Attachment A

Technical Support Document: Coal Combustion Waste Impoundments at Electrical Coal Fired Power Plants

Illinois Environmental Protection Agency

Subtitle G

Coal Combustion Waste Impoundments at Electrical Coal Fired Power Plants

Technical Support Document (TSD)

Subpart A – General Provisions

Purpose

The Illinois Environmental Protection Agency (Agency) developed proposed regulations of general applicability specifically to fill a regulatory gap that exists pertaining to Coal Combustion Waste (CCW) Impoundments at electrical coal-fired generation plants (facilities). In addition, the Agency developed this proposed rule because of the inorganic chemical (IOC) contaminants that were found in the groundwater from the hydrogeologic assessment of 24 power generating facilities that use approximately 83 surface impoundment units to treat waste water CCW. The contaminants found have the potential to degrade groundwater and threaten/preclude its use. Contaminants such as total dissolved solids (TDS) can cause: scaling within plumbing systems; loss of well yield, poor pump performance, and encrustation of the water line/pump that may render a water supply to be inoperable (AWWA, 1996). Further, it can cause objectionable taste and odor conditions (organoleptic), and cause poor performance and reduce the life time of hot water appliances (i.e., water heater, dishwasher, clothes washer and so forth). Participants in the study of Health Effects from Exposure to High Levels of Sulfate in Drinking Water Study (U.S. EPA, 1999) complained that they could not drink the water because it smelled and tasted so bad. Boron contamination may prevent watering of sensitive plants (U.S. EPA, 1986). Additional treatment for these contaminants above naturally occurring levels would be an economically and technically unacceptable burden for owners of private drinking water system wells, semi-private drinking water system wells, non-community water system wells, and small community water systems (AWWA, 1995). For this reason the Agency is emphasizing prevention of groundwater degradation and improvement of groundwater quality to the extent practical prior to adopting restricted use ordinances that write off groundwater up front.

Nationwide studies of CCW have been shown to contain: antimony (Sb), arsenic (As), barium (Ba), boron (B), beryllium (Be), cadmium (Cd), chromium (Cr), chloride (Cl), iron (Fe), lead (Pb), mercury (Hg), manganese (Mn), nickel (Ni), selenium (Se), silver (Ag), sulfate (SO_4), and thallium (Tl). Numerous studies have also been conducted of coal ash chemistry from coal extracted from Illinois Basin coals (Suloway, 1983 and Natusch, 1977). These studies concluded that in addition to calcium (Ca), some of the more soluble IOC contaminants that leach from coal ash are: B, SO_4, and Mn. Sulaway 1983, indicates that from the 12 fly ashes studied in Illinois:

> The general trend for EP [extraction procedure] solubility for Illinois Basin fly ashes was: SO_4-S > Ca, B > Cd > Sb, Mn, Mg> Zn, Na, Mo > K, Ni, Cr, Cu >Be, Ba, Si, AL, and Fe.

Boron, sulfate, and manganese are the same contaminants that have been found in recent hydrogeologic assessments of groundwater in multiple confirmed sample results collected from down gradient dedicated monitoring wells adjacent to surface impoundment units containing CCW at power generating facilities in Illinois. These contaminants were found to be attributable to these surface impoundment units. Further, high levels of TDS have been found in the down gradient monitoring well results. TDS represents a summary concentration of the dissolved inorganic contaminants [e.g., SO_4 + Ca + B + Mn (Hem, 1992)]. As and Tl have also been detected in a few monitoring wells in more than two sampling events. These two contaminants are not wide spread in down gradient monitoring wells like TDS, SO_4, and B.

Many of these surface impoundment units containing CCW have been in existence for long periods of time. Thus, the highly soluble and mobile contaminants of concern found at down gradient monitoring wells represent the observed outcome of the fate and transport of CCW dissolved IOC contaminants during that time frame under various transient hydrologic and climatic conditions. The mobility of other IOC contaminants in CCW is being attenuated due to such processes as oxidation and reduction/cation-anion exchange.

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Many of these power generating facilities are located adjacent to Illinois' major river systems. These modern day river systems overlay Illinois' principle aquifer systems[1] in many parts of the State. In addition, many of these aquifers are in areas that have been mapped as having a high to very high potential for aquifer recharge, as shown on Figure 1.

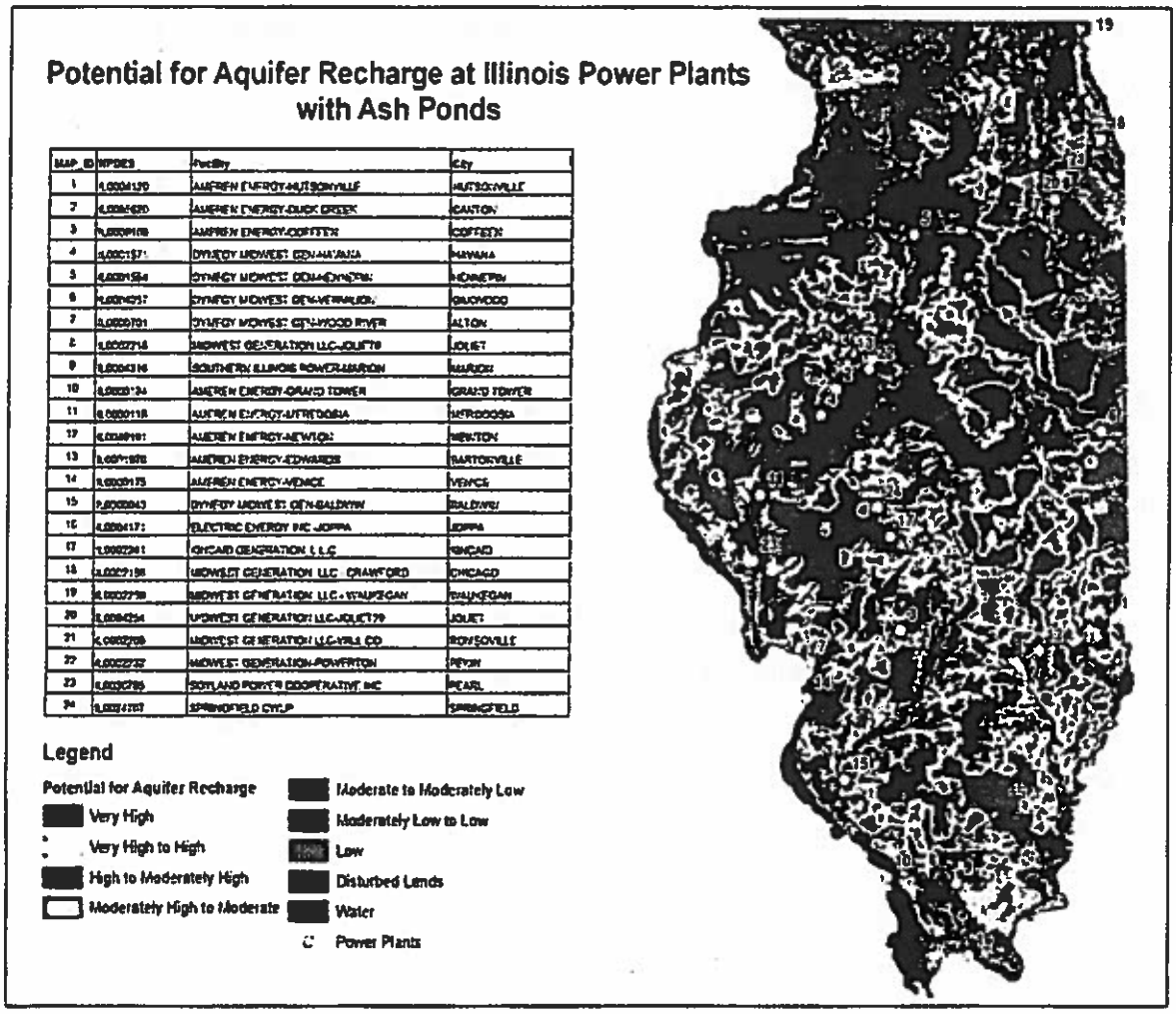

Figure 1. Illinois Potential for Aquifer Recharge Map with Power Generating Facilities

[1] "Principle aquifer" means an aquifer that has been mapped by the Illinois State Geological Survey, and Illinois State Water Survey has been determined to yield 100,000 gallons per day per square foot over at least a 50 square mile area.

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Statistical Analyses - The Agency used statistical techniques combined with geographic information system (GIS) spatial analyses tools to evaluate IOC contaminant sample data results. Many dissolved IOCs are naturally occurring in groundwater[2], and statistical tools can help to discern statewide background concentrations of such naturally occurring chemical compounds versus compounds that are detected and are attributable to anthropogenic sources.

Thus, statistics have a critical role in determining environmental impacts to groundwater quality, especially with respect to IOCs. In descriptive statistics, a box plot or boxplot (also known as a box-and-whisker diagram or plot) is a convenient way of graphically depicting groups of numerical data through their five-number summaries: the smallest observation (sample minimum), lower quartile (Q1), median (Q2) , upper quartile (Q3), and largest observation (sample maximum). A boxplot may also indicate which observations, if any, might be considered outliers (Helsel & Hirsch, 1993). Figure 2 illustrates the components of a box plot.

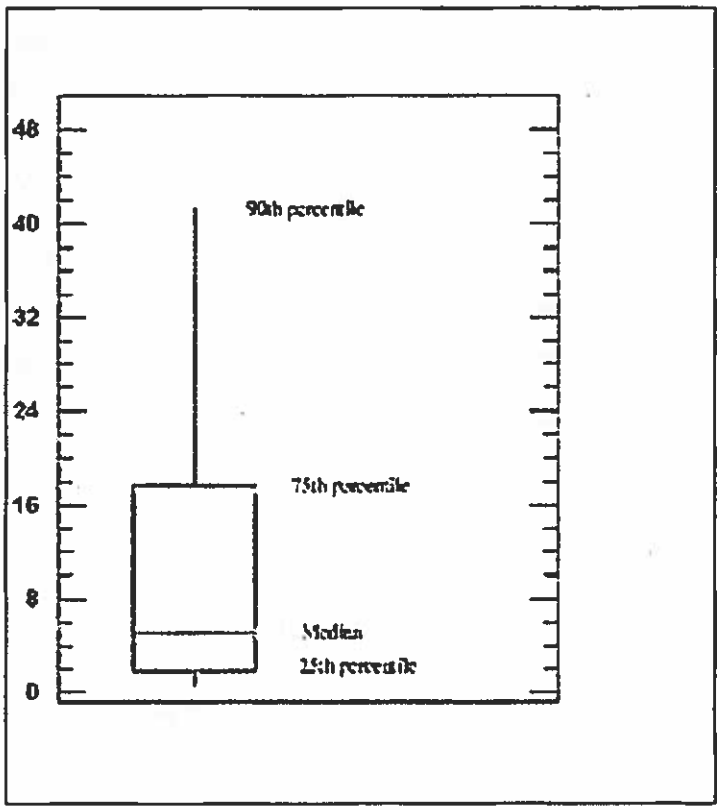

Figure 2. Box Plot

Ambient Groundwater Quality Conditions - Pursuant to Section 13.1 of the Illinois Environmental Protection Act (Act) and Section 7 of the Illinois Groundwater Protection Act

[2] Groundwater is a solvent that is contact with various earth materials. As a result, groundwater naturally contains dissolved cations and anions as well as some nonionic inorganic material, such as silica. Naturally occurring groundwater can contain dissolved solids (Hem, 1992). The major ions constituents of groundwater include calcium, magnesium, sodium, potassium, chloride, sulfate and bicarbonate (Fetter, 1993). In addition, inorganic ions that impact on water quality can be released to the subsurface via human activity.

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(IGPA), Illinois EPA implements an ambient groundwater monitoring network. A probabilistic monitoring network of community water supply (CWS) wells was designed to meet this mandate. The design of this network was completed in coordination with the United States Geological Survey (USGS), the Illinois State Geological Survey (ISGS), and the Illinois State Water Survey (ISWS), with the USGS performing the detailed design. The goal of the network is to represent contamination levels in the population of all active CWS wells. The network wells were selected by a random stratified probability-based approach using a 95 percent confidence level (CWS Probabilistic Monitoring Network). This results in an associated plus or minus 5 percent precision and accuracy level. Further, the random selection of the CWS wells was stratified by depth, aquifer type and the presence of aquifer material within 50 feet of land surface to improve precision and accuracy. Illinois EPA used geological well log records and construction log detail to perform this process. The random stratified selection process included nearly 3,000 CWS wells resulting in 354 fixed monitoring locations. Additionally, in order to prevent spatial or temporal bias 17 random groups of 21 wells, with alternates, were selected from all the 354 fixed station wells (see Figure 3). The CWS wells are overlain with maps of Illinois' three principle aquifer systems. To further assure maximum temporal randomization within practical constraints, the samples from each sample period are collected within a three-week timeframe (Illinois EPA, 2010).

This probabilistic network is designed to provide an overview of the groundwater conditions in the CWS wells; provide an overview of the groundwater conditions in the principle aquifers (e.g., sand and gravel, Silurian, Cambrian-Ordovician, etc.,); establish background of water quality within the principle aquifers; identify trends in groundwater quality in the principle aquifers; and evaluate the long-term effectiveness of the IGPA, CWA and Safe Drinking Water Act (SDWA) program activities in protecting groundwater in Illinois (Illinois EPA, 2010).

These production wells cannot be used for detection monitoring because the zone of capture (ZOC) may mask a contaminant plume or under represent plume concentration due to mixing with clean groundwater sources in a ZOC.

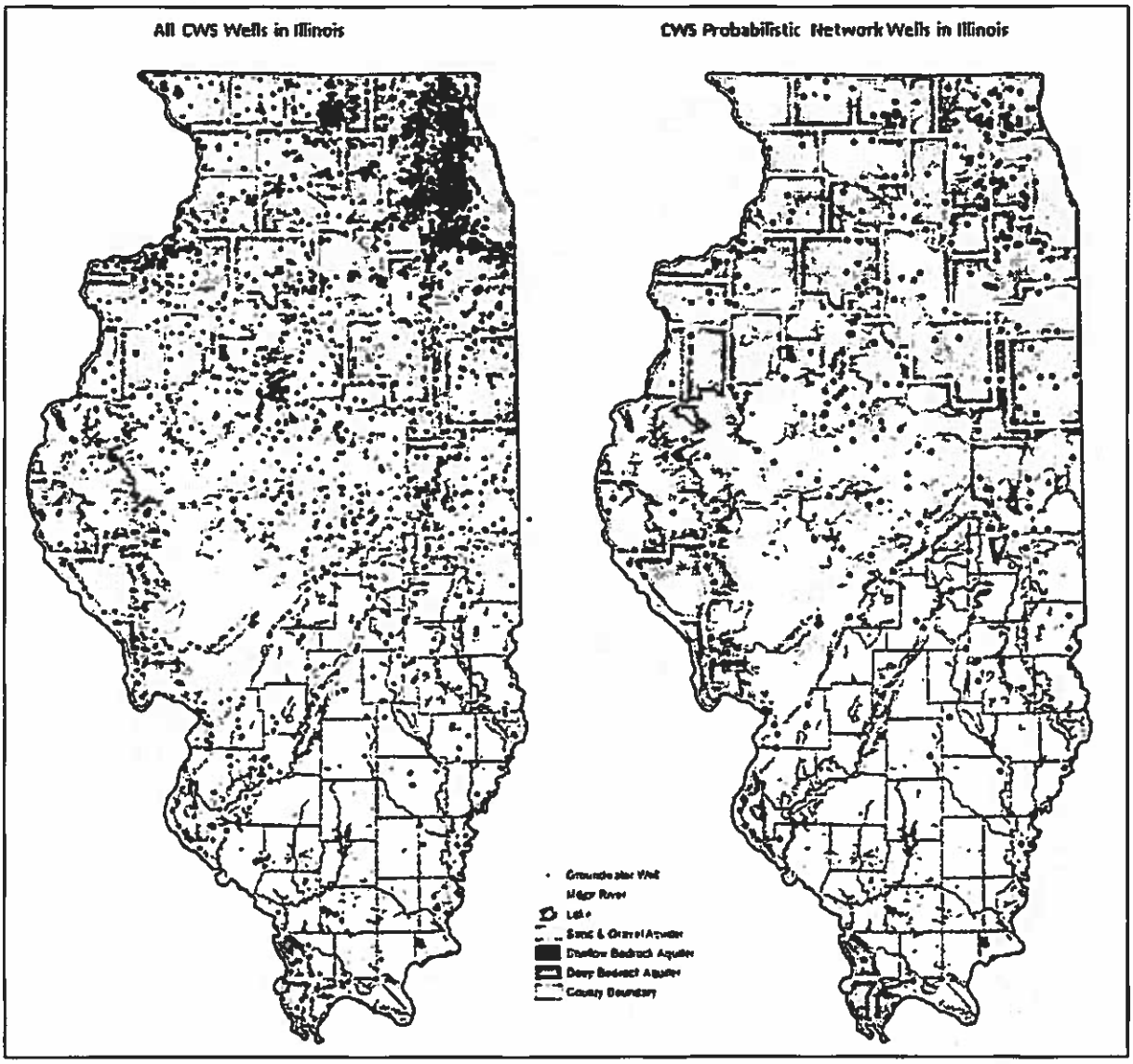

Figure 3. All CWS Wells and the Probabilistic Network

Since the probabilistic network of CWS is stratified by aquifer type the sampling data collected from wells associated with a specific aquifer used can be illustrated. For example, Figure 4 shows the network of CWS wells using the principle sand and gravel aquifer and the associated box plot statistics for IOC. Further, Figure 5 shows the IOC box plot statistics relative to the wells using shallow bedrock aquifers.

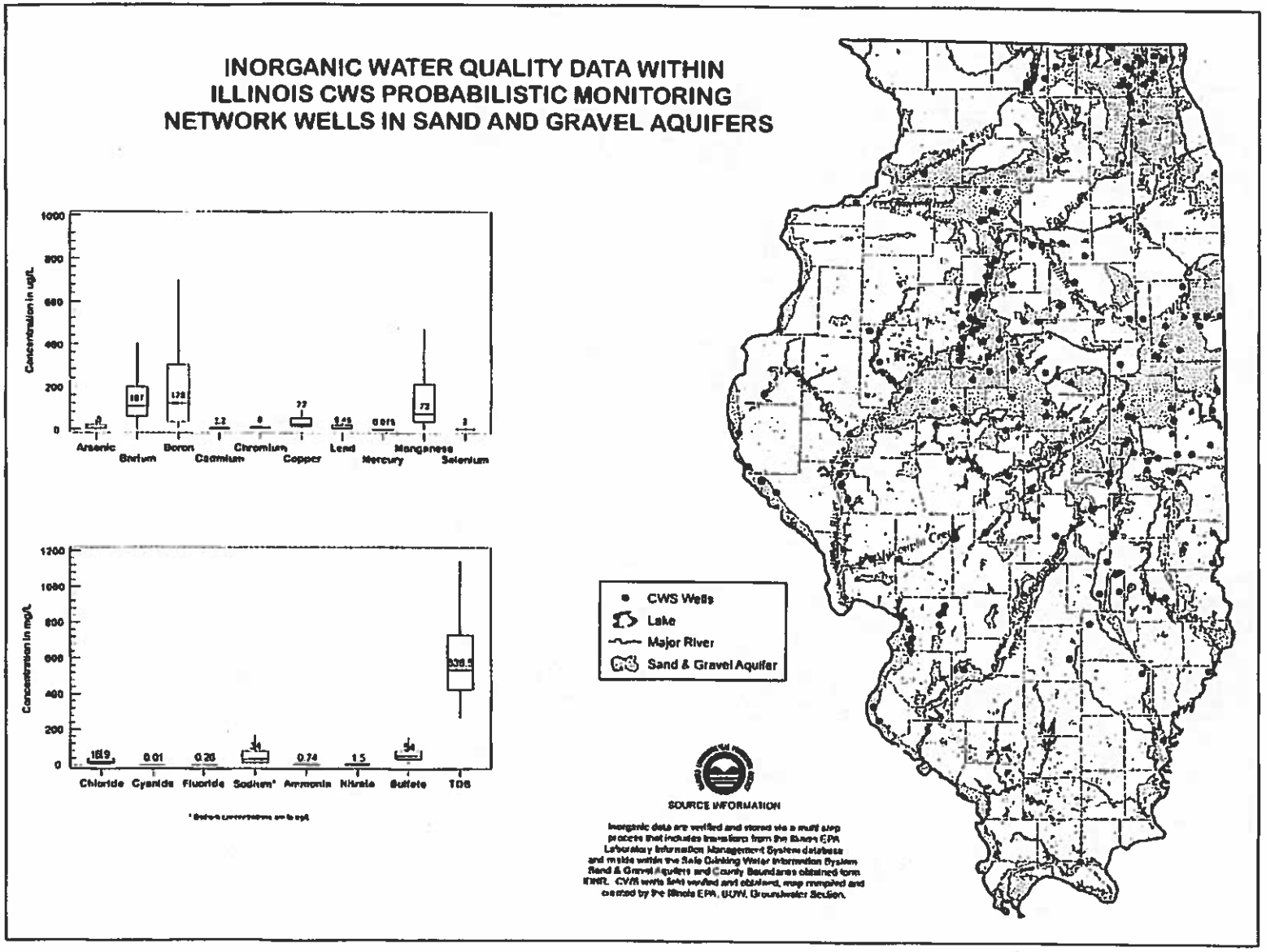

Figure 4 . Inorganic water quality data within Illinois Sand and Gravel Aquifers

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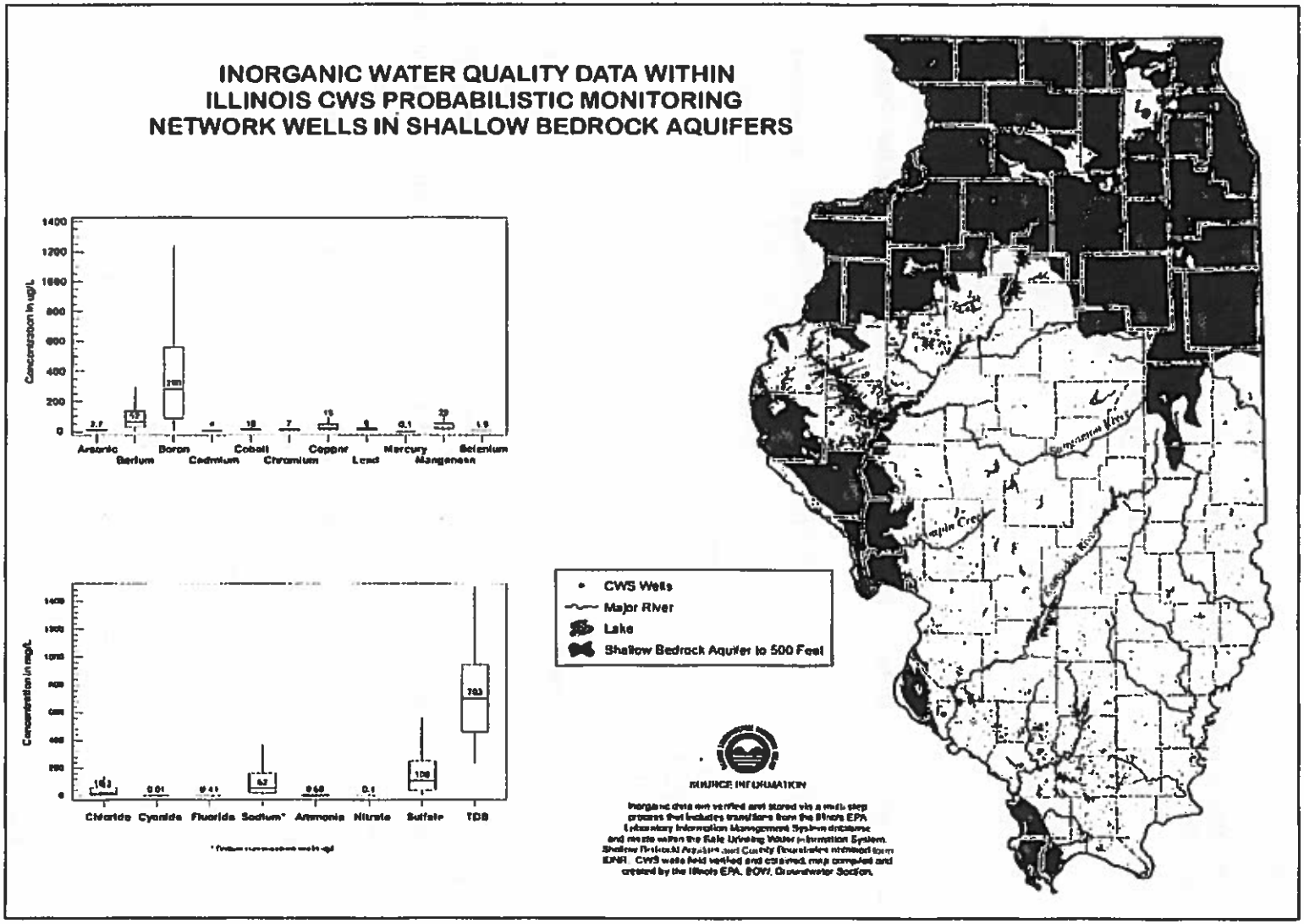

Figure 5. Inorganic water quality data within Illinois Shallow Bedrock Aquifers

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The ambient monitoring network median concentration results for B, sulfate SO_4, total TDS, and Mn, are as follows:

Table 1. Median Concentrations of IOCs in the Ambient Network Wells in the Sand and Gravel Aquifer

IOC	Ambient groundwater concentration in milligrams per liter (mg/L)
B	0.12
SO_4	54
TDS	703
Mn	0.072

Table 2. Median Concentrations of IOCs in the Ambient Network Wells in the Shallow Bedrock Aquifer

IOC	Ambient groundwater concentration in milligrams per liter (mg/L)
B	0.28
SO_4	106
TDS	530
Mn	0.029

Statistics for IOCs that Exceed Groundwater Standards at Electrical Coal Fired Power Plants -- Descriptive statistics and box plots have been developed for the IOC contaminants at 13 power generating facilities relative to the applicable Illinois Pollution Control Board's (Board) groundwater quality standards[3] (GWQS) at 35 Ill. Adm. Code 620. Currently, violation notices (VN) were issued in 2012 to Midwest Generation (5 facilities), Ameren (4 facilities), Dynegy (2 facilities), and Prairie Power (1 facility – Pearl Station). Compliance commitment agreements are in place for all 5 Midwest Generation facilities and the Prairie Power Facility to address groundwater contamination issues. The 2 Dynegy facilities and the 4 Ameren facilities were issued Notices of Intent to Pursue Legal Action on February 13, 2013. Based upon review of additional hydrogoeologic information no action will be taken at the Electric Energy Joppa Power Station and Dominion Resources Services Kincaid Power Station at this time. Groundwater monitoring data indicates water quality has improved at the Kincaid and the Joppa Power Stations.

[3] The Board's numerical groundwater standards apply except due to natural causes.

The two facilities that have the potential to impact off-site drinking water are Havana East Pond, which is lined, and currently in compliance, and Edwards, which is unlined, but currently in compliance.

Figure 6 shows that the median concentration of SO_4 per power generating facility, which is the most soluble fly ash contaminant (Suloway, 1983), ranges from a low of 570 to a high of 2,089 mg/L relative to the Board's Class I numerical standard of 400 mg/L. For comparison, the statewide median background concentration of SO_4 in CWS wells using principle sand and gravel aquifers is 54 mg/L.

Descriptive Statistics: Sulfate at Ash Impoundments with VNs

Variable	N	Mean	Median	TrMean	StDev	SE Mean
Crawford	12	1098	1000	1061	371	107
Joliet 2	6	1205	1350	1205	464	189
Powerton	20	850.5	815.0	842.8	259.4	58.0
Waukegan	6	948.3	950.0	948.3	138.0	56.4
Will Cou	32	854	570	704	837	148
Joppa	8	637.0	599.0	627.0	81.6	28.8
Coffeen	16	744.1	761.0	751.1	121.3	30.3
Grand To	3	421.00	425.00	421.00	8.64	5.57
Newton	14	2099	1900	2089	1063	284
Baldwin	20	639.4	568.5	630.4	177.1	39.6
Vermilio	6	857	740	857	477	195
Kincaid	3	572.0	517.0	572.0	147.4	85.1
Pearl	14	854.3	730.0	834.2	365.0	97.6

Variable	Minimum	Maximum	Q1	Q3
Crawford	670	1900	803	1350
Joliet 2	580	1600	705	1600
Powerton	440.0	1400.0	652.5	982.5
Waukegan	780.0	1100.0	802.5	1100.0
Will Cou	410	4800	440	755
Joppa	565.0	768.0	570.5	721.3
Coffeen	450.0	940.0	655.0	838.3
Grand To	410.00	428.00	410.00	428.00
Newton	618	3700	1303	3075
Baldwin	411.0	1030.0	507.8	796.8
Vermilio	410	1500	440	1350
Kincaid	460.0	739.0	460.0	739.0
Pearl	450.0	1500.0	572.5	1070.0

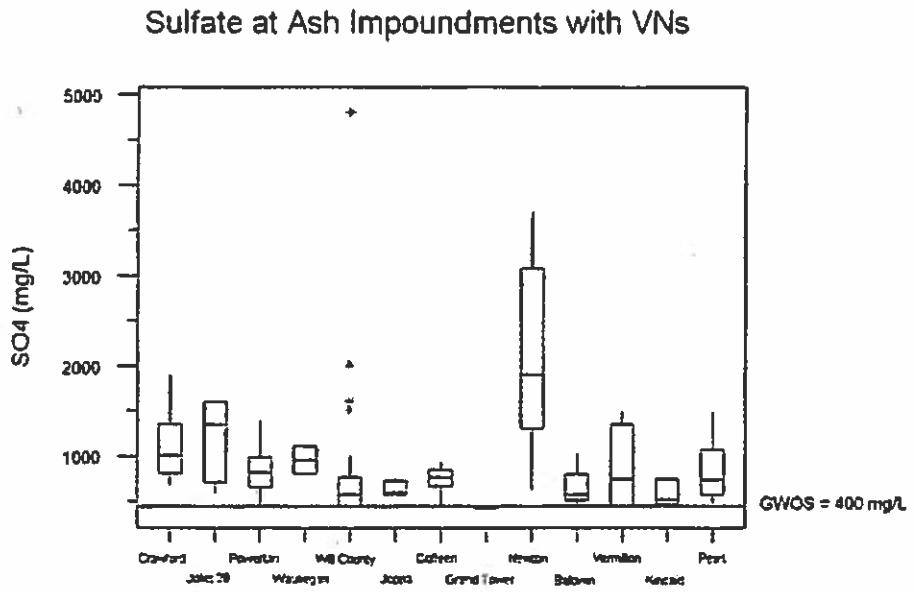

Figure 6. Sulfate Concentrations at Power Plant Groundwater Monitoring Wells

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Figure 7 shows that the median concentration of B, the second most soluble fly ash contaminant (Suloway, 1983), ranges from a low of 2.1 to a high of 44 mg/L relative to the Board's Class I numerical standard of 2.0 mg/L. For comparison, the statewide median background concentration of B in CWS wells using principle sand and gravel aquifers is 0.12 mg/L.

Descriptive Statistics: Boron at Ash Impoundments with VNs

Variable	N	Mean	Median	TrMean	StDev	SE Mean
Joliet 2	2	2.400	2.400	2.400	0.283	0.200
Powerton	16	2.888	2.700	2.857	0.621	0.155
Waukegan	16	11.38	2.55	9.71	15.12	3.78
Will Cou	39	3.136	2.600	3.046	0.942	0.151
Joppa	12	5.30	11.15	9.59	3.49	1.01
Coffeen	15	4.765	3.900	4.715	2.122	0.548
Grand To	18	5.761	5.370	5.761	1.684	0.397
Meredosi	14	13.45	4.20	12.60	13.87	3.71
Baldwin	6	9.54	8.40	9.54	4.97	2.03
Vermilio	11	19.73	19.00	18.51	12.32	3.71
Pearl	23	7.99	6.40	7.74	5.18	1.08

Variable	Minimum	Maximum	Q1	Q3
Joliet 2	2.200	2.600	*	*
Powerton	2.100	4.100	2.500	3.075
Waukegan	2.10	44.00	2.20	25.50
Will Cou	2.100	5.700	2.500	3.600
Joppa	3.45	12.30	5.33	11.70
Coffeen	2.070	8.700	3.200	7.160
Grand To	2.970	8.900	4.635	7.023
Meredosi	2.11	35.00	3.03	30.40
Baldwin	3.60	18.00	6.05	13.50
Vermilio	4.90	40.00	7.10	29.00
Pearl	2.20	19.00	3.40	13.00

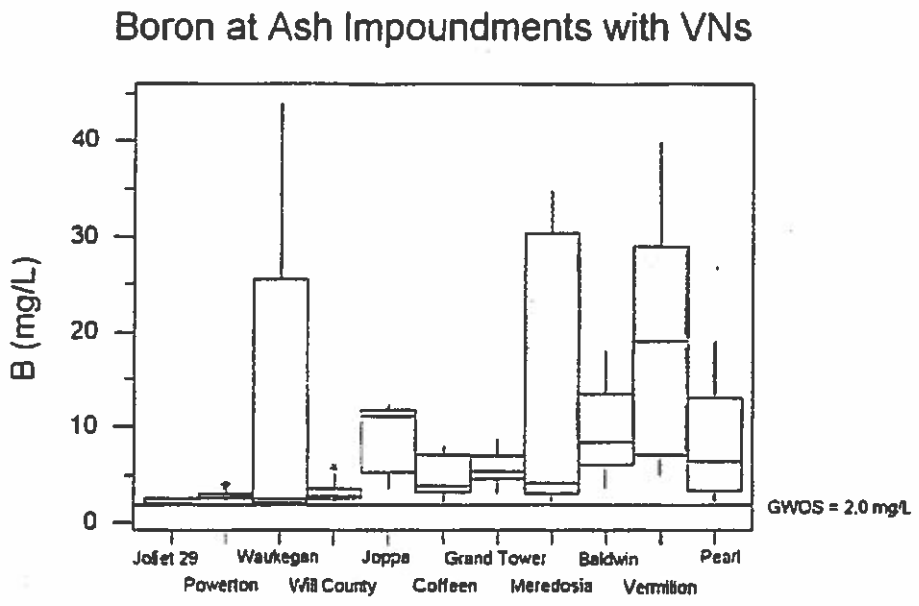

Figure 7. Boron Concentrations at Power Plant Groundwater Monitoring Wells

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Comp. 019080

Figure 8 shows that the median concentration of Mn, the third most soluble fly ash contaminant (Suloway, 1983), ranges from a low of 0.17 to a high of 12 mg/L relative to the Board's Class I numerical standard of 0.15 mg/L. For comparison, the statewide median background concentration of Mn in CWS wells using sand and gravel aquifers is 0.072 mg/L.

Descriptive Statistics: Manganese at Ash Impoundments with VNs

Variable	N	Mean	Median	TrMean	StDev	SE Mean
Crawford	12	1.457	1.350	1.437	0.818	0.236
Joliet 2	6	0.881	0.885	0.881	0.455	0.161
Powerton	74	1.798	0.630	1.377	2.516	0.292
Waukegan	5	0.598	0.600	0.598	0.291	0.130
Will Cou	31	0.3523	0.2900	0.3296	0.1699	0.0341
Joppa	12	3.175	4.285	3.249	2.188	0.632
Coffeen	17	0.6129	0.6700	0.6209	0.2119	0.0514
Grand To	13	0.4629	0.3150	0.4538	0.2142	0.0594
Meredosi	14	1.434	0.805	1.209	1.595	0.426
Newton	14	0.4031	0.2550	0.3802	0.2704	0.0723
Baldwin	26	1.084	0.485	0.884	1.461	0.286
Vermilio	9	0.587	0.340	0.587	0.350	0.117
Kincaid	11	1.667	0.735	1.212	2.543	0.767
Pearl	31	6.29	4.80	5.52	6.03	1.08

Variable	Minimum	Maximum	Q1	Q3
Crawford	0.310	2.800	0.763	2.125
Joliet 2	0.290	1.600	0.413	1.250
Powerton	0.180	12.000	0.368	2.725
Waukegan	0.280	0.990	0.320	0.875
Will Cou	0.1600	1.0000	0.2200	0.4500
Joppa	0.174	5.480	0.279	4.693
Coffeen	0.2400	0.8660	0.4140	0.8250
Grand To	0.2520	0.7740	0.2670	0.6690
Meredosi	0.169	5.400	0.295	2.875
Newton	0.1700	0.9100	0.2175	0.6500
Baldwin	0.180	6.800	0.362	1.125
Vermilio	0.220	1.000	0.300	0.955
Kincaid	0.174	7.260	0.168	0.907
Pearl	0.21	23.00	2.40	6.60

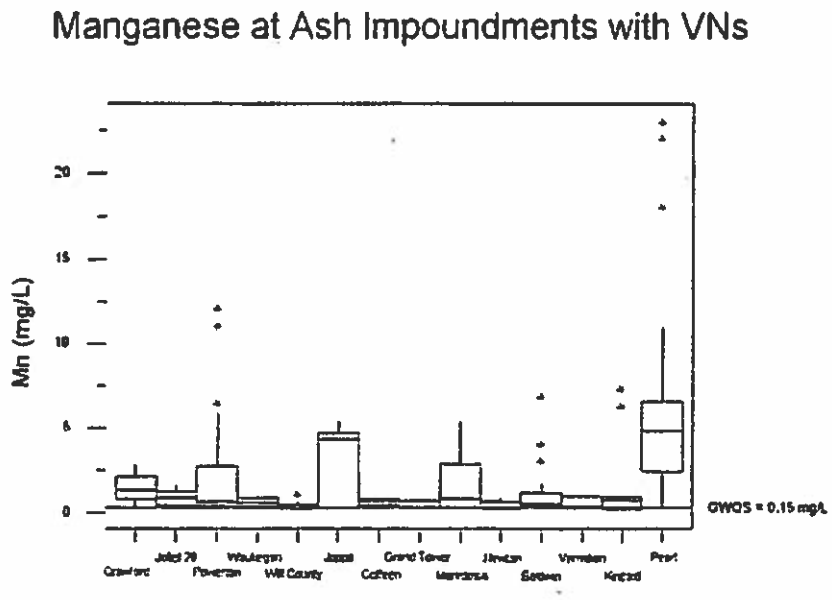

Figure 8. Manganese Concentrations at Power Plant Groundwater Monitoring Wells

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Comp. 019082

Figure 9 shows that the median concentration of TDS, which includes SO4 and B two of the most soluble fly ash contaminants (Suloway, 1983), ranges from a low of 1,205 to a high of 18,000 mg/L relative to the Board's Class I numerical standard of 1,200 mg/L. For comparison, the statewide median background concentration of TDS in CWS wells using sand and gravel aquifers is 703 mg/L.

Descriptive Statistics: TDS at Ash Impoundments with VNs

Variable	N	Mean	Median	TrMean	StDev	SE Mean
Crawford	12	9200	7200	8970	4907	1417
Joliet 2	6	2200	2400	2200	477	195
Powerton	20	1735.0	1750.0	1711.1	370.3	82.8
Waukegan	6	2200	2150	2200	620	253
Will Cou	16	2169	1500	1957	1280	320
Coffeen	15	1662.0	1700.0	1656.2	229.5	59.3
Grand To	1	1310.0	1310.0	1310.0	*	*
Newton	14	3409	2400	3393	1452	388
Baldwin	18	1472.0	1404.5	1456.8	231.4	54.5
Vermilio	3	1967	2000	1967	252	145
Kincaid	2	1400.0	1400.0	1400.0	70.7	50.0
Pearl	12	1925	1700	1900	545	157

Variable	Minimum	Maximum	Q1	Q3
Crawford	2700	16000	6100	14000
Joliet 2	1500	2600	1650	2600
Powerton	1300.0	2600.0	1400.0	1975.0
Waukegan	1500	3300	1725	2550
Will Cou	1300	6000	1325	2750
Coffeen	1300.0	2100.0	1600.0	1800.0
Grand To	1310.0	1310.0	*	*
Newton	1910	5100	2200	5000
Baldwin	1205.0	1983.0	1295.3	1665.3
Vermilio	1700	2200	1700	2200
Kincaid	1350.0	1450.0	*	*
Pearl	1300	2800	1525	2475

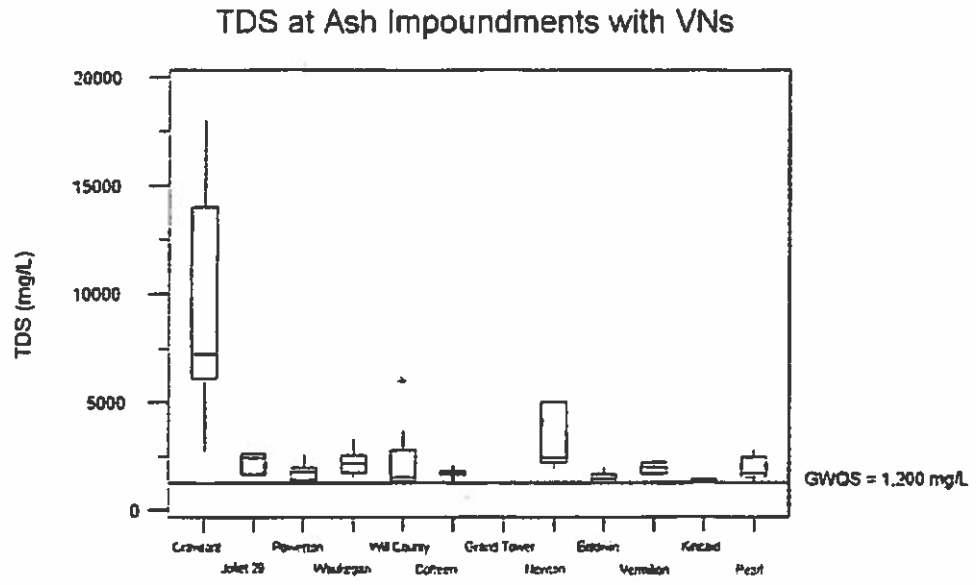

Figure 9. Total Dissolved Solids Concentrations at Power Plant Groundwater Monitoring Wells

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Comparison of Power Plant IOC Concentrations to Ambient Groundwater IOC Concentrations - Many of the unlined surface impoundment units containing CCW overlay the same aquifers from which the ambient network wells are drawing water. Comparison of the concentrations of SO_4, B, Mn and TDS from the ambient network (Tables 1 and 2) to the IOC results from the groundwater monitoring conducted at the power generating facilities, described and illustrated above, shows these IOC concentrations are an order of magnitude or more above ambient network groundwater quality results.

Applicability

These rules apply to units in operation after the effective date of these rules or that are causing groundwater contamination after the effective date of these rules. However, these rules are not proposed to apply to units already operated and regulated under a solid waste landfill permit issued by the Agency; operated pursuant to procedural requirements for a landfill exempt from permits under 35 Ill. Adm. Code 815; or that are subject to 35 Ill. Adm. Code 840.

These rules are not applicable to units used to store de minimus amounts of CCW for less than one year or leachate from CCW if there is at least two feet of material with permeability equal or superior to 1 $X10^{-7}$ centimeters per second lining the bottom of the unit. This low permeability layer impedes the migration of contaminants and reduces the threat of contaminating groundwater. Further, CCW or leachate from coal combustion waste that remains in the unit for no longer than one year also reduces the risk of exposure to recharge from precipitation and thereby also minimizes the threat of groundwater contamination. A CCW unit will be excluded only if the unit's maximum volume is no more than 25 cubic yards which is a small volume of CCW. The Agency also excludes units used to only collect stormwater runoff, which does not contain leachate, because this represents a low potential for groundwater contamination (i.e. de minimus conditions).

Definitions

The majority of the definitions in this proposed regulation have already been codified in the Act, Illinois Groundwater Protection Act (IGPA), and/or Board regulations. We based most of the definitions on those existing in current Board regulations. However, a few definitions warrant further discussion:

Compliance point – The Agency included a compliance point definition for CCW waste surface impoundments because Section 620.505(a)(2) specifies that compliance with the Board's standards for groundwater that underlies a potential primary or secondary source is to be determined at the outermost edge as described in Section 620.240(e)(1). Potential primary sources of contamination (415 ILCS 5/3.345) include units that surface impound special waste (includes pollution control waste [415 ILCS 5/3.335]) that is generated on-site, and CCW is a pollution control waste. Additionally, we also included in the definition of compliance point(s) compliance points for a GMZ, where chemical constituents attributable to a CCW surface impoundment have migrated to a delineated three dimensional region that already exceeds the groundwater quality standards set forth in Section 620.410 or Section 620.430, and a corrective action is applicable. Moreover, chemical constituent concentrations may exceed the standards in Section 620.410 within the boundary of a GMZ, but may be measured or modeled to threaten the preclusion of an existing or potential use of resource groundwater beyond the GMZ compliance point(s).

On-site, on the site, or on the same site means the same or geographically contiguous property which may be divided by public or private right-of-way, provided the entrance and exit between the properties is at a crossroads intersection and access is by crossing as opposed to going along the right-of-way. Noncontiguous properties owned by the same person but connected by a right-of-way which he controls and to which the public does not have access is also considered on-site property.

The provision means that if a person owns properties next to each other (contiguous) these properties are treated as being one property, for the purposes of regulatory applicability. If the two properties are separated by a public right-of-way (e.g. road), the two properties must be connected by driveways that are directly across the road from each other. This stipulation insures that the properties are truly contiguous. It is important for "on-site properties" to be close to each other because regulatory requirements are different for on-site properties than for off-site properties. For instance, on-site landfills are permit exempt, whereas off-site landfills are required to obtain a permit, with the associated reporting.

Leachate – The leachate definition we are proposing to include under this regulation is generated from the storage of coal combustion waste in a surface impoundment, and is not just stormwater

runoff that may have come into contact with fugitive ash. Precipitation moving through a larger quantity of CCW stored in a surface impoundment could produce a larger quantity of leachate and a higher concentration of contaminants that represent a threat to groundwater.

Unit – The reason why this definition was proposed was to specifically focus on surface impoundments containing CCW at a power generating facilities and not the definition of unit under the Illinois Environmental Protection Act at Section 3.515 applicable to a broader array of potential primary or potential secondary source of groundwater contamination definitions.

Groundwater Standards

This proposed rule adopts the Board's groundwater quality standards at 35 Ill Adm. Code 620. Like the IGPA, these proposed regulations prioritize groundwater based on their inherent differences. Section 8 of the IGPA [415 ILCS 55/8(b)(2)] required the Board to consider in the adoption of groundwater standards:

> Classification of groundwaters on an appropriate basis, such as their utility as a resource or susceptibility to contamination

Moreover, key terms such as *potable resource groundwater* and *resource groundwater* are used within the IGPA to distinguish between groundwaters with differing characteristics. Studies around the State have documented a variety of conditions including the existence of very pristine waters, heavily contaminated waters resulting from human activities, and waters whose quality is adversely affected by natural geologic conditions. Thus, the Agency has proposed, and the Board adopted, a resource based classification under 35 Ill. Adm. Code 620, as follows:

- Class I: Potable Resource Groundwater;
- Class II: General Resource Groundwater;
- Class III: Special Resource Groundwater; and
- Class IV: Other Groundwater.

The Agency's regulatory proposal sets priorities for corrective action, closure and preventive response activities differentially within these different classes of groundwater.

Further, another reason that these proposed regulations are tightly integrated with the Board's groundwater standards is because they apply to newly constructed CCW units where the

preventive response processes in 35 Ill. Adm. Code 620.310(c) may be applicable. Moreover, this proposal also includes older CCW units where a standard set forth in Section 620.410 or Section 620.430 is exceeded, and the appropriate remedy is corrective action under 35 Ill. Adm. Code 620.250. The Agency is proposing to include these processes in these rules because they are intended to apply for new and existing units containing CCW. A new unit should be properly engineered and designed to prevent contamination, but in the event that a release does occur the contamination level in a plume should be caught in the early stages of movement and at concentrations below the applicable numerical standards. Thus, the preventive response provisions of the Board's groundwater quality standards would be applicable to proactively address lower level contaminant concentrations in high value resource groundwater. However, these proposed regulations also apply to existing units that we already know have exceeded the numerical groundwater standards. The Board's standards are very specific in Section 620.302(c) that if a contaminant exceeds a standard in Section 620.410 (i.e. Class I groundwater) or 620.430 (i.e. Class III groundwater), that the appropriate remedy is corrective action and Sections 620.305 and 620.310 do not apply. The Agency proposed and the Board adopted this approach in 35 Ill. Adm. Code 620 due to the potential technically infeasible treatment of groundwater at higher concentrations.

Under Section 620.250, a GMZ can be established to mitigate impairment of the groundwater contaminants from CCW unit(s) after Agency approval of a corrective action process. Corrective actions can be phased in based on measures in place to protect off-site groundwater. For example, hydraulic containment could be implemented to protect off-site resource groundwater prior to closure of the unit. This allows for the phase-in of the closure of operating units, in a manner similar to those proposed in U.S. EPA regulations. The intent of the corrective action process under a GMZ is to make every effort to first improve groundwater quality to the applicable numerical standards. However, after every effort has been made to improve groundwater quality, but it has been determined that it is not technically and economically feasible to restore the groundwater quality to the numerical standards, Section 620.450 provides for alternative groundwater standards if the conditions in Subsection 620.450(a)(B) can be met. This is the point where the Agency will consider the appropriateness of alternative water supplies and restricted use ordinances.

Submission of Plans, Reports and Notifications

To provide for consistency, the proposed regulations require all reports, plans, modifications and notification be submitted to the Agency's Groundwater Section. Moreover, in order to better assure compliance on the same order as a permit application, all documents submitted to the Groundwater Section must contain the seal and signature of a professional engineer or where appropriate a professional geologist. This proposed regulation requires all plans and reports approved by the Agency to be maintained on site so that these materials would be available to our Field Operation Section staff for on-site inspections to help assure compliance.

Previous Investigations, Plans and Programs

Previous investigations, plans or programs already in place may be used to meet the requirements of this section, provided all components required in this section are included. If an existing investigation, plan or program is missing a component required under this proposed part, the existing investigations, plans and programs may need to be modified to include the required missing component.

Construction Quality Assurance (CQA) Program

The purpose of the proposed CQA Program is to assure that a qualified person [i.e. Construction Quality Assurance (CQA) officer] is monitoring the progress and quality of construction. The process provides an objective overview of project progress, and can help identify potential deficiencies or future problem areas during and after construction. A CQA Program can help an owner/operator complete a project in a more cost-effective manner by requiring compliance with Quality Control (QC) specifications before the project components proceed to the extent where substantial rework may have to be done in order to correct a defect. The CQA Program identifies the personnel involved in construction quality controls, their inter-relationships, and their responsibilities. The CQA Program establishes QC reporting requirements. Finally, the CQA Program requires that a compendium of test results, observations, and as-built plans be compiled into a Construction Certification Report, which is signed and sealed by a professional engineer and shows the construction was completed as designed.

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Public Notice – Section 841.165

The Agency believes that it is important to provide transparency to the public on the actions that are being undertaken at these facilities to mitigate and protect groundwater quality. This is the same principle that the Agency has used during the implementation of our Ash Impoundment Strategy detailed at the Agency's web page at: http://www.epa.state.il.us/water/ash-impoundment/index.html. Moreover, we think it is important to provide means for the public to provide input to the process of corrective action/closure of CCW units at these facilities. Therefore, this is why we are proposing a public notice process.

Subpart B – Monitoring

Hydrogeologic Site Characterization

The Agency proposes a hydrogeologic site characterization at all sites where proposed Part 841 is applicable. For new units, the Agency anticipates that the site characterization will be done prior to submission of the groundwater monitoring system and groundwater monitoring plan. This is needed in order to determine the nature and extent of stratigraphic horizons that are potential contamination migration pathways. The information from the characterization is also needed to determine depth to groundwater and direction of groundwater flow. Based upon the results of the hydrogeologic site characterization, appropriate locations for groundwater monitoring wells will then be chosen to represent background groundwater quality, groundwater quality at the compliance point(s), and compliance with the groundwater quality standards in 35 Ill. Adm. Code 620. However, for existing units, site characterization and monitoring systems/plans may have been conducted in a different order or simultaneously as part of the Agency's Ash Impoundment Strategy.

In addition, information from the hydrogeologic site characterization will be needed as part of a corrective action plan in proposed Section 841.310 or development of a closure plan in proposed Section 841.410. The information will be used in the development of groundwater modeling performed as part of an evaluation of alternatives.

Groundwater Monitoring System

A groundwater monitoring system is required for all units for which proposed Part 841 applies in order to identify and evaluate any violation of the groundwater quality standards in 35 Ill. Adm. CCodeCode 620 that may be attributable to the unit. At sites where there are multiple units to be monitored, one groundwater monitoring system may be proposed, provided the proposed Code 620 that may be attributable to the unit. At sites where there are multiple units to be monitored, one groundwater monitoring system may be proposed, provided the proposed monitoring system is capable of detecting and identifying contamination from all of the units. For example, if a site contains three units to be monitored, one groundwater monitoring system may be proposed as long as any contamination resulting from any of the three units will be identified by the monitoring system.

The standards for monitoring well design and construction are specified in order to ensure accurate and representative groundwater monitoring results and are similar to those listed in Ill. Adm. Code 811.318(d). Integrity of the boreholes, vented caps, and protective devices are needed to prevent potential outside sources of contamination from entering the monitoring well and skewing monitoring results. Well screen installation located at the appropriate specified depth interval allows groundwater monitoring results to be reflective of the potential contamination migration pathways identified in the hydrogeologic site characterization required by proposed Section 841.200.

The number and location of groundwater monitoring wells must be able to represent the quality of groundwater at the site that has not been affected by activities and unit(s), represent the quality of groundwater at the compliance point(s), and whether the groundwater is in compliance with the applicable groundwater quality standards in 35 Ill. Adm. Code 620. There may be multiple compliance points based upon the number and physical locations of units. If a GMZ is requested and approved by the Agency, there may be additional compliance points based upon the monitored or modeled extent of contamination in relation to the GMZ boundary.

Groundwater monitoring systems already in place at existing units may be used to meet the requirements of this proposed section, provided all components required in this section are included in the existing system. If an existing groundwater monitoring system is missing a

component required under this proposed section, the existing system may need to be modified to include the required missing component.

Groundwater Monitoring Plan

A groundwater monitoring plan must be developed to monitor and evaluate groundwater quality both on-site and as needed off-site to demonstrate compliance with the groundwater quality standards in 35 Ill. Adm. Code 620. This plan must include a description of the monitoring quality assurance program for sample collection, preservation, and analysis to ensure proper techniques and procedures are followed in order to produce quality data from the sampling events. A site map identifying all units, existing and proposed groundwater monitoring wells, including compliance points, all buildings and features of the site, and other information requested by the Agency must also be included as part of the plan for complete understanding of the geographic layout of the site during review of the plan and associated groundwater monitoring data by the Agency.

A description of the dates of operation of the unit(s), contents of the unit(s), including where available and to the extent practicable, the date when each unit began receiving CCW or leachate, changes in the coal source with dates and/or tons of material from each source, changes in the type of CCW or leachate with dates and/or tons of each material, and the date when the unit(s) stopped receiving coal combustion waste or leachate must be contained in the groundwater monitoring plan. The description should also include the total estimated volume of material in the unit(s) and a description of any type of engineered liner with the date of installation that may exist for the unit(s). While the Agency acknowledges that records of this information may be difficult to compile or may not exist, if records are in existence, this information would be important for complete understanding of the unit(s) and could be especially important for any modeling of groundwater impacts from the unit(s) and modeled predictions of expected extent of any groundwater plume emanating from the unit. Groundwater models generally require large amounts of input data. Site-specific background data collected and input into a groundwater model of the site will yield a more accurate representation and prediction of future conditions, as compared to input parameter estimates that might be used due to a lack of site specific data.

The monitoring plan should contain a description and results of all hydrogeologic site characterizations, including those developed pursuant to proposed Section 841.200, and plans, specifications and drawings for the groundwater monitoring system developed pursuant to proposed Section 841.205. A maintenance plan for the groundwater monitoring system is important to ensure continued collection of pertinent, accurate and relevant data. Deterioration of groundwater monitoring wells can cause collected data to inaccurately reflect existing groundwater quality. An explanation of the sample size, procedure, and the statistical method used to determine background, assessment monitoring and compliance monitoring as specified pursuant to proposed Section 841.225 must be included.

The Agency proposes sixty days for analysis and reporting of sample results. A sixty day schedule after sampling for reporting of results of the groundwater sampling analysis gives ample time for return of the analysis from the laboratory but allows prompt notification to the Agency of any changes in groundwater quality potentially related to the unit(s). A schedule of submission for the annual reports pursuant to proposed Section 841.235 allows some flexibility to the facility but also allows Agency tracking of expected submissions.

Only chemical samples must be analyzed by a certified laboratory using procedures for groundwater analysis set forth in the documents incorporated by reference in proposed Section 841.120. The procedures and methods in these documents detail the specific requirements for analysis in the laboratory of the different chemical constituents, along with proper sampling techniques for obtaining the sample from the monitoring well.

Any change to the groundwater monitoring plan must be approved by the Agency in order to ensure agreement with the proposed changes. Groundwater monitoring plans already in place at existing units may be used to meet the requirements of this section, provided all components required in this section are included in the existing plans. If an existing plan is missing a component required under this section, the existing plan may need to be modified to include the required missing component.

Chemical Constituents and Other Data to be Monitored

Chemical constituents to be monitored are all those listed in 35 Ill. Adm. Code 620.410 (a) and (e), with the exceptions of radium-226 and radium-228. The basis for the selection of chemical

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constituents to include for monitoring is that this list includes the constituents of which concentrations in groundwater could potentially be affected by the types of materials stored/deposited in these units. The exceptions of radium-226 and radium-228 result from the fact that there is low-risk of concentrations of these constituents being affected by the unit(s), and testing and analysis requirements for these two constituents is more burdensome. Further, research conducted by the United States Geological Survey (USGS, October 1997) indicates radium and radioactive elements in coal ash are not found elevated above concentrations that occur naturally in the environment, and are not found at levels above health concern. Therefore, due to the low risk and increased burden for analysis, the Agency proposes excluding these constituents from testing. The addition of specific conductance, groundwater elevation and monitoring well depth provides information which is helpful during review of associated groundwater monitoring data. For instance, groundwater elevation and monitoring well depth are used for the determination and evaluation of groundwater flow direction in monitored aquifer units.

An existing groundwater monitoring plan for a unit must include at a minimum the monitoring of the chemical constituents listed in this section in order to satisfy the groundwater monitoring requirements of this part. If any of the listed chemical constituents is missing from the monitoring plan, a modification to the existing groundwater monitoring plan would be required.

Determining Background Values

Owners or operators will be required to determine the background concentration of the chemical constituents for which monitoring is required, at all regulated units. In this proposed rule, the term "background" is applied broadly. Background refers to the concentration of chemical constituents migrating through groundwater towards a regulated unit (up gradient), whether they are of natural or anthropogenic origin. Background also refers to the existing concentration of chemical constituents migrating in groundwater away from a regulated unit (down gradient). Both sets of data must be measured and analyzed to properly apply groundwater quality standards. Therefore, the term background is applied in a general fashion, while the specific circumstances of a chemical's occurrence dictates how groundwater quality standards are applied. The Unified Guidance (U.S. EPA, March 2009) incorporated by reference in Section 841.120, recommends for RCRA sites that no fewer than four samples be used for establishing

background. Since proposed Section 841.130 provides one year after the rules become effective to establish background, the number and frequency of the samples that must be collected in that year may vary from site to site depending on the statistical method(s) being used to establish background concentrations and the amount of existing data currently available for use. The Guidance anticipates that background groundwater quality may occasionally be updated due to natural variations in groundwater quality that may become apparent after additional data is collected. The Guidance does not provide a specific guideline for the frequency of updates, but generally provides that there should be enough new data to be statistically validated against existing background. Depending on the statistical method being used and the amount of data already available, the Guidance recommends a frequency on the order of 1-3 years. The Agency is proposing to require owners or operators to recalculate background chemical concentrations at least every five years to assure that the concentrations in use reflect, as nearly as possible, background groundwater quality.

Statistical Methods

The fundamental goals of the groundwater monitoring requirements under this proposed regulation is fairly straightforward. The owner or operator of an electrical coal-fired power generating facility is to accurately characterize existing groundwater quality at their CCW unit(s), assess whether a chemical constituent release has occurred and is attributable to a CCW impoundment, and if so, make a determination about whether measured levels meet the groundwater quality standards in 35 Ill. Adm. Code 620. Numerical resource groundwater standards of Class I, II, III apply except due to natural causes. Naturally occurring concentrations of groundwater exist above or below the numerical criteria. Thus, the naturally occurring concentration of a chemical constituent is the applicable groundwater standard. If this naturally occurring level is below the numerical criteria then this is the naturally occurring base line from which a statistically significant increase is occurring. This is the process for determining if a preclusion of a use is being threatened or additional treatment will be needed for chemical constituents beyond their naturally occurring concentrations, and is also the basis for a preventive response. If the naturally occurring level of a chemical constituent(s) in resource groundwater is above the numerical criteria in Part 620, then this level or concentration (mg/L) is the applicable numerical groundwater standard, and is the basis for determining if a corrective

action will be needed for chemical constituents. Therefore, the Agency is proposing to use accepted statistical methods for the evaluation of groundwater quality because it will have a high probability of leading to correct decisions about a facility's regulatory status.

The last century saw the rise of statistics and its fundamental theory of *estimation* and *hypothesis testing*. All of the tests described in the Unified Guidance, are based upon this theory and involve the same key concepts. The Unified Guidance presents a range of *detection monitoring* statistical procedures. Considering a case where the standard deviation of a population is unknown and an estimated standard deviation is obtained from a sample, it must first be determined what the effect of that estimated standard deviation is. First, in the Unified Guidance there is a discussion of the Student's *t*-test[4] and its non-parametric counterpart, the Wilcoxon rank sum test, when comparing two groups of data (*e.g.*, background versus one down gradient well). This part of the Unified Guidance also defines both parametric and non-parametric prediction limits, and their application to groundwater analysis when multiple comparisons are involved. A variety of prediction limit possibilities are presented to cover likely interpretations of sampling and testing requirements.

Substantial detailed guidance is offered for using prediction limits with retesting procedures, and How various retesting algorithms might be constructed. The final chapter of the detection monitoring portion of the Unified Guidance considers another statistical method especially useful for *intrawell*[5] comparisons, namely the Shewhart-CUSUM control chart.

The Guidance is also contains statistical methods recommended for *compliance* or *assessment monitoring* and *corrective action*. Compliance monitoring typically involves a comparison of downgradient well data to a groundwater protection standard [GWPS], which may be a limit derived from background (i.e. naturally occurring and anthropogenic) or a fixed concentration limit (such as the numerical standards in 35 Ill. Adm. Code 620). The key statistical procedure is the confidence interval, and several confidence interval tests (mean, median, or upper percentile)

[4] "Student's t-test" means a test for determining whether or not an observed sample mean differs significantly from a hypothetical normal population mean. This problem was first studied by W. S. Gosset, a statistician at the Guinness' Brewery in Dublin who wrote under the pseudonym *Student* (Adler, H.L. and E.B. Roessler, 1964).

[5] "Intrawell" means comparisons over time at a given monitoring well between early and later measurements.

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may be appropriate for compliance evaluation depending on the circumstances. The statistical procedure chosen to use depends on the distribution of the data, frequency of nondetects, the type of standard being compared, and whether or not the data exhibits a significant trend. Strategies for corrective action differ from those appropriate for compliance monitoring primarily because statistical hypotheses are changed, although the same basic statistical methods may be employed.

The Agency specified the use of the Unified Guidance for several reasons. First, the Unified Guidance has been through a formalized review process by USEPA. Second, the Unified Guidance is applicable for compliance and assessment monitoring at RCRA Subtitle C and D facilities. Third, the Unified Guidance is publicly available on the USEPA website. Fourth, the Unified Guidance contains a number of reasonable and current statistical methods with broad applicability to groundwater analysis.

Statistical methods are used to assess groundwater quality because many of the chemical constituents for which monitoring is required commonly occur in nature. Groundwater quality naturally varies with time and with location, due to interactions with variable geologic materials, precipitation cycles and biological activity. The same chemical constituents may also be introduced into the environment from anthropogenic sources, but arise from a source other than one of the regulated units. Therefore, to assess changes or trends in chemical constituent concentrations and whether those changes or trends are attributable to the regulated units, statistical methods must be employed. Ideally, to assess groundwater quality and whether or not a regulated unit has had an effect on the groundwater, thousands of sampling points would be used to collect samples over a very long time period. That would give a complete picture of the entire range of groundwater quality (the population), but this is not practical. By using statistical methods a much smaller sampling of groundwater quality can be taken, and the full range of groundwater quality can be estimated. However, when using these estimation techniques (statistical methods) certain assumptions are made about the data being tested. For instance, it must be assumed that the samples are independent of each other. Many tests assume that the data is normally distributed, also known as parametric data (i.e. when graphed the data fits the shape of a bell curve) or can be mathematically manipulated, such as using the logarithm of the values, to be made parametric. Sometimes data is not parametric and cannot be mathematically

manipulated to make it become parametric. Under these conditions non-parametric tests are used. The formulas for the calculations are different, but tolerance limits and confidence limits can be determined with either parametric or non-parametric data.

Since groundwater quality and groundwater monitoring programs at each site are expected to vary, no single statistical method is likely to be appropriate for determining compliance with groundwater quality standards at all units at a site. In addition to these factors, the stage in its life-cycle that a unit is in (e.g. active or in closure) and the time since the unit's compliance period began, may dictate that certain statistical tests are more appropriate than others. Most of the units regulated under the proposed rule have been operating for many years or may no longer be active since they are at the end their operational life. However, the proposed rule will also regulate any new units which are permitted. Also the concentration or range of concentrations of a chemical constituent, and whether that concentration is significantly different up gradient and down gradient of a unit may require the use of multiple statistical methods for analysis. The type of statistical test that is appropriate may also vary by constituent. Chemical constituents that occur at relatively higher concentrations, and are therefore usually above the reported limit can be handled differently from those that are frequently below the limit of detection. If chemical constituents are above the level of detection, the data can usually be manipulated such that a parametric statistical test can be used. However, when non-detects make up a significant portion of the dataset, non-parametric tests are appropriate. These circumstances would limit the types of statistical tests that can be used. For instance Control Charts require parametric data, and could not be used if the data is non-parametric.

The Unified Guidance establishes performance standards for other statistical methods not included in the Unified Guidance. These performance standards establish minimum criteria that other statistical procedures must meet. Though the Unified Guidance provides an array of statistical tools to analyze groundwater quality, it does not include all methods currently in existence nor can it possibly contain methods as yet undeveloped. Therefore, the Agency does not prohibit the use of other statistical methods, if the owner or operator can demonstrate to the Agency that the statistical method is applicable to site conditions. While the Unified Guidance will meet the specified performance standards, the performance standards enumerated in the rule establish minimum criteria a statistical method must meet if it is not included in the Unified

Guidance. Since statistical methods use chemical constituent concentrations, and reported chemical constituent concentrations are controlled by laboratory analytical limitations, the rule specifies that the practical quantitation limit (PQL) must be approved by the Agency, but must also be protective of human health and the environment. The PQL of the analytical method used to analyze samples to determine background and compliance with the groundwater quality standards must be protective of human health and the environment. To be protective, the PQL must, at a minimum, be equal to or less than the numerical groundwater quality standard. The PQL should be significantly less than the numeric groundwater standard (e.g. one order of magnitude less) of a chemical constituent to allow the application of the non-degradation provisions of 35 IAC 620, Subpart C.

Sampling Frequency

The selected statistical method will govern the number of samples required to determine background groundwater quality conditions and the time frame during which those samples must be collected. Therefore, the amount of applicable existing data and the number of required samples will combine to dictate the initial sampling frequency at the beginning of the compliance period, under the proposed rule. The lowest frequency for monitoring will be semiannually. The Agency believes a semiannual monitoring schedule will be protective of human health and the environment provided that the selected statistical method allows a semi-annual sampling frequency and there will not be a loss of relevant data. To insure that relevant data is not lost, quarterly monitoring is required under the following circumstances:

A chemical constituent exceeds the numerical groundwater standard, except due to natural causes. Quarterly monitoring is required when a numerical groundwater standard is exceeded to better assess chemical constituent concentrations in groundwater that will require a corrective action or closure;

A statistically significant increasing concentration of a chemical constituent, caused by the unit, is detected in a down gradient well. Quarterly monitoring is required to more closely monitor groundwater quality conditions that will result in a preventive response designed to prevent the exceedence of a numerical groundwater standard; or

The concentration of a chemical constituent in a down gradient well differs to a statistically significant degree from the concentration detected in an up gradient well. Quarterly monitoring is required in this instance to assess chemical constituent concentrations in groundwater that may require a corrective action or closure. This circumstance is specific to units at which natural or anthropogenic activities up gradient of a unit exceed a numeric groundwater standard, but additional contribution from the subject unit is being assessed.

Only the chemical constituents that meet one of these three criteria must be sampled quarterly. The remaining chemical constituents may be sampled on a semiannual basis or as otherwise required by the chosen statistical method. If the conditions requiring quarterly monitoring are mitigated, shown to be transient in nature or the subject unit is not the source of the exceedence, the sampling frequency may be reduced to semiannually. Any reduction of sampling frequency must be approved by the Agency. Groundwater monitoring is required to continue at least semiannually until the end of the post-closure care period to insure that applicable groundwater quality standards are met.

Annual Statistical Analysis

All owners or operators of units regulated by this Part must submit an annual report using the statistical method(s) selected to analyze the chemical constituents for which samples are collected. The annual report should include the background determination. The annual report will assess water quality down gradient of regulated units to evaluate compliance with groundwater standards. The concentration of chemical constituents in up gradient wells will also be necessary for comparison to down gradient groundwater quality.

If concentrations of chemical constituents exceed numerical groundwater standards and that exceedence is attributable to a unit, the annual report and statistical analysis for those chemical constituents will be used to assure that the actions required by the approved corrective action plan or closure plan are effective. The schedule for completing the annual statistical analysis will be adjusted to meet the requirements of the corrective action plan or closure plan to prevent unneeded or duplicative efforts. The statistical method used to determine the effectiveness of a corrective action or preventive response is likely to be different than the method used to alert the

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Agency that a change in groundwater quality has occurred. This is because the test will no longer evaluate if a compliance well has deviated from the background population of groundwater quality, but instead the search will be for a statistically significant change (decreasing chemical constituent concentration) within the population of the groundwater quality data from the specific compliance well.

The annual report will also provide a statistical analysis of chemical constituents that do not exceed numerical groundwater quality standards and chemical constituents that exceed numerical groundwater quality standards when an exceedence of numerical groundwater standards also occurs in the up gradient monitoring wells. Such analyses allow each chemical constituent in groundwater to be assessed relative to the non-degradation provisions of 35 Ill. Adm. Code 620 Subpart C. The statistical analysis also allows the Agency to assess groundwater quality in situations where anthropogenic sources of contamination, not associated with the units regulated by this Part, exist. As discussed in the proposed Statistical Methods (Section 841.225), those chemical constituents that naturally occur at low concentrations will probably be assessed with different statistical methods than the chemical constituents typically found in higher concentration or with common anthropogenic sources. Similarly, the Agency can determine that existing groundwater conditions in Class IV groundwater are being maintained, with no statistically significant additional concentrations of chemical constituents being added to the groundwater by a regulated unit. This analysis will take place even though some chemical constituents may exist at rather elevated concentrations, particularly in previously mined areas.

When dealing with chemical concentrations that do not exceed numerical groundwater standards, the first step is to determine if a noted increase is statistically significant. If the increase is not statistically significant, the increase must be assumed to represent random variability in groundwater quality and not an impact from a unit. If the increase is statistically significant the owner or operator must monitor quarterly for any chemical constituent with a statistically significant increasing concentration. A statistically significant increase in chemical concentration is the trigger to initiate preventive response under 35 Ill. Adm. Code 620; Subpart C. Quarterly monitoring provides additional data with which to do statistical analysis. Quarterly monitoring will help to determine if the statistically significant increase has a seasonal component. If the increase is statistically significant and no source other than a regulated unit is

identified, additional investigation must be completed if the groundwater at the site is identified as Class I or Class III. Part of that assessment must determine if the statistically significant increase causes, threatens or allows contamination to the extent that treatment or additional treatment is required to maintain a use or potential use of the groundwater. The assessment must also determine if an existing use or potential use is precluded by the concentrations of chemical constituents. Because Class I and Class III groundwater make up the most valuable groundwater resources in the State, additional protection is afforded to them. Protective actions are required prior to the concentration of a chemical constituent reaching a numerical standard. This proposed Part reflects the requirements of the non-degradation provisions of 35 Ill. Adm. Code 620 by requiring a preventive response for Class I groundwater as specified in 620.302(a)(1) and Class III groundwater as specified in 620.302(a)(2). These particular categories of groundwater are specified because they represent the most abundant and useful groundwater resources.

A preventive response to mitigate chemical constituent concentrations that are less than numerical standards can employ the same measures (e.g. hydraulic control of groundwater) as a corrective action. The primary difference is that the measures are being taken to prevent the increase in concentration of a chemical constituent from reaching the level of the numerical standard. The owner or operator must submit a preventive response plan for Agency review and approval within 180 days of the annual statistical analysis if there is a statistically significant increase in chemical constituent concentration. Since a preventive response plan may be as detailed as a corrective action plan, a significant amount of time may be required to develop the plan, but the time allowed is limited to insure that prompt actions are taken to prevent an exceedence of a numerical groundwater standard. Should the actions taken by the owner or operator not stop the increase in chemical constituent concentration within two years, additional investigation is required, since some cause or source of contamination must not have been adequately characterized during previous investigations. Two years is not excessive since the actions being taken are in response to statistically significant increasing concentrations of chemical constituents that do not exceed their respective numerical groundwater standards. None the less, the increasing trends must be addressed to preserve use and potential use of the groundwater resource without additional treatment being required. If the preventive response does not successfully mitigate the increasing concentrations and a numerical standard is

exceeded due to operation of a regulated unit, the owner or operator may become subject to a notice of violation that could result in penalties and a corrective action process or closure of the unit.

Inspections

Weekly inspections and inspections after each storm must be conducted during operation of a unit. Storm events can cause, threaten, or allow violations of the Act and Board regulations. The inspections during operation are required as the Agency believes, even if the unit is not currently receiving ash, there is an on-going potential threat of failure which would not be mitigated until closure. "Storm" used in this Part refers to a maximum 24-hour precipitation event with a probable recurrence interval of once in 25 years. The Agency proposes the "25-year" storm as opposed to, for instance, a "10-year" storm, as inspections are already occurring weekly. An inspection after a more frequent but less severe "10-year" storm does not add much benefit to the weekly inspections already occurring. Therefore, the "25-year" storm is more appropriate.

The purpose of inspections is to visually assess whether CCW units may cause or threaten a violation of Board rule or the Act. This is a different purpose than the Department of Natural Resources dam safety program. Early intervention resulting from weekly inspections may prevent groundwater and surface water pollution.

During the inspections, the owner or operator should look for evidence of deterioration, malfunctions or improper operation of overtopping control systems, sudden drops in the level of the contents, severe erosion or other signs of deterioration in dikes or containment devices, or a visible leak. A report of the results of each inspection, along with any resulting repairs, must be prepared. Any visual identification of these types of problems could be evidence of a failure, visible or invisible, of the unit containment.

When the results of an inspection show that the level of liquids in the unit has suddenly and unexpectedly dropped and the drop is not caused by changes in influent or effluent flows, the Agency must be notified. Upon notification, if the owner or operator cannot provide a reasonable explanation other than a failure for the sudden drop, the Agency may conduct an inspection of the unit and/or take further actions to work with the owner to solve the problem.

The ultimate goal of these inspections is to prevent or end any release from the unit that may result in a violation of the groundwater quality standards. The Agency believes it is important to try to identify problems with active units which may lead to groundwater standards violations and prevent or minimize such problems before they have the opportunity to become larger problems or lead to catastrophic failure of the unit(s).

Subpart C: Corrective Action

Confirmation Sampling

When monitoring results report exceedences of numeric standards of chemical constituent concentrations, confirmation sampling is required. Confirmation sampling is required to demonstrate that the chemical constituent of concern did occur above the particular threshold against which it is being measured. The chance occurrence of two consecutive samples indicating an exceedence is small, unless the chemical constituent exists at the indicated concentration. The statistical methods required to be employed by owners or operators with units regulated in proposed Section 841.225 may result in false positive detections (e.g. exceedence of the statistically calculated background when no exceedence actually exists) at a rate of no less than 0.01 (1 percent) or 0.05 (5 percent), depending upon the type of comparison being done. Confirmation that the chemical constituent is occurring at the reported concentration within 30 days allows the Agency and the owner or operator to focus resources quickly where they will provide the greatest environmental benefit. Upon confirmation, the owner or operator must notify the Agency within 30 days of the chemical constituent(s) that exceed the numeric standard and the location(s) where the exceedences occurred. The notification is required because the owner or operator will have to take one of three actions. Demonstrate an alternative cause pursuant to proposed Section 841.305, submit a corrective action plan pursuant to proposed Section 841.310 to remediate groundwater quality or submit a closure plan pursuant to proposed Section 841.410 to mitigate groundwater quality. The notification sent to the Agency by the owner or operator must contain the chemical constituent(s) with exceedences. These chemical constituent(s) could then be listed for relief in a GMZ, if one is adopted as part of an approved corrective action or closure. The report also includes the location(s) where the exceedences took place. This information would indicate which unit(s) is the probable source of the contamination and in need of remedial activities or closure to protect groundwater quality.

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Alternative Cause Demonstration

The Agency acknowledges that there may be instances where a confirmed exceedence of a groundwater quality standard at a compliance point is not attributable to the unit(s). With this in mind, an owner or operator may demonstrate that a confirmed exceedence of a groundwater quality standard at a compliance point is not attributable to a release from a unit due to a sampling, analysis, or evaluation error, a natural cause, or a source other than the unit. For example, a groundwater quality standard exceedence at a compliance point on-site could be shown with an analysis of additional data collection or groundwater modeling to be due to a plume of contaminated groundwater emanating from a neighboring site. Or additional analysis could show, for example, an exceedence in the concentration of chloride is due to nearby road salting in the winter months. The information provided in the hydrogeologic site characterization in proposed Section 841.200 and in the groundwater monitoring plan in proposed Section 841.210 is beneficial and necessary in the analysis and in any modeling done as part of the alternative cause demonstration as it provides a more complete picture of existing conditions at the site that may be affecting groundwater quality at the compliance point(s).

Due to the complexity of the information included as part of an alternative cause demonstration, the Agency allows 180 days after the date of the submission of the confirmation sample for submission of the alternative cause demonstration. The Agency would then review the submitted information provided as part of the demonstration and give either written concurrence or non-concurrence within ninety days. If an owner or operator receives a written response of non-concurrence, they would then have 35 days to appeal the decision to the Illinois Pollution Control Board or 90 days to submit either a corrective action plan or a closure plan. The 90 day timeframe to submit either a corrective action or a closure plan, if not appealing the decision, seems a fair compromise between giving the facility time to conduct the alternative cause demonstration (180 days) and, if the Agency disagrees with the demonstration, starting the facility on the path to solving any groundwater contamination problem identified. The Agency believes this process allows ample opportunity for the owner or operator to provide information regarding any possible alternative causes of groundwater quality exceedences and also opportunity to voice disagreement to Agency determinations regarding alternative cause demonstrations.

Corrective Action Plan

Where verification of an exceedence of a numeric groundwater quality standard is attributable to the Unit, and the owner or operator would like to continue to operate the unit, the proposed Section 841.310 Corrective Action Plan, requires the owner or operator to mitigate impacts to groundwater and to address impacts to potable wells. In addition to being used to facilitate settlement of ash, the impoundment units are utilized to treat additional power plant waste water streams. When a unit is taken out of service the owner or operator must have a means of treating the other waste water streams which the unit was receiving. This need to treat other waste water streams has been taken in to account in this section. This section requires the owner or operator to submit a corrective action plan to the Agency within a specified period of time after sample results are confirmed. The purpose of this proposed part is to assure that potable well users continue to have a viable source of water and to mitigate numeric exceedences of groundwater quality standards with a corrective action plan approved by the Agency. Upon approval of the corrective action plan, the owner or operator will implement the plan on a schedule approved by the Agency. Corrective action plans are designed to control the migration of contaminated groundwater using pumping wells or collection trenches to capture the impacted groundwater (U.S. EPA, July 1996, Gorelick et.al., 1993, and Russell, 2012). These devices remove contaminated groundwater from the aquifer. The effects of the corrective actions taken will be assessed by monitoring the groundwater quality at a site to determine when groundwater quality standards are met and corrective action may cease. Proposed Section 841.315 Groundwater Collection System, describes the processes for obtaining Agency approval for installation of groundwater collection systems and approval of discontinuing their use once compliance with applicable groundwater quality standard has been achieved. In cases where groundwater collection systems are required, due to off-site or potential off-site groundwater contamination and the technical and economic difficulties with removing dissolved contaminants such as TDS from groundwater[6], the water collected by these systems will need to be discharged. Proposed Section 841.320 Groundwater Discharge System requires that these discharges be properly permitted.

[6] Reverse osmosis treatment technologies would be required to remove such contaminants (Nyer, Evan K., 1992).

The purpose of the proposed Section 841.325 Corrective Action Report and Certification is to define how the owner or operator and a registered professional engineer will certify that the obligations agreed to under their approved corrective action plan proposed under Section 841.310 have been fulfilled.

Subpart D: Closure

Surface Impoundment Closure

Each unit will at some time be taken out of service and closed. This process may be completed with ash left in place or after ash has been removed. In many cases, the units provide wastewater treatment in addition to ash handling. The purpose of the closure provisions of the proposed rules is to ensure that the units are closed in a manner which minimizes impacts to the environment including groundwater, surface water and air. There are many options for addressing materials remaining in the units. In some cases recovering useable materials from the units may be possible. Recovering useable materials is highly dependent on local market conditions. When ash is left in place, this material will need to be stabilized in order to construct a final cover system. The final cover system will be designed to minimize the impacts to groundwater. This will be accomplished by covering the ash with a low permeability soil or synthetic cap material which will then be covered with a protective soil layer and re-vegetated (Hauser, 2009 and Russell, 2012).

The purpose of the closure process is to tie together the assessment work done to identify groundwater issues and the corrective actions designed to address the identified problems. During closure, construction of the components of the corrective action and the final cover of the unit takes place. The post closure period begins when the construction of these components has been completed. Finally, the post closure report and certification is produced to document completion of closure and post closure requirements.

Closure Prioritization

The Agency has progressed with implementing its Ash Impoundment Strategy; the 24 facilities with approximately 83 impoundments have conducted hydrogeologic investigations, installed new or supplemented their existing groundwater monitoring networks, and assessed groundwater

quality. Initial groundwater monitoring and evaluation of potential off-site threats has been completed for all facilities. Prioritization of the work to be completed at these impoundments is necessary due to the large number of existing impoundments. The Agency anticipates that significant capital resources will be required to address issues at these impoundments.

The proposed Section 841.405 Closure Prioritization requires the impoundments which are impacting groundwater to be divided in to four categories. The length of time required to close a unit once impacts have been confirmed varies with each category. Category 1 impoundments have 180 days to submit a closure plan to the Agency and two years after receiving the Agency's approval of the plan to complete the closure. This is the shortest duration of the closure time frames due to the impact to water users near the impoundment. Category 2 applies to inactive units. These units have 180 days to submit a closure plan to the Agency and five years after receiving Agency approval to complete closure. Category 3 units have two years to submit a closure plan to the Agency and five years after receiving the agency's approval of the plan to complete the closure. More time is provided for Category 3 units because closure of these active units will affect the daily operations of the power plant and additional time is needed to design replacement water treatment/ash impoundment units. Category 4 units are located in Class IV groundwater areas (e.g., where coal mining has previously taken place and has adversely impacted groundwater quality). Category 4 units have three years to submit a closure plan to the Agency and 6 years after receiving the agency's approval to complete the closure.

The Agency's strives to protect the rights of individuals using groundwater resources near ash impoundments. Category 1 applies where an existing potable water supply well is impacted by a release attributable to the unit. The owner or operator must replace the water supply with a supply of equal or better quality and quantity within 30 days of notice that such impact has occurred. Presently there are no units in this category.

Unless Category 1 or 4 apply, category 2 applies where the unit is inactive. A unit is inactive if it has not received coal combustion waste or leachate from coal combustion waste within the most recent period of eighteen months. If the unit is inactive, a closure plan must be submitted to the Agency within 180 days of confirmation of an exceedence of a numeric groundwater quality standard. The unit must be closed within five years of the Agency's approval of the closure plan, unless the Agency approves a longer timeline.

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Unless Category 1 or 4 apply, category 3 applies where the unit is active. A unit is active if it has received coal combustion waste or leachate from coal combustion waste within the most recent period of eighteen months. If the unit is active, a closure plan must be submitted to the Agency within 2 years of confirmation of an exceedence of a numeric groundwater quality standard. The unit shall be closed within five years of the Agency's approval of the closure plan, unless the Agency approves a longer timeline.

Unless Category 1 applies, Category 4 applies where the unit is located on a site that has been characterized as Class IV groundwater beyond a lateral distance of 25 feet from the edge of the unit. If the unit is located in a Class IV groundwater area, a closure plan must be submitted to the Agency within three years of confirmation of an exceedence of the applicable groundwater quality standard. The unit shall be closed within six years of the Agency's approval of the closure plan, unless the Agency approves a longer timeline. Presently there is one facility in this category.

Closure Plan

The purpose of the Closure Plan requirement contained in proposed Section 841.410 is to provide the details of plans for addressing impacts to groundwater caused by a unit. Prior to closing a unit the owner or operator is required to submit a closure plan which will document the plans, specifications and drawings, and the description of the CQA Program for the closure of the unit. The plans would include details of the groundwater monitoring, groundwater mitigation measures, final cover, groundwater management zone, and a proposed schedule for completing the work. Due to the wide variety of site conditions encountered at these units, the Agency has provided the owner or operator flexibility to utilize earth materials as well as synthetics for low permeability covers and will consider emerging technologies for final cover systems (Hauser, 2009). There are synthetic products on the market which are being proposed for use as final cover options. Some of these products are similar to astroturf (Hauser, 2009). Before a unit may be closed, the owner or operator must submit a closure plan to the Agency for review and approval. The closure plan must be signed by the professional engineer supervising the preparation of the closure plan.

Final Slope and Stabilization - The purpose of the proposed Final Slope and Stabilization Section 841.415, is to maintain the integrity of the impoundments relative to earth quake hazards and to make sure the closed impoundments are properly drained. While the stability of the impounding structure is regulated by DNR Office of Water Resources, this proposed section applies to the cover on the impoundment, which has the potential for slope failure if the sides of the cover are too steep. This proposed section will also apply to new units that may be built in the future.

Final Cover System - The proposed Section 841.420 Final Cover System details the placement of a permanent cover on a unit. The purpose of the Final Cover System is to minimize the migrations of liquids through the closed impoundment, promote drainage, and minimize erosion of the cover. Before the final cover can be placed on a unit the unit needs to be graded to establish foundation materials for the cover and to optimize drainage (Hauser, 2009)

Closure Report and Certification- Within 90 days after the completion of construction of the required elements found in proposed Section 841.415 Final Slope and Stabilization, Section 841.420 Final Cover System, and Section 841.425 Closure Plan the owner or operator of the unit must prepare and submit to the Agency a closure report and a closure certification for review and approval, which documents the completion of the work required in these sections.

The closure certification must be made on forms prescribed by the Agency and must contain a certification by a professional engineer that the unit has been closed in accordance with the approved closure plan required by proposed Section 841.410. Corrective action, closure and post-closure activities will not be deemed complete until the reports are approved by the Agency. The certification must be signed by the owner or operator and by the certifying registered professional engineer.

Post-Closure Care Plan

Proposed Section 841.435 requires the owner or operator of the unit to prepare and submit to the Agency a post-closure care plan for review and approval at the same time it submits the closure plan pursuant to proposed Section 841.410 of this Part. These two plans are submitted simultaneously because if the cover system is not properly maintained it will not perform as designed. The post closure care plan specifies the duties of the owner or operator to properly

maintain the integrity of the final cover system and any other corrective actions taking place at the site once the final cover is in place. The plan includes the post-closure care activities required by proposed Section 841.430, a description of the operation and maintenance that will be required for the groundwater collection and discharge systems if applicable and the information and documents required in the closure plan pursuant to proposed Section 841.410 of this Part. The post-closure care activities include inspecting the cover system and repairing any eroded or degraded areas[7] as well as maintaining pumps required for groundwater collection systems. The plan requires the signature and seal of the professional engineer supervising the preparation of the post-closure care plan (Hauser, 2009 and Russell, 2012).

Post-closure care continues until compliance with the groundwater quality standards set forth in 35 Ill. Adm. Code 620 or in a GMZ established pursuant to 35 Ill. Adm. Code 620.250 is achieved. At a minimum post-closure care must continue for ten years from the Agency's approval of the closure report.

The owner or operator of the unit must prepare and submit to the Agency for review and approval a post-closure report and post-closure certification within 90 days after satisfying the requirements of the approved post-closure care plan and achieving the applicable groundwater quality standards. A professional engineer or professional geologist may supervise post-closure care activities as appropriate under the Professional Engineering Practice Act [225 ILCS 325] or the Professional Geologist Licensing Act [225 ILCS 745].

The post-closure report also must contain documentation demonstrating compliance with the applicable groundwater quality standards, any photographs relied upon to document construction activities, including but not limited to, photographs of the final cover system and groundwater collection system, if applicable, a written summary of post-closure care requirements and activities as set forth in the post-closure care plan and their completion, and any other

[7] When a final cover system is used to close the unit, the owner or operator of the unit must maintain the surface of the cover system beginning immediately after construction until approval of the post-closure report by the Agency. The final cover system must effectively protect the low permeability cover beneath it. The purpose of proposed Section 841.430 is to establish the requirements for maintaining the cover on the unit. During this period the owner or operator of the unit must conduct inspections of the cover system quarterly and maintain the integrity of the cover system.

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information relied upon by the professional engineer or professional geologist, as appropriate for the activity, in making the post-closure care certifications.

The signature and seal of the professional engineer or professional geologist supervising the implementation of the post-closure care plan and the signature and seal of the professional engineer supervising preparation of the post-closure report are required.

The post-closure certification will be made on forms prescribed by the Agency and must contain a certification by a professional engineer that the post-closure care for the unit was performed in accordance with the specifications in the proposed Section 841.435, Post Closure Care Plan, and the requirements set forth in this Part. The certification must be signed by the owner or operator and by the certifying registered professional engineer.

Closure and Post-Closure Annual Reporting

Proposed Section 841.445 requires the owner or operator of the unit to file an annual report with the Agency no later than January 31 of each year during the closure of the unit and for the entire post-closure care period. The purpose of this reporting is to verify that the obligations of the owner or operator specified in the Closure and Post-Closure Care plans are being fulfilled. Once the requirements of proposed Section 841.440 have been met, annual reports are no longer required.

All annual reports must contain the annual statistical analyses required by Section 841.235 of all groundwater monitoring data generated by the groundwater monitoring program required by Section 841.210, a copy of any notice submitted to the Agency pursuant to Section 841.235(c)(1), a discussion of any statistically significant increasing concentrations and actions taken to mitigate such increases in accordance with Section 841.235(c)(3), and the completed closure or post-closure activities performed during the preceding year.

Resource Conservation and Recovery Act

Proposed section 841.450 addresses the provisions of the federal Resource Conservation and Recovery Act of 1976 (P.L. 94-580) (RCRA), as amended, or regulations adopted under that Act. If any rules adopted under Part 841 are less stringent than or inconsistent with any portion of RCRA applicable to the closure of a unit, RCRA will apply.

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Subpart E: Agency Review Procedures

Plan Review, Approval, and Modification

Any plan prepared and submitted to the Agency pursuant to Part 841, and any modifications to those plans, will be reviewed and approved by the Agency prior to implementation. The purpose of this Section is to specify the procedures for submission of plans, reports and modifications. and to lay out a time frame and procedures for review of these submissions by the Agency. Any plan required by this Part and any modifications to approved plans must be submitted to the Agency for review and approval prior to implementation. The Agency will have 90 days from the receipt of a plan or proposed modification to conduct a review and make a final determination to approve or disapprove a plan or modification or to approve a plan or modification with conditions. Proposed Section 841.500 provides for all final determinations made by the Agency to be appealable.

Review and Approval of Reports and Certifications

The corrective action report, certification of corrective action, closure report, certification of closure, post-closure report, and certification of completion of post-closure care prepared and submitted to the Agency in accordance with Section 841.505 must be reviewed and approved by the Agency prior to the completion of corrective action, closure, or post-closure care. Proposed Section 841.505 provides for all final determinations made by the Agency to be appealable.

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