BEFORE THE ILLINOIS POLLUTION CONTROL BOARD

IN THE MATTER OF:	)	
	)	
PROPOSED AMENDMENTS TO	)	
CLEAN CONSTRUCTION OR DEMOLITION	)	R2012-009
FILL OPERATIONS	)	(Rulemaking-Land)
(35 ILL. ADM. CODE 1100	)	

NOTICE OF FILING

To: John Therriault, Clerk
Illinois Pollution Control Board
James R. Thompson Center
100 West Randolph Street - Suite 11-500
Chicago, IL 60601

Mitchell Cohen
Chief Legal Counsel
Illinois Depart.of Natural Resources
One Natural Resources Way
Springfield, IL 62702-1271

Matthew J. Dunn, Chief
Environmental Enforcement/Asbestos
Litigation Division
Illinois Attorney general's Office
69 West Washington St., 18th Floor
Chicago, IL 60602

Marie Tipsord, Hearing Officer
Illinois Pollution Control Board
James R. Thompson Center
100 W. Randolph, Suite 11-500
Chicago, IL 60601-3218

Persons included on the attached

Please take notice that I have today filed electronically with the Office of the Clerk of the Illinois Pollution Control Board the attached Pre-Filed Testimony of James E. Huff, P.E. and accompanying Attachments, a copy of which is served upon you.

HUFF & HUFF, INC.

By: ______________________
Senior Vice President

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PRE-FILED TESTIMONY OF JAMES E. HUFF, P.E.

Introduction

My name is James E. Huff, and I am Senior Vice President of Huff & Huff, Inc., an environmental consulting firm founded in 1979. I received a Bachelor of Science in Chemical Engineering in 1970 from Purdue University and was awarded a Masters of Science in Engineering from the Environmental Engineering Department at Purdue University in 1971. I am a registered Professional Engineer in Illinois. A copy of my resume is included in Attachment 1.

I have actively participated in reviewing and preparing comments on the Agency's earlier draft regulations on behalf of the Illinois Society of Professional Engineers and also for the Illinois Road and Transportation Builders Association. Since the initial implementation of this law, I have been involved with over twenty projects where the CCDD Form 663 was required, all related to transportation projects. I have experienced first hand the difficulties in attempting to keep projects moving while managing Clean Construction or Demolition Debris (CCDD) in a cost effective manner.

I have been retained by the Illinois Tollway, Kane County Division of Transportation, Lake County Division of Transportation, DuPage County Division of Transportation, and Will County Department of Highways, the Cities of Geneva and St. Charles, and the Villages of Hinsdale, Libertyville, New Lenox, and Villa Park to review the proposed CCDD regulations and offer comments.

The transportation sector in northeast Illinois manages over $2 billion dollars per year of construction work and encounters CCDD issues on a significant number of projects. Developing a workable CCDD program is critical to maintaining the current level of construction and also to the commitment to sustainable transportation practices that is practiced today.

Background

Public Act 96-1416 modified the Illinois Environmental Protection Act to increase the regulatory oversight of the management of CCDD as well as uncontaminated soil fill operations. These changes became law on July 30, 2010, with some modifications in Public Act 97-0137, effective July 14, 2011.

With the lack of implementing regulations, the market place (CCDD Facilities) has implemented its own program. For example, many of the CCDD facilities routinely require Form 663 for all material accepted and many require full Target Compound List testing on all material before acceptance. These policies were adopted by CCDD facilities because of the liability concerns associated with the proposed regulations. These policies have resulted in increased costs to the taxpayers in Illinois for all public works projects. Increased costs in any economy is not good for job creation, but in today's economy these costs create economic hardship for the generators of CCDD and uncontaminated soil. All Illinois environmental regulations require an analysis of the costs and benefits of proposed regulations. My testimony focuses upon addressing this balance and what is practical and necessary to protect our environment.

One would assume the motivation behind Public Act 96-1416 was that CCDD facilities and uncontaminated soil fill operations were impacting the environment, and that these regulations are necessary to protect the citizens of Illinois. As CCDD facilities have been around longer than we have had environmental regulations, one would expect the Agency would have a list of such facilities where environmental issues have been identified. As Stephen Nightingale of the Agency noted in his pre-filed testimony, fill operations place material directly in contact with groundwater (pg 24). In the July 6, 2006, Board opinion to add Part 1100-*Clean Construction or Demolition Debris Fill Operations*, the Board found no basis for adding either leachate testing or groundwater monitoring. So what has changed since 2006? The Agency's Statement of Reasons at page 6 notes that both public and private wells are found in close proximity to CCDD fill operations "due to the fact that the same geologic material that is good to be quarried is also appropriate material in which to sink a groundwater well." However, the Agency failed to go the next step and identify the groundwater issues that have actually occurred attributed to CCDD operations. So the fundamental question is what level of regulation is necessary to protect groundwater given the nature of CCDD materials and historical performance? Is there a problem?

Regulatory Comparison

Illinois has two very different programs for addressing sites that are discovered to have impacted groundwater. Under 35 Illinois Administrative Code Part 742-Tiered Approach to Corrective Action Objectives (TACO), a property owner has the option of placing a groundwater use restriction on not only his property, but also on the entire community, if that is acceptable to the community. The City of Chicago is an example where a groundwater use ordinance is in place, prohibiting extraction of groundwater for potable water purposes. I have had the opportunity to work on contaminated sites in over 25 states, as well as sites enrolled in the Illinois Site Remediation Program, which utilizes the Part 742 regulations. The Illinois program is the most cost-effective remediation program I have with throughout the country. This program was developed to provide environmental protection of human health and the environment by allowing assessment of risks and applying the appropriate level of remediation. This includes the ability to use engineering controls and groundwater use restrictions. The Part 742 program is also used in the Leaking Underground Storage Tank Program and hazardous waste remedial actions in Illinois to establish clean up objectives.

35 Illinois Administrative Code Part 620, the Groundwater Quality Standards, includes a non-degradation requirement in Subpart C. The Board's original opinion in R89-14(B) describes non-degradation as a prohibition against impairment of any existing or potential use of groundwaters (pg 127-67). The Board goes on to note that it declined to generally extend non-degradation beyond the prohibition against loss of use (pg 127-68). However, the Agency has continued to interpret the non-degradation regulation as any increase in any contaminant above background, and formally proposed this in R08-18 for a large list of contaminants. Mr. Richard Cobb's

testimony in the R08-18 proceedings at page 10 explains this concept, which has been included in the Agency's proposed CCDD regulations. The proposed CCDD regulations submitted to the Board made one concession in that Section 1100.720 allows operators to achieve Class I groundwater standards on the subject property in lieu of the being held to a non-degradation standard; however, if corrective actions are needed beyond the fill operations property boundaries, Subsection 1100.755(d) requires compliance with Part 620, and as Mr. Nightingale noted "includes the non-degradation provisions" (pg 36).

The Board has a decision to make with respect as to how contamination will be managed at CCDD sites. There is an opportunity to apply the Tiered Approach to Corrective Action Objectives (TACO) to CCDD facilities and uncontaminated soil fill sites, or accept the Agency's more conservative approach currently applied to landfills, including applying background concentrations for all parameters at the property line. The Agency has consistently rejected a TACO approach to landfills because of the difficulty in characterizing the waste, but the same argument cannot be applied to CCDD material or uncontaminated soil fill sites. The economic implications of these two approaches are very different and will be discussed later in my testimony.

<u>Groundwater Impact Data from a CCDD Site</u>

The Board has been provided no data from the Agency on groundwater impacts from CCDD operations. This type of information would seem critical to the Board. Huff & Huff has had the opportunity to address this question at one of our highway sites.

As part of a road improvement project in Kane County, the southern edge of a former CCDD Facility was planned to be utilized for the highway improvements. This facility operated as a clean construction and demolition debris (CCDD) landfill from 1972 to approximately 1989. Prior to being a CCDD Facility, the site was part of a gravel pit. Kane County was required to purchase the entire closed CCDD facility and assume responsibility for closure in order to complete the road improvements. There were 34 private residential wells within a quarter of mile of the inactive facility which the Agency required be tested. The 34 wells were sampled for all parameters identified in 35 Illinois Admin. Code Subpart D, Section 620.410 (a) through (d), with the exception of Radium 226, Radium 228, Tritium and Strontium-90. No semi-volatile or volatile organic compounds (SVOCs/VOCs), phenols, herbicides, pesticides, or polychlorinated biphenyls (PCBs) were reported above detection limits. Toluene was detected in nine wells and methylene chloride was detected in one well; however, these private wells were all re-sampled for toluene and/or methylene chloride and all re-samples were non-detect. The toluene and methylene chloride in the original samples were attributed to equipment and/or laboratory cross-contamination and therefore not detected in the wells.

Fluoride and cyanide were both non-detect with the exception of one location each (0.018 mg/L cyanide and 0.531 mg/L fluoride). Both of these detected compounds achieve the Class I Standards of 0.2 mg/L and 4 mg/L, respectively.

Total iron, chloride, total dissolved solids, manganese and antimony were the only constituents above the Class I groundwater standards. Total iron, which was attributed to particulates, in the water, was reported in three homes just over the Class I standard of 5 mg/L. Manganese, a naturally occurring metal associated with water hardness, was 0.168 mg/L compared to the Class I groundwater standard of 0.150 mg/L. This home was sampled from an outside spigot, most likely prior to the water softener, which would reduce the manganese concentration in the drinking water.

The Illinois EPA subsequently required additional documentation to satisfy the requirements for closure including the installation of monitoring wells surrounding the landfill limits and sampling for the target compound list. Four monitoring wells were installed at the site on April 10-11, 2008. No semi-volatile and volatile organic compounds (SVOCs/VOCs), herbicides, pesticides, atrazine, polychlorinated biphenyls (PCBs), fluoride, or cyanide were detected above reporting limits. Phenols, analyzed using EPA method 9066, were detected at the reporting limit of 0.01 mg/L in three of four monitoring wells. However, phenol (included on the priority pollutant list) and all phenolics analyzed using EPA method 8270C were not detected (less than 0.01 mg/L) in any sample.

Various metals (total) were analyzed with no reported detections above reporting limits for arsenic, cadmium, selenium, silver, antimony, beryllium, thallium, or mercury. Of the total metals reported including barium, chromium, lead, cobalt, copper, iron, manganese, nickel, and zinc, only manganese did not achieve the Class I groundwater standard of 0.15 mg/L in two of four wells at 0.925 mg/L and MW-4 1.190 mg/L. These two wells were re-sampled on July 1, 2008. Low-flow samples were collected using a peristaltic pump and disposable tubing for both total and dissolved manganese at each well. This methodology produced water samples that were less turbid than the bailer sampling methodology, and for the dissolved samples they were filtered by the laboratory prior to analysis. Confirmation sampling results reported manganese at 0.007 mg/L (total) and 0.001 mg/L (dissolved). Both of these results achieve the Class I groundwater standard of 0.150 mg/L. Confirmation sampling results from MW-4 reported manganese at 0.641 mg/L (total) and 0.119 mg/L (dissolved). The dissolved results achieve the Class I groundwater standard of 0.150 mg/L.

Sulfate results ranged from 52 mg/L to 87 mg/L, well below the Class I groundwater standard of 400 mg/L. Chloride results ranged from 6 mg/L to 180 mg/L, below the Class I groundwater standard of 200 mg/L.

This extensive testing (34 private wells within 0.25 miles) revealed that the private wells achieve the Class 1 groundwater standards and monitoring wells installed adjacent to the CCDD fill area also achieve the Class 1 standards. There is no indication that CCDD operations are causing exceedences of Class 1 groundwater standards in private or public water supply, at least based on this extensive testing at one CCDD facility.

However, if a "background" criterion is applied, sulfates, chlorides, manganese, and iron will be a problem at CCDD facilities. The chlorides in one monitoring well at 180 mg/L is at 90 percent of the Class I groundwater standard, and it is likely that at some CCDD facilities chloride values above 200 mg/L will be recorded. Under the Agency's proposal, corrective action for chlorides would be necessary if on site monitoring revealed a level above 200 mg/L, which presumably means pumping groundwater for the foreseeable future and discharging it somewhere. As chlorides do not degrade, if a background standard is applied at the property line, and if the lowest chloride recorded, 6 mg/L was to be determined by the Agency to be "background", then extensive pumping in multiple locations would become necessary. Clearly there is an economic impact to pumping the State's precious groundwater for the foreseeable future to maintain "background" concentrations at the property lines of CCDD facilities, without consummate benefits.

Under the Part 742 regulations, there are three exposure pathways that soils contaminant levels are to be compared against; ingestion, inhalation, and soil-migration-to-groundwater. As Mr. Nightingale noted, much of the CCDD material will be placed below the groundwater table. The ingestion and inhalation remedial objectives are not relevant below the water table, and the soil-migration-to-groundwater is the pathway we should be focusing upon. As the quarries reach the upper ten feet of fill, the inhalation pathway would be relevant and for the top three feet the ingestion pathway would be relevant. We have a TACO program that could easily be applied to CCDD operations. This would reduce significantly the high rejection of material with arsenic above 13 mg/kg and the material with polynuclear aromatic hydrocarbons above the background levels. Another example would be the polynuclear aromatic hydrocarbons, such as benzo(a)pyrene. For material placed below the three feet of final cover, the remedial objective would be increased from the background value, 1.3 mg/kg in the Chicago area to 8 mg/kg, the remedial objective for the soil-migration-to-groundwater pathway. This would allow the upper excavated soils, which typically is fill material, to be sent to CCDD facilities while still being protective of the environment.

Chemical Testing, Field Screening, and Rejected Loads

There remains much confusion on the role of analytical testing versus field screening with a photo-ionization detector (PID). Due to liability concerns associated with the proposed regulations, many CCDD sites routinely require testing for the target compound list for all material brought into their sites. However, these analytical results do not override the PID screening, and as Mr. Nightingale noted, PID readings in excess of background levels must result in rejection of the inspected load (Pg 13). Mr. Nightingale goes on to recommend that the Professional Engineer or Professional Geologist screen all loads before sending to fill operations. Section 1100.205(b)(4)(ii) simply directs the generator that rejected material "must be managed appropriately," which leaves everyone in a state of confusion. As Mr. Nightingale noted, "Ordinarily, laboratory results would trump field instrument readings." That is certainly not the case as this CCDD program has been implemented, nor is it the case under the proposed regulations.

The problem is not in the analytical testing or unrepresentative samples. The problem is relying on field screening and setting a pass/fail criteria of *background*. Humidity results in false positives, so when wetter materials are received, the probability of rejection increases dramatically. Naturally occurring organic rich soils also will produce a PID reading above background. Along streets with sewers, there is often a trace septic odor, which is grounds for rejection, yet the samples achieve all TACO remedial objectives. Petroleum products have very low odor thresholds; it is common to have a trace petroleum odor and deflection on a PID, yet pass all TACO remedial objectives. Soil removed from an area associated with a fire would also exhibit an odor. In theory, a slight odor is not grounds for rejection under Section 1100.204(j), yet these same materials will cause a deflection on the PID meter. Mr. Nightingale discussed the acceptance of dredging materials and associated odors, but did not address the PID deflections associated with dredged material (pg 10). The background criterion for field screening is too low and results in a significant amount of trucking clean material back to the job site, and ultimately landfilling. This landfilling and double trucking of clean soil/CCDD material is another economic cost to the taxpayers of Illinois. The question is why are analytical tests, certified as being representative, and being conducted in certified laboratories not sufficient compared to a field instrument that the Agency would never use to determine closure of a LUST or TACO site?

A specific mechanism for handling rejected loads needs to be outlined in the regulations. We would suggest a better approach to simply rejecting loads would be to allow the CCDD facilities to quarantine suspect loads, sorted by job site. The CCDD facilities could then notify the generator of the issue, and offer to have it tested by the CCDD, and if the material achieves the remedial objectives, it could then be accepted. If above the TACO remedial objectives, the CCDD would coordinate with the generator to landfill the material. The savings in fuel and reduced greenhouse gas emissions from eliminating double trucking would be significant, as well as savings on the landfilling of clean material. There are very significant logistic challenges associated with bringing back rejected loads to a linear highway project site, and locating a place to store and separate the material in a narrow right-of-way and work zone. There are related impacts to the project schedule and project cost.

Comments on Specific Sections of the Proposed Regulations

Applicability: Section 1100.101(b)(1) indicates that these regulations do not apply to sites that use this material as fill that is not a current or former quarry, mine or other excavation. "Other excavation" means a pit created primarily for the purposes of extracting resources and does not include holes, trenches, or maintenance of a structure, utility, or transportation infrastructure. So, if I am reading this section correctly, a community would be free to move clean material from one point in the community to another, totally outside these regulations, as long as they were not filling a pit previously used for extracting resources. Application on farmland or constructing berms anywhere in the community would fall outside of these regulations. In Mr. Nightingale's testimony (pg 6), he provides more narrow examples of the exemptions, including filling in basements, backfilling a cleanup site, installing or maintaining sewer trenches, or filling in natural depressions.

I would suggest filling in natural depressions as noted in Mr. Nightingale's testimony be specifically excluded in the definition of "Other excavation" as well as clarifying exclusion of berm construction from these regulations.

Certifications and Load Checking: Section 1100.205(b)(1)(A) specifies that any load that has a photo-ionization detector(PID) reading in excess of background levels results in rejection. This requirement is independent of analytical results. Based upon my experience with the TACO and LUST programs, a value of 5 ppm would be sufficient to assure any volatile organic contaminant residual present would achieve the proposed Maximum Allowable Concentrations (MACs), while allowing dredging material, sanitary sewer backfill, and material in some proximity to petroleum tanks where trace odors are present to be accepted by the CCDD facilities. In addition, where representative analytical provided by the generator should be relied upon over the PID screening.

Use of Painted CCDD as Fill Material: Section 1100.212 takes a different approach in characterizing material than under TACO and under the hazardous waste regulations. The definition of painted CCDD and painted fill material is material "that has been painted." How much paint coverage does it take to constitute "painted CCDD"? Does a simple line striping down the center of a concrete roadway constitute a painted CCDD material when removed? What about (temporary) utility markings applied to a material prior to removal, does that constitute painted CCDD?

Equally troubling is the sampling protocol specified where instead of taking a "representative sample" of the material for analysis, the proposed regulations specify collection of paint chips or scrapings and then compares the results to the soil-migration-to-groundwater pathway under the 742 regulations, using either the SPLP or TCLP analysis. This approach contradicts procedures adopted by both the Illinois EPA and USEPA in characterizing waste, and is contrary to the sampling protocol used under the Part 742 regulations.

To characterize the material for landfilling, Illinois EPA and the USEPA sampling protocol specify analyzing a "representative sample", not just a very tiny percentage of the material being managed. Under the draft regulations, averaging results is not allowable, but the regulations are silent on whether compositing of paint chips is allowable. Given the volume of material being brought into these facilities, both averaging and compositing of samples would be appropriate, just as is provided under TACO currently. Illinois has a successful program under 35 Illinois Administrative Code Part 742, and there is no technical basis for not including these same procedures for the Part 1100 facilities.

As Mr. Paul Purseglove stated in his pre-filed testimony (pg 2), the Agency believes that paint is a contaminant, and therefore cannot be accepted at a CCDD facility. This interpretation needs to be placed into a practical perspective as to what is the risk to the environment from a paint surface? What about oil drippings from autos on parking lot asphalt, wouldn't that be considered a contaminant as well? Is the Professional Engineer to inspect entire parking lots looking for oil drips? If the regulations remain with simply sampling the paint material, instead of the technically sound representative sample, I would recommend a de minimis exclusion for painted CCDD, such as ten (10) percent of the surface that is painted. For a 24 foot- two lane pavement with two 5 inch edge lines and a double 4 inch centerline, the paint coverage is 6.25%.

I suspect the Agency's concern from paint entering a CCDD facility is the potential impact on groundwater. This is really no different than the TACO program and hazardous waste program, which characterize the entire material, not some thin layer. The paint has been subjected to the elements for a long time, with surface water runoff and groundwater infiltration occurring without environmental concern. There is no technical justification that if this same painted material is placed in a CCDD facility that it would suddenly become an environmental hazard.

If maintained as written, and paint fails the criteria the Agency proposes, then the entire material will have to be taken to a landfill, at a very significant economic impact, or the generator may elect to remove the paint, releasing the paint dust into the atmosphere. This requirement is not a sustainable environmental practice and the impacts of accepting painted surfaces at CCDD have not been demonstrated by the Agency.

<u>Maximum Allowable Concentrations for Chemical constituents in Uncontaminated Soils:</u> Section 1100.605(a)(1) specifies the maximum allowable concentration as the most restrictive of the three pathways in 742. As outlined above, except for the final ten (10) feet of fill, only the soil-migration-to-groundwater makes technical sense.

Part 605(a)(2) and (3) specify only the lowest pH-dependent value for ionizing organics and pH dependent metals, as the worst case scenario. There is no technical justification for such an approach. Given the lack of organics accepted into CCDD facilities, there would be no reason to encounter lower pH values (from anaerobic decomposition of organic matter producing volatile acids). In fact, the presence of concrete, common in CCDD facilities would raise the pH closer to the highest range. If the CCDD facilities are actively dewatering, which I understand is the case during the filling, then groundwater pH can be readily measured, which would be representative for that facility. From this pH, the Maximum Allowable Concentrations (MAC) can be determined for each site on a case-by-case basis just like at all Illinois sites utilizing a TACO approach. This would save significant costs in clean material unnecessarily taken to landfills.

The Board needs to consider the impact of using the "worst case" pH for specifying MAC values. A similar conservative approach was taken originally in the Part 742 regulations for arsenic, where a 3 mg/kg ingestion remedial objective was proposed and adopted, despite testimony by our firm that nearly all soil in Illinois had naturally occurring arsenic above this remedial objective. TACO was subsequently amended because of the difficulties in achieving closure of sites to recognize this background condition. In fact, the CCDD statute has also been amended to allow background arsenic because the economic burden and impracticability of the objective. The issue of soil pH is similar to what occurred with arsenic and absolutely critical to the implementation of these regulations. Attachment 2 is a summary of pH values in soils in Illinois, with a map of soil pH. In southern Illinois, pH values between 5.2 and 5.5 occur, but in northern Illinois, pH values greater than 6.0 are dominant. This is further verified by the pH of soil and non-soil samples analyzed by First Environmental Laboratories. Attachment 2 also includes a memorandum from Lorrie Franklin of First Environmental Laboratories, where she reports on a data set of 8500 samples, 8,345 had a pH greater than 5.75 (98.2 percent) and 8,300 had a pH greater than 6.25 (97.6 percent).

The pH range of 4.5 to 4.74 has been proposed by the Agency for establishing the MACs for the ionizing metals. In my 40 years of practice in this field, I have never encountered a soil pH in this range in Illinois, which is not surprising based on the Illinois State Water Survey data and First Environmental Laboratories data, both found in Attachment 2.

As currently proposed with the use of the lowest pH range, 4.5 to 4.74, five inorganic constituents (arsenic, iron, lead, manganese, and mercury) are more stringent than the background standards, and so the background levels become the MAC values. Along highways, it will be very difficult to find soil with lead below the background level given the historical use of lead in gasoline. Soils with any fill material present will likely have arsenic, manganese, and iron levels above the proposed MACs, all because of the use of the artificially low pH range assumed. This low pH assumption used to calculate the soil-migration-to-groundwater pathway will have an economic impact on the taxpayers of Illinois, with no corresponding environmental benefit.

Compliance with 35 Ill. Adm. Code 620: Section 1100.755 is a subtle, yet very costly addition to the regulations. Mr. Nightingale (pg 36) highlights the non-degradation provision of the groundwater regulations. As noted previously, the Agency has interpreted Section 620.301 as meaning achieving background concentrations, as opposed to creating *an existing or potential use* impairment, which is what Section 620.301(a)(2) states. This subtle wording change can result in groundwater objectives far below the Class I standards. In addition, there is no recognition of risk assessment, receptors, or other concepts, in the CCDD Proposal, as presently available to LUST sites, Site Remediation Program sites, or hazardous waste sites under Part 742. Bringing these CCDD and Uncontaminated Soil Fill Operations under the same regulatory framework would be a better approach for the Board to consider.

The Agency's non-degradation interpretation is described in Mr. Richard Cobb's testimony in R08-18 in the matter of Groundwater Quality Standards Amendments. Section 620.301 is entitled *General Prohibition Against **Use Impairment** of Resource Groundwater.* Section 620.301(b) would also allow a CCDD to establish a groundwater management zone, presumably where groundwater standards were exceeded, as opposed to where levels were above background concentrations. Whether the Agency would ever support such a groundwater management zone for a CCDD is unclear.

Summary

The draft regulations have been prepared to protect the citizens of Illinois from groundwater impacts from the operation of CCDD Operations and uncontaminated soil fill operations, without any evidence that there is a problem despite decades of operation of such facilities. The material being accepted at such facilities is already exposed to the elements and contributing to groundwater and surface water recharge with whatever contaminants being carried by storm water. All the CCDD facilities provide is a location to consolidate material spread across a wide area, and ultimately less exposure to rainfall.

My testimony today is offered to assist in developing regulations that protect our groundwater resources but also that are based upon an assessment of the costs and benefits of these regulations. The conservative approach presented by the Agency results in excessive costs, without consummate benefits. If construction projects are forced to take all of the CCDD material to landfills, this would effectively double the construction costs. This is a real economic burden to the taxpayers, is not a sustainable practice, and results in no benefits from an environmental perspective.

Existing CCDD facilities will have a year to commit to operate under the new regulations under Section 1100.412(c)(1)(D). I would expect these facilities would be installing monitoring wells and testing so that they can decide whether to cease operations prior to the year. I would expect there will be groundwater issues with chlorides, sulfate, iron, and manganese identified from the early monitoring, especially with respect to the achieving background concentrations at the property line for the conservative pollutants chlorides and sulfates. The result will be a large number of CCDD operations will elect to close, leaving partially filled quarries across the area, with no potential for future redevelopment. Costs for finding locations for final disposition of for CCDD material and uncontaminated soils will escalate at an alarming rate, resulting in fewer capital projects due to budget limitations and making Illinois less attractive to securing new industries, except for landfill expansions.

Thank you, this concludes my pre-filed testimony.

James E. Huff, October 6, 2011

CERTIFICATE OF SERVICE

I, the undersigned, certify that on this 6th day of October, 2011, I have served electronically the attached Pre-Filed Testimony of James E. Huff, P.E., accompanying Attachments, and Notice of Filing upon the following person(s):

John Therriault, Clerk Pollution Control Board James R. Thompson Center 100 West Randolph Street - Suite 11-500 Chicago, IL 60601	
and by U.S. Mail, first class postage prepaid, to the following person(s):	
Marie Tipsord, Hearing Officer Illinois Pollution Control Board James R. Thompson Center 100 W. Randolph St., Suite 11-500 Chicago, IL 60601	Matthew J. Dunn, Chief Environmental Enforcement Office of the Attorney General 69 West Washington Street, Suite 1800 Chicago, IL 60602
Stephen Sylvester, Asst. Attorney General Environmental Enforcement Office of the Attorney General 69 West Washington Street, Suite 1800 Chicago, IL 60602	Claire A. Manning Brown, Hay & Stephens LLP 700 First Mercantile Bank Building 205 South Fifth St., P.O. Box 2459 Springfield, IL 62705-2459
Kimberly A. Geving, Assistant Counsel Illinois Environmental Protection Agency 1021 North Grand Avenue East P.O. Box 19276 Springfield, IL 62794-9276	Mark Wight, Assistant Counsel Illinois Environmental Protection Agency 1021 North Grand Avenue East P.O. Box 19276 Springfield, IL 62794-9276
Stephanie Flowers, Assistant Counsel Illinois Environmental Protection Agency 1021 North Grand Avenue East P.O. Box 19276 Springfield, IL 62794-9276	Dennis Wilt Waste Management 720 East Butterfield Road Lombard, IL 60148
Michele Gale Waste Management 720 East Butterfield Road Lombard, IL 60148	Mitchell Cohen, General Counsel Illinois Department of Natural Resources One Natural Resources Way Springfield, IL 62702-1271

Steven Gobelman, Geologic/Waste Assessment Specialist Illinois Department of Transportation 2300 S. Dirksen Parkway Springfield, IL 62764	Tiffany Chappell City of Chicago, Mayor's Office of Intergovernmental Affairs 121 N. LaSalle Street City Hall – Room 406 Chicago, IL 60602
James Huff – Senior Vice President Huff & Huff, Inc. 915 Harger Road, Suite 330 Oak Brook, IL 60523	Greg Wilcox – Executive Director Land Reclamation & Recycling Association 2250 Southwind Blvd. Bartlett, IL 60103
Greg Lansu, Attorney Land Reclamation & Recycling Association 2250 Southwind Blvd. Bartlett, IL 60103	

James E. Huff, P.E.

ATTACHMENT 1

RESUME-JAMES E. HUFF, P.E.

JAMES E. HUFF, P.E.
Senior Vice President

Expertise: Soil & Groundwater Remedial Design
Hazardous Waste Management
Wastewater Treatment Planning and Design
Stream Surveys/Antidegradation Analysis

Experience:

Since 1980, Mr. Huff has been vice president of Huff & Huff, Inc. responsible for projects pertaining to groundwater and soil remediation, wastewater treatment, design and operation, water quality studies, hazardous waste management, and compliance assessments. Mr. Huff has recently served on both the Illinois Society of Professional Engineers' and the Illinois Road and Transportation Builders Association's CCDD committees. On behalf of the American Council of Engineering Companies-Illinois, Mr. Huff serves on the Illinois Site Remediation Advisory Committee, overseeing regulatory changes in the Site Remediation Program.

For our municipal clients, Mr. Huff has directed village-wide records search, overlaying all recognized environmental conditions on village maps to assist in both management and disposal of CCDD generated within the villages. Since 2010, Mr. Huff has directed the CCDD activities for over 25 projects, from pre-sampling to sampling during construction.

Remediation designs, many associated with coal tar and chlorinated solvents are a major portion of Mr. Huffs activities. He has designed and implemented landfarming, soil vapor extraction, air sparging, groundwater recirculating systems and treatment systems utilizing batch biological reactors, activated carbon, air strippers, and in situ enhanced bioremediation. Mr. Huff was the project manager on the remediation of four former manufactured gas plants (MGPs). Innovative remediation approaches utilized at these MGP sites included securing regulatory and client approval to use coal tar impacted soil in a hot-mix asphalt plant for making asphalt, the first time this approach was used in the Midwest. This site received one of the first Comprehensive *No Further Remediation* letters from the Illinois EPA and was the recipient of the top *Honor Award for Engineering Excellence* in 2000 from ACEC-IL. Another MGP site received a *Special Achievement Engineering Excellence* Award in 2007, which incorporated soil vapor extraction operation prior to excavating out the tar well, to reduce benzene levels and the construction of a new reporting center building incorporating a significant number of "green" features. A third MGP site involved excavation of tar below the water table, which required dewatering. A water treatment system with discharge to the local POTW proved very cost effective in controlling remediation costs.

Huff & Huff, Inc. holds a licensed for Emulsified Zero-valent Iron (EZVI), a NASA technology for remediating chlorinated solvent soil and groundwater contamination. Mr. Huff leads this effort, and has successfully applied EZVI full-scale at eight chlorinated solvent contaminated sites to date in four different states, and has one project planned for 2012 in Kansas. He has completed treatability studies at a Federal Superfund site for cyanide and thiocyanate destruction in groundwater, including operation of a 4,000 gallons per day (gpd) pilot reactor at the site and has completed a Feasibility Study (FS) for a major chlorinated solvent release at a State Superfund site in Ohio. The selected remedy for this state site was the first in Ohio that recognize intrinsic bioremediation as part of the remedy, and Mr. Huff is the Project Manager. The remediation focused on the source area, and included a combination of technologies, including EZVI, four SVE systems, automated free product removal, and enhanced anaerobic bioremediation using sodium benzoate. Mr. Huff was the project manager on a State Superfund site in upstate New York investigated for chlorinated solvents and drugs from a local pharmaceutical company that found impacted private water supply wells. Mr. Huff has directed over 15 hazardous waste closures of

TSD facilities, ranging from drum storage areas to the complete clean-up of a 27-acre abandoned manufacturing facility. This abandoned manufacturing site included plating solutions, cyanide bearing sludges, oils, and over 20,000 gallons of virgin chemicals requiring placement.

In the hazardous waste field, over sixty industrial plants have relied on Mr. Huff's expertise for complying with regulations. Mr. Huff conducts approximately 15 RCRA and DOT training sessions annually. He has prepared inspection plans, contingency plans, training plans, and waste minimization plans. Mr. Huff was active in two trade associations providing written comments during the development of the hazardous waste regulations. Mr. Huff directs H&H's underground storage tank (UST) closure and remediation projects for a variety of clients. Both petroleum and solvent tank releases have required regulatory reporting and remediation.

Compliance assessment is a significant part of Mr. Huff's work. Over 100 environmental audits of manufacturing firms have been conducted by Mr. Huff over the last fifteen years. These audits have included potential acquisitions as well as on-going industrial operations. Mr. Huff has also been involved in locating and permitting of new industrial facilities, including mining operations, chemical plants, metals, and peak energy plants.

Mr. Huff has completed a number of studies evaluating the feasibility of deep well injection for high saline wastewater for both chemical plants and for two petroleum refineries. He permitted the disposal of over 5 million gallons of brine from a closed brine solution mine in North Dakota, as a novel approach for eliminating a large brine pond. In New York, Mr. Huff has assisted a brine solution salt mine for the past 30 years with injection permitting and groundwater monitoring.

Mr. Huff has designed industrial wastewater treatment plants ranging in size from less than one thousand gallons per day to eight million gallons per day. He has assisted two petroleum refineries with nitrification issues, conducted treatability studies on alternative amine products and elevated sodium sulfate. These designs have applied to various industrial sources, such as: foundries, plating, printed circuit boards, organic chemical, pharmaceutical manufacturers, and meat packing. Examples of industrial wastewater designs are listed below:

- Sequential batch reactors (SBRs) for BOD_5/COD reduction at pharmaceutical plant
- Side stream SBR for nitrification on meat packing three-stage lagoon
- Breakpoint chlorination for ammonia removal at chemical plant and also a meat packer
- Land application, with winter lagoon at chemical plant
- Copper removal from printed circuit board facility using sodium borohydride
- Integrated settling basin sludge drying beds at foundry

Mr. Huff has also directed over 20 municipal wastewater treatment design projects. Facilities Plan Development

Mr. Huff is a leader in sustainable wastewater issues, with an emphasis on decentralized wastewater treatment approaches or cluster wastewater treatment systems with subsurface discharge for seven residential developers/country clubs, and a temple. These systems are typically 10,000 to 20,000 gpd, utilizing two SBRs, computer controlled, followed by a large leach field allowing for groundwater recharge and more open space within developments. Constructed wetlands for polishing wastewater effluents are also a key part of the sustainable design practices.

Mr. Huff has also completed a number of CSO studies including Long-term Control Plans, Nine Minimum Controls, O&M Plans, and Water Quality Impact Studies. Two novel in-stream aeration systems, using high-purity oxygen on a shallow Illinois stream, were designed and installed, and a system designed by Mr. Huff for ammonia removal from anaerobic digesters received an engineering excellence award in 1999 from ACEC-IL

In the area of water quality, Mr. Huff is active in the DuPage River/Salt Creek Work Group and the Hickory Creek Work Group. For the DuPage River/Salt Creek Work Group, Mr. Huff worked on the low dissolved oxygen problems, from measuring sediment oxygen demand to evaluating in-stream aeration and dam removals. This work has lead to the first project by the Work Group to improve dissolved oxygen, with a dam removal project underway, which Mr. Huff is part of the team. Mr. Huff has directed studies for two of the Quad Cities to assess the environmental impact of water treatment plant discharges on the Mississippi River. These studies included evaluating various locations along the Mississippi for the presence of mussel beds, the potential presence of endangered species, primarily the *Lampsilis higginsi* and whether the areas were important for fish spawning, and recently completed a mussel relocation project for another discharger on the Mississippi River extending its outfall. On the Fox River, Mr. Huff was project manager for a group of municipal dischargers on a project to collect and analyze weekly water quality samples along the river, its tributaries, and outfalls at over 30 locations to establish a better database on un-ionized ammonia levels. Mr. Huff has directed fish, mussel, and benthic surveys for industrial, storm water, and municipal wastewater discharges located across over 15 watersheds in Illinois.

Mr. Huff in 2004 was retained by the Northeastern Illinois Planning Commission (NIPC) as the lead consultant to review FPA requests for consistency with the Commission's Water Quality Management Plan. Mr. Huff has evaluated over 200 FPA requests, including the Facilities Plan associated with these for consistency with the Illinois water quality plan. Antidegradation and nutrients have been two major issues on many of these applications.

From 1987 through 1990, Mr. Huff was a part-time faculty member, teaching the senior level environmental courses in the Civil Engineering Department at IIT-West in Wheaton, Illinois.

From 1976 to 1980, Mr. Huff was Manager of Environmental Affairs for the Armak Company (now Akzo Nobel Chemicals), a diversified industrial chemical manufacturer. At Armak, Mr. Huff was responsible for all environmental activities at eight plants located throughout the United States and Canada. Technical work included extensive biological and chemical treatability studies as well as designing new facilities, including two wastewater pretreatment facilities, a land application system, and an incinerator system.

Previously, Mr. Huff was an Associate Environmental Engineer in the Chemical Engineering Section at IIT Research Institute (IITRI). Much of this work involved advanced wastewater treatment development, including applying a combination of ozone/UV treatment of cyanide, PCB's, RDX, HMX, and TNT and the use of catalytic oxidation of cyanide using powdered activated carbon impregnated with cupric chloride in petroleum refinery activated sludge units.

At Mobil Oil's Joliet Refinery from 1971 to 1973, Mr. Huff was employed as an Advanced Environmental Engineer during the construction and start-up of the largest grassroots refinery ever constructed. Mr. Huff was responsible for wastewater training, permitting start-up, and technical support as well as for water supply, solid waste, and noise abatement issues at the refinery.

<u>Membership</u>

American Council of Engineering Companies - IL
- Environmental Committee 1999 – 2005
- Chairman-June 2000-2004
- Board of Directors-2005-2010
- Vice President-2008-2010
- Secretary/Treasurer-2010-2011

Water Environment Federation Member
Illinois Water Environment Association
National Water Well Association
Certified Class 2 and Class K Sewage Treatment Works Operator in Illinois

Licenses:	Registered Professional Engineer, Illinois
Education:	
1966-1970	Purdue University, West Lafayette, Indiana B.S. in Chemical Engineering
1970-1971	Purdue University, West Lafayette, Indiana M.S.E. in Environmental Engineering
1974-1976	University of Chicago Graduate School of Business. Part time
Honors:	Omega Chi Epsilon (Chem. Engr. Honorary) President's Academic Award Graduated with Distinction Fellowship from the Federal Water Quality Admin.
Thesis:	"Destabilizing Soluble Oil Emulsions Using Polymers with Activated Carbon," Major Professor, Dr. James E. Etzel

Papers:

"Ozone-U.V. Treatment of TNT Wastewater," E.G. Fochtman and J.E. Huff, International Ozone Institute Conference, Montreal, May 1975.

"Characterization of Sensory Properties" Qualitative, Threshold, and Supra-Threshold," J.E. Huff and A. Dravnieks, American Water Works Assoc. Seminar, Minneapolis, MN, June 1975.

"Optimizing Wet Scrubber Systems for Odor Control in the Rendering Industry," R.H. Snow, J.E. Huff, and W. Boehme, Purdue Air Quality Conference, Lafayette, IN, November 1975.

"Control of Rendering Plant Odors by Wet Scrubbers: Results of Plant Tests," R.H. Snow, J.E. Huff, and W. Boehme, APCA Conference Boston, MA, June 1975.

"Asbestos Manufacturing Waste Disposal and Utilization," P. Ase, J.E. Huff, L.L. Huff, C.F. Harwood, and D. Oestreich, Mineral Waste Utilization Symposium, Chicago, IL, April 1976.

"Alternative Cyanide Standards in Illinois, a Cost-Benefit Analysis," L.L. Huff and J.E. Huff, 31st Annual Purdue Industrial Waste Conference, Lafayette, IN, May 1976.

"Cyanide Removal from Refinery Wastewaters Using Powdered Activated Carbon," J.E. Huff, J.M. Bigger, and E.G. Fochtman, American Chemical Society Annual Conference, New Orleans, LA, March 1977. Published in Carbon Adsorption Handbook, P.N. Cheremisinoff and F. Ellerbusch, Eds., Ann Arbor Science Publishers, Inc., 1978.

"Industrial Discharge and/or Pretreatment of Fats, Oils and Grease," J.E. Huff and E.F. Harp, Eighth Engineering Foundation Conference on Environmental Engineering, Pacific Grove, CA, February 1978.

"A Review of Cyanide of Refinery Wastewaters," R.G. Kunz, J.E. Huff, and J.P. Casey, Third Annual Conference of Treatment and Disposal of Industrial Wastewater and Residues, Houston, TX, April 1978. Published as: "Refinery Cyanides: A Regulatory Dilemma," Hydrocarbon Processing, pp 98-102, January 1978.

"Treatment of High Strength Fatty Amines Wastewater - A Case History," J.E. Huff and C.M. Muchmore, 52nd Conference - Water Pollution Control Federation, Houston, TX, October 1979. Published JWPCF, Vol. 54, No. 1, pp 94-102, January 1982.

"An Overview of Environmental Regulations," E.F. Harp and J.E. Huff, Soap & Detergent Association Annual

Meeting, Boca Raton, FL, January 1980.

"A Proposal to Repeal the Illinois Pollution Control Board's Construction Permit Water Regulations," J.H. Russell and J.E. Huff, Chicago Bar Record, Vol. 62, No. 3, pp 122-136, Nov.-Dec., 1980.

"Disinfection of Wastewater Effluents in Illinois-A Cost-Benefit Analysis," L.L. Huff and J.E. Huff, Illinois Water Pollution Control Association 2nd Annual Conference, Kankakee, IL, May 20, 1981.

"Measurement of Water Pollution Benefits - Do We Have the Option?" L.L. Huff, J.E. Huff, and N.B. Herlevson, IL Water Pollution Control Assn 3rd Annual Conference, Naperville, IL, May 1983.

"Evaluation of Alternative Methods of Supplementing Oxygen in a Shallow Illinois Stream," J.E. Huff and J.P. Browning, IL Water Pollution Control Assn 6th Annual Meeting, Naperville, IL, May 7, 1985.

"Environmental Audit for Wastewater Compliance," J.E. Huff, Federation of Environmental Technologists Environmental '86 Seminar, Milwaukee, WI, March 5, 1986.

"Technical and Economic Feasibility of a Central Recovery Facility for Electroplating Wastes in Cook County, IL," J.E. Huff and L.L. Huff, 1986 Governor's Conference on Science and Technology in Illinois, Rosemont, IL, Sept. 3, 1986.

"Hazardous Waste Closure Procedure," J.E. Huff, Federation of Environmental Technologists Seminar, Rockford, IL, Dec. 17, 1986.

"Training & Contingency Plan Requirements Under the Hazardous Waste/Right-To-Know/OSHA Regulations," J.E. Huff, Federation of Environmental Technologists Environment '88, Milwaukee, WI, March 9, 1988.

"Biomonitoring/Bioassay," J.E. Huff, Federation of Environmental Technologists Seminar, Harvey, IL, December 11, 1989.

"Storm Water Discharges," J.E. Huff, Federation of Environmental Technologists Environment '90 Seminar, Milwaukee, WI, March 7, 1990.

"Cleanup Standards-Past, Present and Future," J.E. Huff and D. O'Neill, Chicago Bar Association's Environmental Law Seminar "Underground Tanks: Down and Dirty," Chicago, IL, June 8, 1993.

"Engineering Aspects of Individual Wastewater System Design," J.E. Huff, 22nd Annual Northern Illinois Onsite Wastewater Contractors Workshop, St. Charles, IL, February 27, 1995.

"Illinois Site Remediation Program," J.E. Huff, Institutional Lenders Environmental Focus Group, Chicago, IL, March 14, 1997.

"Cleaning Up Contaminated Property in Illinois," J.W. Watson and J.E. Huff, Midwest Environmental Corporate Counsel Association, September 18, 1997.

"Total Maximum Daily Loadings (TMDL) and Ammonia Conditions in the Fox River Waterway," J. E. Huff and S. D. LaDieu, Illinois Water '98 Conference, Urbana, IL, Nov. 16, 1998.

"The Illinois Ammonia Water Quality Standards: Effluent Implications & Strategies for Compliance," L.R. Cunningham & J. E. Huff, Illinois Water '98 Conference, Urbana, IL, Nov. 16, 1998.

"Beneficial Reuse of Coal Tar Impacted Material in Recycled Asphalt-LaGrange Illinois Case Study," J.E. Huff, Midwest Energy Association's Environmental Management Conference, Denver, CO, October 5, 2000 and at the Site Remediation Technologies & Environmental Management Practices in the Utility Industry, Orlando, FL, December 4-7, 2000.

"Impact of a High Sulfate and TDS Industrial Discharge on Municipal Wastewater Treatment," J.L. Daugherty, J.E. Huff, S.D. LaDieu, and D. March, WEFTEC 2000, Anaheim, CA, October 17, 2000.

"Remediation of MGP Source Material Below the Water Table & On-Site Water Treatment," J.E. Huff, M. Matuck, and L.M. Paulson, Midwest Energy Association Environmental Management Conference, Itasca, IL, October 28, 2002.

"Phase II Storm Water Regulations – Compliance Strategies For The Gas Transmission/Distribution Industry," J.E. Huff, American Gas Association 2003 Operations Conference, Orlando, Florida, April 28, 2003.

"Endocrine Disruptors or Better Living Through Chemistry" J. E. Huff, Illinois Association of Wastewater Agencies Fall Meeting, Bloomington, IL, November 14, 2003.

"Emulsified Zero-Valent Iron: An Emerging Technology" J. E. Huff, Association of Environmental & Engineering Geologists-North Central Section, February 20, 2007 and ACEC-IL Environmental Seminar, Nov 2008.

"Permitting Wastewater Treatment Plant Expansions in Northeast Illinois in the 21st Century", J.E. Huff, 28th Annual Illinois Water Environment Association Conference, Bloomington, IL, March 6, 2007.

"How Storm Water Regulations Affect Pavers and Sweepers," L .L. Huff and J. E. Huff, National Pavers Association Conference, Las Vegas, NV, Nov 2008.

"Lessons Learned from the New Lenox Decision," R. Harsch, R. Sly, and J.E. Huff, Illinois Association of Wastewater Agencies, Annual Meeting, Springfield, IL, March 12, 2009.

"Implementation of Antidegradation in Illinois," Indiana ACEC Environmental Business Conference, Indianapolis, IN, September 16, 2009.

"Removal of Low Head Dams to Improve Water Quality and other DuPage River/Salt Creek Workgroup Watershed Management Efforts", J.E. Huff and D. Bounds, Illinois Association of Floodplain and Stormwater Management Annual Meeting, Tinley Park, IL, March 10, 2010.

"Emulsified Zero-Valent Iron, a Summary of Five Full Scale Applications", J.E. Huff, RemTec 2011, Wheeling, IL, May 17, 2011. Accepted for publication in *Remediation,* Fall 2011.

"Public Act 96-1416, Clean Construction and Demolition Debris Update, J.E. Huff, APWA 2011 Expo, Schaumburg, IL, May 26, 2011.

ATTACHMENT 2

PH DATA

First Environmental Laboratories, Inc. IL ELAP / NELAC Accreditation # 100292
1600 Shore Road • Naperville, Illinois 60563 • Phone (630) 778-1200 • Fax (630) 778-1233

Date: 09/28/11

To: Jim Huff (Huff & Huff)

From: Lorrie Franklin (First Environmental)

RE: CCDD Proposed Regulation 07/29/11

pH

The following information was obtained from our database for pH analyses performed from January 2006 to September 2011. The matrix for the samples in this database includes solid samples and "other" (other = non soil solid samples).

The database consists of 8500 sample analyses for pH.
8345 of samples analyzed have pH greater than pH 5.75
8300 of samples analyzed have pH greater than pH 6.25

This translates into only 200 data points or 2.35% having a pH less than 6.25.

I believe that a significant portion of the data points showing pH below 6.25 may be associated with non soil solid samples or "other" matrices, i.e., (waste materials subject to RCRA analysis).

Lorrie Franklin

Lorrie Franklin
Dirctor of Data Quality

1. Soils -- 2. Climate -- 3. Other -- General Information

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Soil

The most detailed Illinois GIS soil descriptions are STATSGO soil map units composed of similar soil types. Each map unit may include up to 21 individual soil types. Soil values used in this Web page are the weighted average values of the soil types contained within the STATSGO map unit; soil pH and texture are weighted averages of the surface soil layer only. The STATSGO map unit soil pH, texture, and drainage values are compared to crop requirements to obtain suitability scores for each soil characteristic.

Soil pH is a measure of acidity (hydrogen ion concentration). The pH values range from 0 to 14: 0 is most acidic, 7 is neutral, and 14 is most basic (lowest hydrogen ion concentration). Soil pH values range from ~3 to 10. Forest and bog soils of the humid east tend to be acidic and grassland and desert soils of the west tend to be basic.

Effect of pH on nutrient availability

Nutrient	pH									
	4	4.5	5	5.5	6	6.5	7	7.5	8	8.5
Nitrogen										
Phosphorus										
Potassium										
Sulfur										
Calcium										
Magnesium										
Iron										
Manganese										
Boron										
Copper/Zinc										
Molybdenum										

Note: Darker shading indicates greater availability.

Extremes of soil pH release substances from soils in amounts that can be toxic to plants. Acid soils may dissolve toxic amounts of metals (such as aluminum and manganese). Alkaline soils may accumulate salts and sodium carbonates in toxic concentrations that can alter soil structure, thereby making it difficult for roots to grow. Stunted root systems have trouble taking up adequate water and nutrients. Toxic metals in acid soils, subsoil nutrient depletion, and subsoil clay pans also stunt root growth.

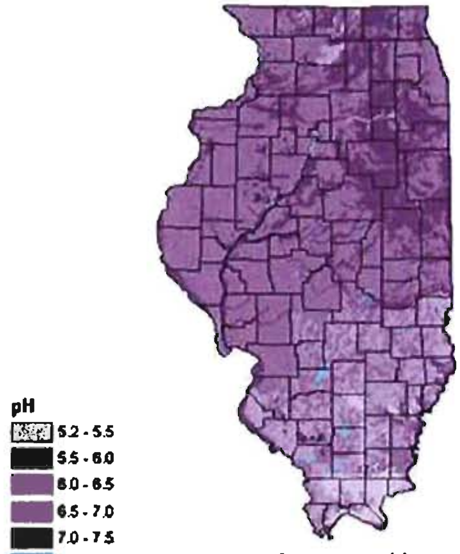
Slightly acidic soils (pH ~6.5) are considered most favorable for overall nutrient uptake. Such soils are also optimal for nitrogen-fixing legumes and nitrogen-fixing soil bacteria. Some plants are adapted to acidic or basic soils due to natural selection of species in these conditions. Potatoes grow well in soils with pH <5.5. Blueberries and cranberries grow well in even more acidic soils (<4.5) . Sugar beets, cotton, kale, garden pea, and many grasses grow well in alkaline soil (>7.5).

Soil pH also affects the soil in other ways. For example, soil microbe activity, particularly nitrogen-fixing bacteria may be reduced in acid soil.

Agricultural soils of Illinois tend to acidify to pH values more acidic than 6.5. This acidity is managed by adding lime (carbonates of calcium and magnesium). Average soil pH values vary from mildly alkaline (7.0-7.5) to strongly acid (5.2-5.5) in extreme southern Illinois.

The Natural Resources Conservation Service has set standard soil pH classifications.

pH classifications	*pH values*
Extremely acid	< 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Medium acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Mildly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	> 9.0



Average pH

DRAINAGE rate refers to the rapidity and extent that water is removed from a soil by surface runoff, underground flow through the soil, and evaporative loss. Drainage also refers to soil drainage status — the frequency and duration with which soil is waterlogged. In Illinois' climate, the drainage rate coincides with soil drainage status. If drainage is very rapid, the soil is excessively drained. If drainage is very slow, the soil suffers from excessive waterlogging and is very poorly drained.

Soil drainage extremes present the same types of problems for crops that extremes of soil pH do. Excessively drained soils do not provide most crops with adequate water and nutrients, and the structure of the soil limits root growth. Additionally, excessively drained soils tend to warm early and generally undergo marked temperature fluctuations. Water and nutrient availability are also limited in poorly drained soils because oxygen deficiency limits the ability of roots to take up adequate water and nutrients. With waterlogging, putrefaction sets in. Putrefaction occurs when partially decomposed organic matter accumulates, clogging soil pores and blocking root growth and the drainage of water through soil. Putrefaction produces toxic substances: reduced nitrogen, sulfur, metals, and organic fermentation products. Furthermore, it produces methane, a gas that attacks the atmosphere's self-cleansing system. Additionally, poorly drained soils tend to warm up slowly in the spring and reduce the length of crop growing seasons.

Illinois' drainage problems are principally those of poor drainage. Ditching and subsurface tiling typically improve drainage. With improved drainage, excessive organic matter is destroyed due to decomposition by oxidation rather than putrefaction. Root and soil fauna penetration of subsoil improves soil drainage and structure. The soil's large store of organic nitrogen undergoes oxidation to water-soluble nitrate. With good drainage, nitrate may drain into groundwater and surface water at rates detrimental to water quality. The map below depicts average drainage for Illinois soils. The sandy soils in Mason and Will counties are unlike the majority of Illinois soils, which are moderately well to poorly drained.

The NRCS assigns soils to one of the following eight drainage classes:

Excessively drained
Semi-excessively drained
Very well drained
Well drained
Moderately well drained
Semi-poorly drained
Very poorly drained
Poorly drained

Texture describes the proportion of sand, silt, and clay in a soil. The relative proportion and physical properties of these separates (i.e., particles) affect drainage, water storage capacity, aeration, permeability, and other soil properties.

Average Drainage

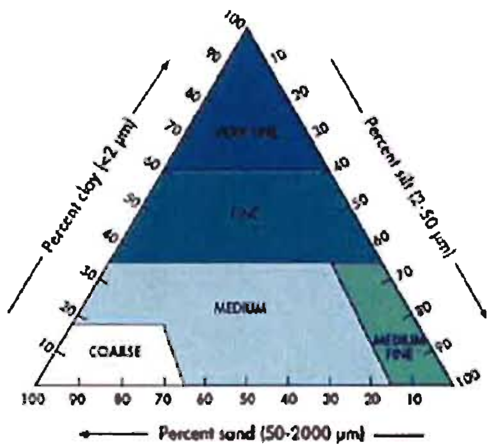
Sand, the largest sized particle (> 0.5 millimeters or mm), has small surface area for its mass. This, in turn, prevents sand from holding significant water or nutrients. Sand, therefore, reduces the amount of a soil's physical and chemical activity. Sand increases the spaces between particles, letting air and water readily enter and exit the soil.

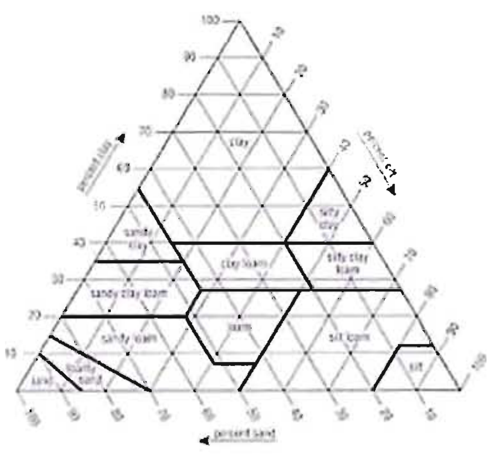
Clay, the smallest sized particle (< 0.002 mm), has the greatest surface area. Clay particles have a millionfold more surface area per mass than silt. Clay is capable of holding large amounts of water and nutrients but may prevent the release of water for plant use.

Silt is intermediary between sand and clay in size, water and nutrient retention, and chemical and physical activity. It has approximately four times the surface area of sand. Soils with large proportions of silt provide greater amounts of water for plant use than other soils.

In addition to sand, silt, and clay, soil is made up of water, air, organic matter, and other larger mineral matter. The coarse fragments of mineral matter are named by their size, shape, and composition. Examples of these coarse fragments are gravel, stones, flagstone, and chert. The amount of organic matter varies. As a general rule, the darker the soil, the higher the organic matter (and productivity). Mucks and peat soils are examples of soils extremely high in organic matter.

Any separate alone would not be a desirable soil. Blends of these separates form soil textures, and some are ideal for plant growth. The soil texture triangle is a method of simultaneously representing the percentage of each separate in a soil. The first soil texture triangle is labeled with general texture class names. The second soil texture triangle is labeled with the soil texture class names used by the United States Department of Agriculture-Natural Resource Conservation Service.

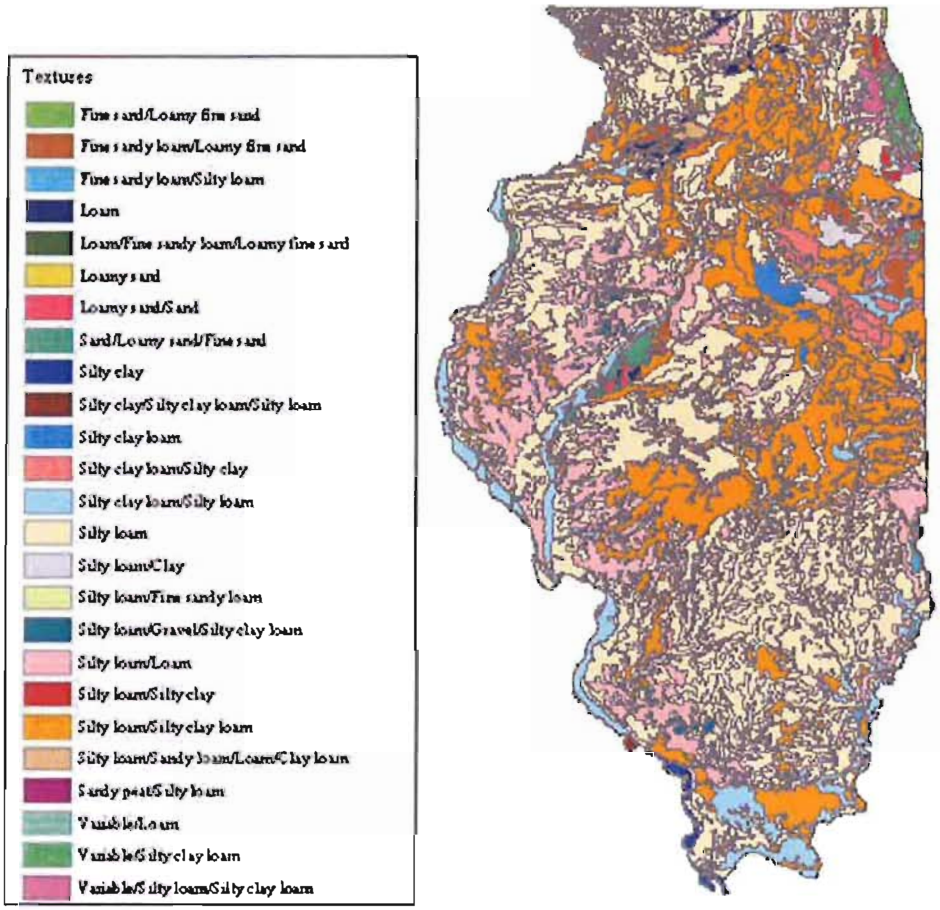




Soil Survey Manual -United States Department of Agriculture

Soil texture triangle with general texture classes

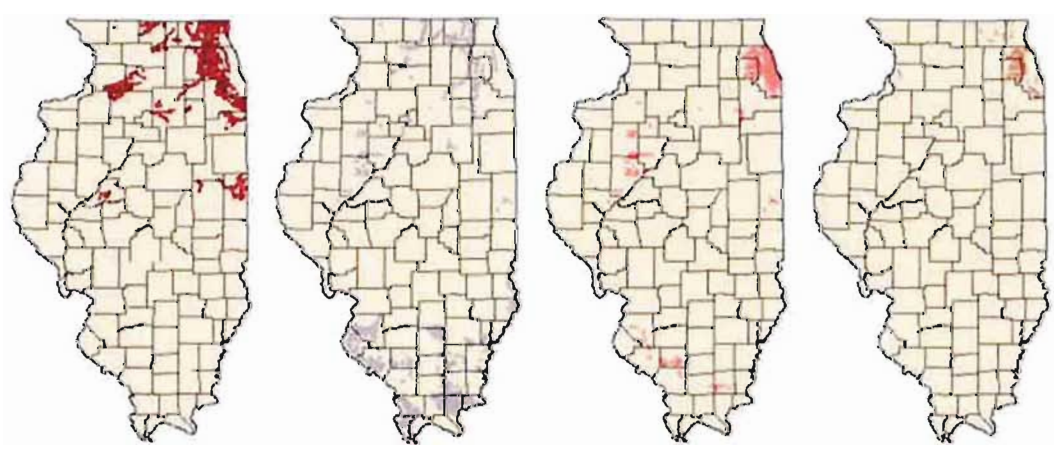
USDA-NRCS soil texture triangle



Predominate Soil Textures

The map above identifies the predominant (>16% area) soil textures within STATSGO map units.

Disturbed soils, such as urban areas and reclaimed stripmines, occur in Illinois. These soils are the result of removal and/or addition of soil or other materials. The maps below highlight map units that contain atypical soil types.



Muck	Coarse Fragment	Disturbed Soils	Sandy Peat

Soil pH, drainage, and texture requirements are available for many crops and were therefore used to create suitability maps. Other soil properties with impacts on crop growth and development are soil depth, organic matter content, permeability, cation exchange capacity, salinity, and fertility. Information on the plant requirement for these soil characteristics was limited to a few crops and therefore were not included in this discussion.

1. Soils - 2. Climate - 3. Other - General Information

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Illinois State Water Survey, Contact Information
University of Illinois at Urbana-Champaign