Area located adjacent to the West Ash Pond. This is the area that the Board concluded contains CCRs up to 22 feet below ground surface, some of which are saturated. (Opinion at 67). Although investigations have been completed in this area, the nature and extent of contamination has not yet been defined.
- No high density samples have been collected around the East and West Ash Pond, other than the FS/FAS Area. My prior expert report (see Section 2.3) determined that both ponds were constructed over and within historic ash from an ash pond onto which the newer lined ponds were constructed. The nature and extent of those CCRs have not yet been defined.
- Phase II ESA soil and sediment samples were sporadically located with few other borings around them. Those sporadic locations demonstrate that the investigation was not meant to define the nature and extent of contamination in the specific areas or station-wide.
- No samples have been collected from the Former Fly Ash Storage Area located at the northwest corner of the property (not illustrated on the WCG figure, see Figure 6, my prior expert report). The area represents a significant potential source of groundwater contamination – yet MWG has never performed an in-depth analysis of that area.

No samples have been collected from the Former Slag Field located north of the Intake / Discharge Channel / Cooling Pond (not illustrated on the WCG figure, but see Figure 6, my prior expert report). That area also represents a potential significant source of groundwater contamination that is adjacent to the intake / cooling water pond that is connected to Lake Michigan.

MCG reported that MWG completed an investigation in November 2020 of the FS/FAS Area located west of the West Pond to determine if off-site contamination from the former Greiss-Pfleger Tannery and General Boiler properties could be contributing to observed groundwater concentrations in a well in that area. (WCG at 46-47). That investigation consisted of 40 borings over an approximate 9-acre area (four borings per acre). (WCG at 46). MWG again used the LEAF test and also used the SPLP to evaluate leachability at select borings. (WCG at 47). WCG concluded that “all LEAF results for samples

at the natural pH are below the applicable Class I Groundwater Quality Standard, except boron and arsenic.” (WCG at 47). WCG concluded that based on the results that “sufficient information is available to determine if a remedy is appropriate to address potential leaching of CCR-related constituents from ash in the FS Area to groundwater at concentrations exceeding Class 1 Groundwater Quality Standards”, without explaining why the investigation was sufficient to select a remedy or what the potential option(s) might be. (WCG at 47). I disagree with WCG’s conclusion that the leaching tests were sufficient to define the leachability of the CCRs for remedial purposes.

As discussed in Section 2.3.5, MWG plans to close the FS/FAS Area by constructing a cap over the wastes that are at least 22 feet below ground and are sometimes saturated. Also, as discussed in Section 2.3.5, that closure method will not prevent continued leaching of CCR constituents to groundwater and in fact, the concentrations might even increase. If the FS/FAS Area is considered to be an active pond according to the CCR Rule and the Illinois CCR regulations, closure-in-place would not be a closure option because CCRs would remain saturated. The only remaining closure option would therefore be closure-by-removal – where MWG would be required to excavate all CCRs and transport them to a lined landfill. MWG’s plan to construct a cap is not a long-term remedy that would be expected to improve groundwater conditions.

In summary, MWG chose to initiate a more in-depth investigation at the FS/FAS Area, while not performing any investigations at other historical disposal areas. Those areas need to be investigated. Further, the investigation that it performed at the FS/FAS Area was not sufficient to evaluate the leaching conditions of the area. The prior investigation in that area demonstrates that CCRs are saturated – yet MWG plans to construct a cap over that waste. That plan might worsen groundwater quality, according to EPRI, as previously discussed in Section 2.3.5.

#### **2.4.6 Will County Specific Comments**

WCG illustrated historical soil borings, groundwater monitoring wells, sediment, and surface sample locations that were samples were reportedly collected for environmental analysis, in support of its conclusion that no more investigations are needed. (WCG at 68). Contrary to that conclusion, the locations of those sampling points and the description of why samples were collected, demonstrate that the nature and extent of contamination has not been defined. That diagram illustrates that:

- No areas of high density samples occur anywhere on the property – demonstrating that no thorough investigation has been performed
- Virtually no soil borings have been advanced at the large Former Ash Basin located south of Ash Pond 3S, and no groundwater monitoring wells exist in that area (not illustrated on the WCG figure, but see Figure 2, my prior expert report). As a result, the nature and extent of contamination has not been defined in that area.
- Phase II ESA soil and sediment samples were sporadically located with few other borings around them. Those samples were mainly collected around the power plant, and not the impoundments. As a result, that investigation was not sufficient to define the nature and extent of contamination anywhere at the station.

- Only two widely spaced samples were collected at the Former Slag / Bottom Ash Disposal area located at the southeastern end of the property. Given the possibility that random CCRs exist in that area, more borings are needed to define the nature and extent of contamination.

WCG described investigations at two historical CCR fill areas: the Former Slag / Bottom Ash Disposal Area and one located adjacent to (east) of Pond 1N. (WCG at 44-45). Significant disparity was present in the density of the borings and the types of analyses used by MWG – demonstrating the haphazard nature of those two investigations. Two borings were advanced at the Former Slag / Bottom Ash Disposal Area – compared to 20 borings that were advanced in a grid pattern east of Pond 1N. (WCG at 44-45). Total metals analyses were analyzed at the Former Slag / Bottom Ash Disposal Area, while NLET leaching tests were performed from the borings adjacent to Pond 1N. (WCG at 44-45). A properly completed nature and extent investigation would have instead used consistent methodologies.

In summary, MWG has still not defined the nature and extent of contamination at areas that it has previously investigated – nor has it thoroughly investigated other historical disposal areas that are known to exist.

## **2.5 Decreasing Groundwater Concentration Trend**

WCG concluded that their “analysis of the historical groundwater quality data indicates that groundwater concentrations are decreasing at the Joliet 29, Powerton, and Will County Stations.” (WCG at 47). I disagree with that conclusion, based in part, upon the results of WCG’s analyses and its conclusions.

WCG’s analysis included approximately 10 years of groundwater well data collected from select wells that are “were at the farthest downgradient locations” because “these wells are most relevant because they best represent groundwater quality after the natural groundwater mechanisms of advective dispersion, and attenuation have impacted groundwater concentrations” before reaching the downgradient property line. (WCG at 48). WCG completely ignored some wells at the stations in its analyses – even though those wells have a history of contamination that has exceeded water quality standards. WCG’s choice of using wells that are the farthest downgradient locations ignores that the CCR Rule requires that MWG demonstrate compliance at the “waste boundary” nearest the wastes, as discussed in Section 2.3.6 of this report.

WCG concluded that “the majority of trend tests” from Joliet, Powerton, and Will County indicated a decreasing trend, and that results for Waukegan were neither skewed upward or downward. (WCG at 49). WCG based this conclusion only on the results where a trend was observed, rather than the complete data set. (WCG at 49).

A close examination of WCG’s results however, demonstrates the “decreasing” trend conclusion to be incorrect. The data instead demonstrate that the majority of constituent concentrations are either increasing or had no trend, and that the decreasing trend results do not meet the desired confidence level, according to the following:

- Joliet: of the 132 tests that it performed, 74 percent exhibited either an upward trend (10%) or no trend (64%). Only 26 percent exhibited a downward trend. Of those with a downward trend, only

32 percent of those results were reliable at the desired 99 percent confidence level. (WCG at 44 and 95).

- Powerton: of the 233 tests performed, 70 percent exhibited either an upward trend (6%) or no trend (64%). Only 30 percent exhibited a downward trend. Of those with a downward trend, only 35 percent of those results were reliable at the desired 99 percent confidence level. (WCG at 44 and 98).
- Waukegan: of the 135 tests performed, 81 percent exhibited either an upward trend (21%) or no trend (60%). Only 19 percent exhibited a downward trend. Of those with a downward trend, only 35 percent of those results were reliable at the desired 99 percent confidence level. (WCG at 44 and 104).
- Will County: of the 140 tests performed, 73 percent exhibited either an upward trend (16%) or no trend (57%). Only 27 percent exhibited a downward trend. Of those with a downward trend, only 34 percent of those results were reliable at the desired 99 percent confidence level. (WCG at 44 and 101).

My review of the groundwater concentration trend analyses identified other significant flaws in WCG's trend analyses and use of the monitoring data to make remedial decisions. Those flaws include:

- WCG failed to include all historically contaminated wells in its statistical analyses. For example:
  - Joliet. MW-9. That well has repeatedly had high concentrations of iron, manganese, nickel, sulfate, and total dissolved solids that have exceeded water quality standards. (Joliet 2021 at 18, 116, 118, 120, 126, and 128). This well has a history of groundwater quality violations and has been a focus of a prior MWG investigation to attempt to explain contaminant concentrations in groundwater.
  - Powerton. MW-9 has repeatedly had high concentrations of boron that have exceeded water quality standards. (Powerton 2021 at 20 and 125). MW-11 has repeatedly had high concentrations of arsenic that have exceeded water quality standards. (Powerton 2021 at 22 and 122).
  - Waukegan. MW-5 has repeatedly had high concentrations of arsenic, boron, iron, manganese, and sulfate. (Waukegan 2021 at 13, 172, 175, 183, 185, and 194). MW-7 has repeatedly had high concentrations of boron and sulfate. (Waukegan 2021 at 15, 175 and 194).
  - Will County. MW-2 has repeatedly had high concentrations of arsenic, boron, and sulfate. (Will County 2021 at 11, 82, 85, and 103). MW-3 has repeatedly had high concentrations of boron. (Will County 2021 at 12 and 85)). MW-4 has repeatedly had high concentrations of boron and sulfate. (Will County 2021 at 13, 85, and 103). MW-5 has repeatedly had high concentrations of boron and sulfate. (Will County 2021 at 14, 85, and 103).
- MWG failed to include manganese in its trend analyses, despite that constituent exceeding groundwater quality standards.
- The wells evaluated by WCG were not always near the disposal areas – meaning that the concentrations nearest the units at the waste boundaries would likely be much higher.

- The analysis assumes that the downgradient wells are properly located and screened (by depth) at the site and within the aquifer to intercept groundwater contamination.
- The analysis assumes that historical disposal areas that are currently unmonitored do not need to be monitored and the groundwater in those unmonitored areas is not contaminated.
- The analysis assumes that the downgradient concentrations will not get worse from upgradient source areas.
- WCG did not determine how many years will be needed to meet each groundwater protection standard, if a standard was exceeded.

In summary, the statistical analyses for wells at each station do not support WCG's claim that concentrations are decreasing at any station. Further, the decreasing trend results reported by WCG were not statistically valid at the desired confidence level.

## **2.6 Risks to Off-Site Receptors**

WCG also concluded that "there is no unacceptable risk to off-site receptors at the four stations." (WCG at 50). I disagree with that conclusion because MWG has not yet collected enough information to conclude that risks to all possible off-site receptors have been defined.

WCG concluded that "each of the Stations are bordered by surface water and the shallow groundwater unit at each of the Stations discharges into either the adjacent river or Lake Michigan (in the case of Waukegan)." (WCG at 50). WCG concluded that their surface water risk evaluation "indicate that downgradient groundwater conditions at each of the four Stations do not pose an unacceptable risk to surface water receptors." (WCG at 52). Although WCG did not define what "receptors" it considered, human and aquatic life are assumed because WCG compared groundwater concentrations to human and aquatic life surface water quality standards.

WCG's determination that there were no unacceptable risks to off-site ecological receptors misses the fact that groundwater discharges into receiving streams can accumulate in sediments along shorelines and in wetlands, for example. WCG's analysis also relies on dilution of contaminated groundwater once it reaches a surface water and assumed ingestion and direct contact exposures.

There is no indication that MWG has ever inspected shorelines for unpermitted discharges of CCR-impacted groundwater or the presence of contaminated sediments that commonly exist, in my opinion, where CCR-contaminated groundwater discharges into a receiving stream. My previous expert report (Section 3.4) discussed groundwater discharge impacts to sediments, vegetation, and surface water. Contaminated sediments and wetlands provide habitat to macro-invertebrate organisms and birds, for example, and provide habitat for fish and aquatic life.

In summary, WCG's "risk" analysis" for off-site receptors is incomplete because it did not consider any receptors other than humans and aquatic life in its analysis. Plus, it is not valid because MWG has not

yet defined the nature and extent of contamination along the shorelines of each station where groundwater discharges into the receiving surface water.

### **3.0 SUMMARY AND CONCLUSIONS**

This report included summaries and conclusions embedded throughout Section 2 as direct rebuttals to WCG comments in their report, in addition to other related information relevant to the report sections and subsections. This section includes global summaries and conclusions for major sections of this report, as follows:

- Respondent experts have minimal CCR experience that qualify them to opine on CCR matters related to the CCR Rule, groundwater monitoring systems, investigating the nature and extent of contamination, and designing groundwater corrective actions.
- My prior expert report and this rebuttal report continues to rely on the Board's Opinion during the liability phase of this case because it was and continues to be the best historical source of information and to establish remedial objectives that MWG is required to meet at each station. The Board concluded that it is immaterial in the liability phase that a contaminant source is from a historical fill area or an active CCR disposal or collection area. Knowledge gained by completing a thorough nature and extent investigation at each station is "material" to adequately select a groundwater remedy.
- Regulatory standards applicable to establishing a remedy at each site include the Act, the CCR Rule, and the Illinois CCR regulations. According to the Opinion, MWG is required to remedy groundwater contamination and cure the violations identified by the Board, regardless of the source of the contamination.
- MWG has not yet performed a nature and extent investigation at each station sufficient to evaluate and select a groundwater remedy. The data that WCG presented in its report support the fact that neither historical fill nor current disposal areas have been thoroughly investigated. Given that there is no foundation to support site conditions by nature and extent investigations, WCG's proposed monitored natural attenuation groundwater remedy is not supported by credible science.
- WCG's proposed closure-in-place remedy at Waukegan does not meet the minimum performance standards established in the CCR Rule or Illinois CCR regulations, nor is it likely to improve groundwater quality according to EPRI. Saturated CCRs belowground will continue to leach constituents into the uppermost aquifer, even with a low permeability cap over the wastes. Plus, the cap will not prevent the uppermost aquifer from flowing laterally into the CCRs beneath the cap.
- WCG's proposed risk-based approach that relies on monitored attenuation is not likely to achieve Part 620 groundwater protection standards or cure the other violations identified by the Board. Plus, WCG's risk assessment only included human and fish / aquatic life receptors. Also, risk-based closures are not allowed by the CCR Rule or the Illinois CCR regulations. WCG failed

to include other receptors such as sediments along river and lake shorelines, vegetation, and wetlands, as examples. As a result, the risk assessments are incomplete. As with any remedial measure, monitored natural attenuation would have to be accompanied by source control and a nature and extent investigation at each station.

- MWG's use of random and sometimes incorrect leaching tests have been insufficient to estimate leachability of CCR contaminants because MWG selected the wrong tests for the intended purpose, in addition to incorrectly evaluating the results associated with the US EPA-preferred LEAF method.
- Although MWG replaced damaged or cracked liners at the stations, groundwater contamination prior to those replacements would have been likely due to the shallow groundwater conditions. That legacy contamination can still exist around the ponds and be present in both hydraulically upgradient and downgradient groundwater monitoring wells. CCR constituents in upgradient wells can invalidate statistical comparisons that are used to trigger corrective actions because the downgradient wells are compared to upgradient wells that are also contaminated.
- WCG's conclusion that constituent concentrations in groundwater are decreasing at Joliet, Powerton, and Will County is not correct. In fact, constituent concentrations are increasing or exhibit no trend at all four stations.

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