

State Regulation of Fly Ash Use in Subbase Stabilization and Fill for Highway Construction in the Minnesota Region

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Andrew Weithe, Paul R. Bloom*, and Thomas Halbach
Department of Soil, Water, and Climate, University of Minnesota

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*Principle Investigator and corresponding author
Paul Bloom
Professor of Soil Science
University of Minnesota
1991 Upper Buford Circle, Rm 439
St. Paul MN 55108
phone; 612-625-4711
email: prb@umn.edu

Introduction

Combustion of coal typically produces 10% or more (w/w) of inorganic ash. Large quantities of ash, also known as coal combustion products, are produced annually; while some ash is utilized, as in Portland cement, much of it is considered a waste in need of disposal. In 2003 the American Coal Ash Association (ACAA) estimated annual production of coal combustion product (CCP) at 128.7 million tons, with 45.5 million tons being utilized (EPA, 2005). With over 83 million tons of CCPs being landfilled each year it is important to evaluate ways to reduce the amount of coal ash discarded as waste (EPA, 2005).

As long as humans have lived in established settlements the methods by which waste has been disposed of have been important. While recycling in the modern sense, whereby materials are converted or recomposed to a new product with chemical or mechanical alteration in designated facilities, is relatively new, the practice of taking a waste material and turning it into something that can be useful has been employed for thousands of years. In modern societies where very large quantities of industrial waste like coal ash are produced it is of particular importance to find uses for these waste products wherever possible.

Efforts in Minnesota to maximize resource use efficiency by reducing waste have been increasing in recent years. Under the provisions of Minnesota rule Ch. 7035, the Minnesota Pollution Control Agency (MPCA) allows waste generators to identify beneficial uses for wastes rather than sending them to a landfill or holding them in long-term storage.

The MPCA approach toward beneficial use of waste is consistent with that of the USEPA. Under Minnesota rule Ch. 7035, to qualify as beneficial a solid waste use must meet the following criteria:

- the solid waste must not be stored in anticipation of speculative future markets;
- the solid waste must be adequately characterized in accordance with part 7035.2861;
- the solid waste must be an effective substitute for an analogous material or a necessary ingredient in a new product;
- the use of the solid waste does not adversely impact human health or the environment; and
- the solid waste used must not be used in quantities that exceed accepted engineering or commercial standards. (excess use of solid waste is considered disposal)

Determinations within this rule that allow for a specific beneficial use are designated as either a standing beneficial use determination (SBUD) or a case specific beneficial use determination (CSBUD). When an SBUD is issued the generator or end user of a material can use the waste in accordance with 7035.2860 without contacting the agency; when a CSBUD is issued the agency makes a case-by-case determination on whether the proposed management option for the specific solid waste is a beneficial use. The use of coal combustion ash currently has a standing beneficial use determination for use as a pozzolan or cement replacement in concrete, and as an ingredient for production of aggregate that will be used in concrete or concrete products. These beneficial use

determinations do not include use as flowable fill or as a stabilizing agent in soil stabilization, however the MPCA has issued a CSBUD authorizing the Aggregate and Ready Mix Association of Minnesota to use coal fly ash as an ingredient in flowable fill. Xcel Energy also has a CSBUD for fly ash from its Black Dog, High Bridge, and Riverside 6 and 7 facilities for use in soil stabilization.

The USEPA has conducted two regulatory determinations on the management and use of coal combustion products, one in 1993 and one in 2000. The EPA did not identify any environmental harm associated with the beneficial use of coal combustion products if proper management practices are followed, and concluded that these materials did not need to be regulated as hazardous waste (EPA, 2005). As a result of this, it is the position of the USEPA that beneficial use of CCPs is an important component for meeting future waste reduction goals with the purpose of conserving natural resources and energy.

Coal ash is a complex mix of combustion products. Fly ash is entrained in the combustion gases, and bottom ash is the ash material that settles to the bottom of the combustion chamber. Some fly ashes are high in calcium and are designated as Class C according to American Society for Testing Materials specification C 618 (ASTM C 618), while ashes high in iron are designated as Class F. Addition of good quality Class C fly ash to concrete increases its strength and there is a high demand for this type of ash; use of fly ash in concrete and concrete products was in excess of 14 million tons nationally in the most recent coal combustion products use survey (ACAA, 2005).

Most of the current effort in expanding the use of CCP is focused on finding uses for ashes that do not have the properties needed for use in concrete. This includes use of fly ash in road construction for stabilization of sticky clayey soil and in mixes of sand and ash for fill around pipes, bridge abutments, in trenches, and other flowable fill applications. Where these uses have been proposed state regulators and highway departments have had to respond to define acceptable versus unacceptable limits of fly ash utilization. Each state has faced this problem in a different way. In this review we present the approaches taken by states adjacent to Minnesota.

All the states surrounding Minnesota have at least experimented with the practice of using coal ash in flowable fill and soil stabilization applications. The ACAA has published a manual entitled "Soil and Pavement Base Stabilization with Self-Cementing Coal Fly Ash" that provides design information on the use of coal fly ash in soil stabilization, which has been used by some states in developing procedures and application standards (Ferguson and Levorson, 1999). Additionally, several engineering studies have been conducted to evaluate the usefulness of fly ash as a means to stabilize soils for engineering purposes. One specific study of note was conducted by researchers at Iowa State University, the results of which were published in two volumes in April of 2005 (White et al., 2005). This study was conducted to develop a broader understanding of fly ash engineering properties, and the results showed that soil compaction characteristics, compressive strength, wet/dry durability, freeze/thaw durability, hydration characteristics, rate of strength gain, and plasticity characteristics are all improved by the addition of fly ash. Among the conclusions were that fly ashes are effective at stabilizing fine-grained Iowa soils, which are similar to many soils found in Minnesota, for earthwork and paving operations.

Below is a brief comparative summary, followed by the compilation of the comprehensive guidelines and rules for each state.

Table 1 - Comparative Summary of State Guidelines and Rules for Coal Ash

	Fly Ash for Fill	Fly Ash for Soil Stabilization
Illinois	Regulation in IL Environment Act; required to not exceed Class I Groundwater Standards for metals in water leachate; notification of project to IL EPA not required for projects utilizing <1000 cubic yards.	Regulation in IL Environment Act; may be used providing coal combustion byproduct (CCB) meets IDOT specs for soil modifier; notification of project to IL EPA not required.
Iowa	Regulation in Adm. Code; must have management plan; if fill not covered, must pass leach test and have total metals risk analysis; must meet pH and placement requirement; source of material must be approved for IDOT projects.	Regulation in Adm. Code; must have management plan; is not subject to leach test or risk analysis if under pavement; no additional requirements by IDOT.
Manitoba	Currently Manitoba's Department of Transportation & Government Services approves lagoon ash as a mineral filler for base, sub-base, and roadway embankments; lagoon ash is a by-product of the combustion of coal, and is a mixture of 75% fly ash and 25% bottom ash combined in a lagoon.	The Department approves the use of lagoon ash as a filler only, but does not attempt to stabilize the base or sub-grade; lagoon ash is approved as fine material for unstabilized base and sub-base aggregates, and as an embankment material for roads requiring a minimum cover.
North Dakota	No rules specific for beneficial use of coal combustion byproducts; the North Dakota Department of Health's Division of Waste Management is responsible for approvals and regulation; some broad approvals have been granted.	No rules specific to beneficial use of coal combustion byproducts; the North Dakota Department of Health's Division of Waste Management is responsible for approvals and regulation; no broad approvals have been granted.
South Dakota	No formal guidelines, regulations, or statutes related to the beneficial reuse of fly ash; regulated case-by-case by SD DENR.	No formal guidelines, regulations, or statutes related to the beneficial reuse of fly ash; regulated case-by-case by SD DENR.
Wisconsin	Regulation in Adm. Code; must pass total elemental analysis and water leach test for Category 4 Industrial Byproduct; no WisDOT requirements beyond what's in Adm. Code.	Regulation in Adm. Code; must pass total elemental analysis and water leach test for Category 4 Industrial Byproduct; must meet WisDOT special requirements for materials and construction methods specified in Department documents.

Illinois

Illinois – State Regulation

- Illinois has provisions for the re-use of coal combustion by-products written into law. Chapter 415 of Illinois state statutes is entitled “Environmental Safety” and contained therein is the Environmental Protection Act, 415 ILCS 5/. Title I, General Provisions, of this Act includes Section 3.140 which defines coal combustion waste and Section 3.135 which defines coal combustion by-product for the purposes of legislation and how it may be used.
- According to Sec. 3.140, “Coal combustion waste” means any fly ash, bottom ash, slag, or flue gas or fluid bed boiler desulfurization by-products generated as a result of the combustion of:
 1. coal, or
 2. coal in combination with: (i) fuel grade petroleum coke, (ii) other fossil fuel, or (iii) both fuel grade petroleum coke and other fossil fuel, or
 3. coal (with or without: (i) fuel grade petroleum coke, (ii) other fossil fuel, or (iii) both fuel grade petroleum coke and other fossil fuel) in combination with no more than 20% of tire derived fuel or wood or other materials by weight of the materials combusted; provided that the coal is burned with other materials, the Agency has made a written determination that the storage or disposal of the resultant wastes in accordance with the provisions of item (r) of Section 21 would result in no environmental impact greater than that of wastes generated as a result of the combustion of coal alone, and the storage disposal of the resultant wastes would not violate applicable federal law. "Agency" is the Illinois Environmental Protection Agency established by the Environmental Protection Act.
- According to Sec. 3.135, “Coal combustion by-product” (CCB) means coal combustion waste when used beneficially in any of nine specifically defined applications. The nine specifically defined applications are:
 - Use in the stabilization of soils providing the CCB meets the IDOT specifications for soil modifiers (see IDOT specifications below).
 - Bottom ash used in non-IDOT pavement sub-base or base, pipe bedding, or foundation backfill.
 - Structural fill in an engineered application or combined with cement, sand, or water to produce a controlled strength fill material and covered with 12 inches of soil unless infiltration is prevented by the material itself or other cover material.
 - CCB used
 - (A) in accordance with Department of Transportation ("IDOT") standard specifications and a subsection of the Section in which the applications are listed or
 - (B) under the approval of the Department of Transportation for IDOT projects.
 - The extraction or recovery of material compounds within CCB.

- The use of CCB as a raw ingredient or mineral filler in the manufacture of certain commercial products, which are listed. Some of those listed are: cement; concrete and concrete mortars; asphalt or cementitious roofing products; asphaltic concrete, or asphalt based paving material.
 - Bottom ash used as antiskid material, athletic tracks, or foot paths.
 - CCB as a functionally equivalent substitute for agricultural lime as a soil conditioner.
 - Mine subsidence, mine fire control, mine sealing, and mine reclamation.
- Provisions for testing and handling under Sec 3.135 include the following:
 - Coal combustion by-products including any prescribed mixture of fly ash, bottom ash, boiler slag, flue gas desulfurization scrubber sludge, fluidized bed combustion ash, and stoker boiler ash, shall be tested as intended for use.
 - Fly ash is required to be managed in a manner that minimizes the generation of airborne particles and dust using techniques such as moisture conditioning, granulating, inground application, or other demonstrated method.
 - Coal combustion by-products are not to be accumulated speculatively. Coal combustion by-product is not accumulated speculatively if during the calendar year, the CCB used is equal to 75% by weight or volume of the CCB accumulated at the beginning of the period.
- Coal combustion by-products may be used for structural fill in an engineered application or combined with cement, sand, or water to produce a controlled strength fill material and covered with 12 inches of soil unless infiltration is prevented by the material itself or other cover material.
 - CCB used as structural fill is required to:
 - not have been mixed with hazardous waste prior to use
 - if not covered with an engineered barrier the ash cannot exceed Class I Groundwater Standards for metals when tested utilizing ASTM D3987-85 Test Method for Shake Extraction of Solid Waste with Water. The Class I Groundwater Standards are defined in Illinois Administrative Code, 35 Ill Adm. Code 620.410; the standards for metals are in Appendix A. The sample or samples tested shall be representative of the CCB being considered for use.
 - If the fill is protected from infiltration by an engineered barrier, e.g. 2 ft. of clay or pavement, the fly ash is not required to meet the Class I Groundwater Standards (Riyad Wahab, personal communication, March 2006).
 - Unless otherwise exempted, users of CCB for structural fill shall provide notification to the Agency for each project utilizing CCB documenting the quantity of CCB utilized and certification of compliance with the conditions regarding mixture with hazardous waste and Class I Ground Water Standards for metals. Notification shall not be required for users of

CCB for the purpose of soil stabilization, nor for flowable fill/grout projects utilizing less than 1,000 cubic yards.

- Coal combustion by-products may be used in the stabilization of soils under pavement without chemical analysis providing the CCB meets the IDOT specifications for soil modifiers. These specifications are outlined below.

Illinois – Department of Transportation Specifications

- Both Class F and Class C fly ash can be use in fill applications (Riyad Wahab, personal communication, March 2006).
- The Illinois Department of Transportation (IDOT) has specifications for the use of fly ash as a soil modifier (i.e. soil stabilization). These specifications (special provisions) are not in the current IDOT Geotechnical Manual, but can be found on the department’s website. Section 302 of these provisions describes what soil modification entails as well as the guidelines for materials, equipment, proportioning, and construction requirements.
- Under Section 302 it is stipulated that fly ash used in soil modification shall meet the physical and chemical requirements of American Association of State Highway and Transportation Officials (AASHTO) M 295 Class C (see Appendix K). No additional elemental limits or analyses are required.
- The full document regarding soil modification can be found at the IDOT website at <http://www.dot.il.gov/desenv/pdf/80135.pdf>. Some of the more relevant construction requirements related to the use of fly ash in soil modification are as follows:
 - The modified soil shall be constructed when the temperature of the soil, measured 150 mm (6 in.) below the surface, is above 10 °C (50 °F); and the ambient air temperature in the shade is above 7 °C (45 °F). The quantity of modified soil constructed shall be limited to that which can be covered by the succeeding pavement layer during the same construction season.
 - The modifier shall be applied uniformly on the soil. The application of modifier shall be limited to that amount which can be incorporated into the soil within the same working day.
 - After application of dry modifiers, but before the addition of any water, the surface of the subgrade shall be lightly scarified or disked.
 - Dry modifiers shall not be applied when wind conditions are such that blowing modifier becomes objectionable to adjacent property owners or creates a hazard to traffic on adjacent highways, as determined by the Engineer.
 - The modifier, soil, and water shall be thoroughly mixed. Mixing shall continue until a homogeneous layer of the required thickness has been obtained and a minimum of 75 percent of the mixture is smaller than 25

mm (1 in.). The moisture content of the modified soil shall be between optimum and three percent above optimum.

- For soil modification with fly ash, more than one pass of the rotary speed mixer may be necessary to obtain a homogenous mixture. If more than one pass of the rotary speed mixer is required, the application of the fly ash shall be modified such that 25 percent of the specified fly ash quantity is applied and mixed with a down-cut motion as a preparation for the final pass of the rotary speed mixer. The remaining specified quantity of fly ash shall be applied prior to the final pass of the rotary speed mixer. Mixing shall continue until a minimum 75 percent of the mixture is smaller than 25 mm (1 in.).
- Compaction of soil modified with portland cement, slag-modified portland cement, or fly ash shall be completed no later than one hour after mixing begins. The compacted, modified soil shall have a minimum dry density of 95 percent of the laboratory standard dry density. The in place dry density will be determined according to AASHTO T 191, or Illinois Modified AASHTO T 310 (Direct Transmission Density/Backscatter Moisture). The laboratory standard dry density will be determined according to AASHTO T 99 (Appendix K).
- Following curing, or after compaction when no curing is performed, the Engineer will determine the stability of the modified soil in terms of the immediate bearing value (IBV), according to Illinois Test Procedure 501. The IBV shall be a minimum of 10.0. No equipment or traffic shall be on the modified soil after compaction until the required IBV is attained.

Iowa

Iowa – State Regulation

- The regulation of fly ash in Iowa is specified under Chapter 108 of Iowa Administrative Code on environmental protection, which has the stated purpose “to establish rules for determining when a solid by-product is a resource and not a solid waste.” It then goes on to state that “solid by-products determined by the department not to be a solid waste through a beneficial use determination may not be subject to all sanitary disposal project (SDP) permitting requirements. Furthermore, the purpose of this chapter is to encourage the utilization of solid by-products as resources when such utilization improves, or at a minimum does not adversely affect, human health and the environment.”
- Chapter 108 defines a ‘solid by-product’ as “a secondary material or residual, produced or created by an industrial, commercial or institutional process or activity, that has been source separated by the generating entity and that would otherwise be disposed of as solid waste. Solid by-products are composed of materials suitable for disposal as solid waste in a sanitary landfill.”
- Chapter 108 defines ‘coal combustion by-product’ as “any solid by-product produced by the burning of coal, by itself or in conjunction with natural gas or

other fossil fuel, which is suitable for disposal as solid waste in a sanitary landfill.”

- Additionally, this chapter makes a distinction between ‘fill material’ and ‘subbase for hard-surface road construction.’ It is stated that for the “purposes of this chapter, subbase for hard-surface road construction is not considered fill material.” This is an important distinction because fill material is subject to specific requirements for composition and placement that other beneficial uses are not. Coal combustion fly ash may be used as fill material, subbase for hard-surface road construction, and soil stabilization for construction purposes pursuant to 108.6(1), without further approval from the department, as permitted by 567-108.4(455B,455D).
- Fly ash used as subbase for hard-surface road construction and in soil stabilization covered with pavement for construction purposes does not need to comply with 108.6(1) because it is considered to be encapsulated and not exposed to the environment. As for all uses of fly ash, though, it must have a management plan under 108.6(2) (Jeff Myrom, personal communication, Nov. 2005 and Feb. 2006).
- A management plan for all coal combustion by-product uses is required by Administrative rule 567-108.6(2) and must satisfy the following requirements:
 - a. Lists the source(s) of the solid by-product (see Appendix C).
 - b. Lists procedures for periodic testing of the solid by-product to ensure that the chemical and physical composition has not changed significantly.
 - This refers to the composition of fly ash coming from the generating facility. The Iowa DNR requires that any changes affecting the composition of the ash being used such as changing of the fuel source, or operational changes such as installation of a different boiler or a different type of emission system be made known to the Department. The DNR requires this information so that it may ensure testing procedures are in place and that any new by-product meets current regulations (Matt McDonald, personal communication, Feb. 2006).
 - c. Provides a description of storage procedures including:
 - (1) Storage location(s).
 - (2) Maximum anticipated inventory, including dimensions of any stockpiles.
 - (3) Run-on and run-off controls, which may include a storm water National Pollutant Discharge Elimination System (NPDES) permit.
 - (4) Management practices to minimize uncontrolled dispersion of the solid by-product.
 - (5) Maximum storage time, not to exceed six months unless authorized in writing by the department.
- All materials used as fill in applications where it is not encapsulated must meet the following requirements:

- a. Leachate characteristics of the solid by-product shall be measured by the synthetic precipitation leaching procedure (SPLP, EPA Method 1312) and shall be less than or equal to ten times the maximum contaminant levels (MCL) for drinking water. Foundry sand and coal combustion by-products may limit the SPLP analytes to total metals for drinking water; organics and anions need not be included. The SPLP is a pH 4.2 HCl/HNO₃ solution with no buffering; with ash this solution is not expected to leach very much more than the ASTM distilled water procedure.
- b. The Iowa regulations also include rules dealing with the human health consequences of direct contact with ash modified soil materials that are not well covered, using standard risk analysis procedures that are similar to those used for developing the MPCA soil reference values (SRV). Total metals testing results, which shall include thallium, shall be consistent with the department's statewide standards for soil pursuant to 567—Chapter 137 (Appendix B). Chapter 137 details how toxicology data tabulated by USEPA are to be used to determine the risk due to ingestion. The calculations in this chapter can be modified by Iowa DNR staff for different exposure scenarios (Myrom, personal communication, Feb. 2006). Arsenic levels shall be consistent with the statewide standards for soil or the naturally occurring (i.e., background) arsenic levels of the soil, whichever are greater.
- c. The solid by-product shall produce a fill that has a pH:
 - (1) Greater than or equal to 5 and less than or equal to 8 if the fill may be used as growing media either now or in the future.
 - (2) Greater than or equal to 5 and less than 12 if the fill is specifically intended not to be used as growing media either now or in the future. In this category of fill, materials with a pH equal to or greater than 10 but less than 12 shall be used only in areas where direct physical contact by humans for long periods of time is not expected to occur.
 - (3) For deep fills where only the surface may serve as growing media either now or in the future, then at a minimum the top three feet shall have a pH greater than or equal to 5 and less than or equal to 8. Fill material below the top three feet shall have a pH greater than or equal to 5 and less than or equal to 12.
- d. The by-product shall not be placed in a waterway or wetland or any waters of the state or extend below or within five feet of the high water table.
- e. The by-product shall not be placed within the 100-year flood plain unless in accordance with all local and department regulations including rule 567—71.5(455B).
- f. The by-product shall not be placed closer than 200 feet to a sinkhole or to a well that is being used or could be used for human or livestock water consumption.
- g. The by-product shall not be putrescible.

Iowa – Department of Transportation Specifications

- Iowa Department of Transportation – Office of Materials

- Document Matls. IM 491.17 gives rules for acceptance of fly ash for IDOT projects including use in concrete, fill, and soil stabilization: “Acceptance of fly ash be on the basis of approved sources and upon satisfactory test results on samples obtained at the project site. Test results of fly ash shall meet the requirements of ASTM C618 and the Specifications of the Iowa Department of Transportation.”
 - Appendix A to Matls. IM 491.17 lists the approved certified sources of Class C fly ash and Class F fly ash, as of October 18, 2005 (see Appendix C).
- According to Robert Stanley of the Iowa DOT Office of Design, Iowa DOT does not have any specific guidelines on the use of fly ash in roadway earthwork construction; it is mostly used in subbase stabilization applications under pavement (Stanley, personal communication, Dec. 2005). Their practice, except maybe in a few minor projects and/or applications, is to not use fly ash in/with roadway earthwork construction as a design feature. They do use fly ash occasionally as a "construction aid" to help stabilize soft, wet, unstable areas that are encountered and need to be dealt with during earthwork operations in areas that will not be paved.

Manitoba

- Manitoba’s Department of Transportation & Government Services approves lagoon ash as a mineral filler for base, sub-base, and roadway embankments. The lagoon ash is a by-product of the combustion of coal, and is a mixture of 75% fly ash and 25% bottom ash combined in a lagoon.
- The Department approves the use of lagoon ash as a filler only, but does not attempt to stabilize the base or sub-grade. The lagoon ash is approved as fine material for unstabilized base and sub-base aggregates, and as an embankment material for roads requiring a minimum cover.

North Dakota

North Dakota – State Regulation

- North Dakota has no rules specific to beneficial use of coal combustion byproducts. The Division of Waste Management within the North Dakota Department of Health has published a document called Guideline 11 – Ash Utilization for Soil Stabilization, Filler Materials, and Other Engineering Uses (Appendix E). This is a four-page document that details the information the Department of Health needs in order to review a proposal for a beneficial reuse. According to Steve Tillotson, the Assistant Director of the Division of Waste Management, their approach so far has been to describe or work out processes where they agree the material is being beneficially used and thus does not pose significant pollution risks and thus is not viewed as waste (Tillotson, personal communication, Dec. 2005). Their approvals have some conditions, and the Department may consider rules in the future.

- Guideline 11 states that some projects such as road stabilization "have been reviewed and approved by the Department based on an evaluation of the material's engineering and environmental properties." It then goes on to state that "persons proposing use of waste materials for beneficial use of waste materials for beneficial reuse need to demonstrate that the material will be beneficially used without adversely impacting the environment." A clarification of this was provided by Steve Tillotson, in which he stated that the Department has approved some entities (primarily mine operators who build roads) to use CCB under a broader approval if they have demonstrated the ability to control environmental issues and address concerns (Tillotson, personal communication, Dec. 2005). With others, it is case by case, evaluating the waste, the site, the application, and other factors.
- Generally the guideline applies either case-by-case or for some broader approval. The Department has approved some specific generators for wider uses such as flowable fill, admixture for underground mine reclamation, and a few others. The Department is aware of growing interest in getting broader approvals for soil stabilization and road construction, but there are no specific broad approvals granted.
- The Parameters and Methods for Assessing Leachability of Fly Ash and Runoff from Fly Ash Utilization Sites in North Dakota indicate that fly ash material itself should test below state or federal drinking water standards for each substance listed, using a modified version of EPA SPLP method 1312 (see Appendix E). However, the Department has recognized that individual materials may exceed the state or federal drinking water standards for certain parameters, but that this does not necessarily preclude some uses (Tillotson, personal communication, Dec. 2005). It might necessitate additional controls on project components such as use, site selection, water controls, implementation or management practices.

North Dakota – Department of Transportation Specifications

Provisions outlined below are for, what is stated to be, lime fly ash treated subgrade.

- Fly ash shall be from an electrical generating plant using a single coal source. The Contractor shall provide weather-tight storage facilities for the fly ash either at the source or on the Project site.
- Fly ash delivered to the Department and the Project shall be accompanied by a Certificate of Compliance based on a testing program which ensures a satisfactory and uniform product relative to these Specification requirements.
- The roadbed material shall be scarified or disked to a depth of 6 inches, 12 inches, 18 inches, 24 inches, or more as required. The bottom 6 inches of the scarified or disked depth shall remain on the roadway, mixed with lime, and worked in place.

The subgrade shall be replaced in 6 inch lifts, aerated, mixed with lime or lime-fly ash, and recompact as directed by the Engineer.

- The lime or lime-fly ash shall be spread by dry application or slurry at the rates shown on the Plans. The lime and fly ash may be applied together or separately, provided the lime is applied before the fly ash. Both lime and fly ash shall be distributed uniformly without loss of material by wind or other causes. Lime or fly ash shall not be applied by dry application when the wind is 15 mph or greater.
- Slurry shall be used in areas adjacent to residential or other developed areas so the lime or lime-fly ash does not damage, discomfort, or be an inconvenience to public or private property.
- The slurry shall be applied through pressurized distributing spray bars. Adequate means of accurately determining distribution of lime or lime-fly ash on each area shall be provided.
- The slurry may be applied directly to the scarified or disked subgrade, provided no loss of lime or lime-fly ash slurry is evident and uniform distribution into the soil can be made.
- The lime or lime-fly ash shall be thoroughly mixed with the material to be processed with enough water added to the mixture to maintain not less than optimum moisture content.
- Compaction shall begin immediately after the material has been spread to the specified section.
- If 6 inches are scarified or disked, the 6 inches shall be compacted until a uniform specified density is obtained. If more than 6 inches are scarified or disked, the top 12 inches shall be compacted until a uniform specified density is obtained.

South Dakota

South Dakota – State Regulation

- South Dakota regulations were adopted by reference to the federal regulations which exempt CCBs from classification as hazardous waste. Exempt from hazardous waste regulation are fly ash, bottom ash, slag, and flue gas emission control waste generated primarily from the combustion of coal, S.D. ADMIN. R. 74:28:22; 40 CFR 261.4.
- Coal combustion ash is regulated by the South Dakota Department of Environment and Natural Resources' Solid Waste Program. Some beneficial reuse of fly ash is occurring in South Dakota, but according to the Department it is limited mostly to use for soil stabilization purposes in feedlot settings and it is

limited primarily to northeastern SD where the state's one large coal power plant, the Big Stone Plant near Milbank, is located.

- South Dakota does not have any formal guidelines, regulations, or statutes related to the beneficial reuse of fly ash. The South Dakota DENR is aware of its use and has inspected feedlots where the fly ash has been used, but to date, have not deemed it necessary to formalize any guidelines or rules for its use (Jim Wendte, personal communication, Dec. 2005).

South Dakota – Department of Transportation Specifications

- At this time the South Dakota Department of Transportation does not have formal guidelines for the use of fly ash in soil stabilization. The specifications in the South Dakota DOT's 2004 Standard Specifications for Roads and Bridges were written for the use of fly ash as a cement or grout additive; they were not intended to be used in a subgrade stabilization or fill applications.
- They have only recently begun to use fly ash as a subgrade modifier for roads and their experience is limited to one project where an attempt was made to bind the top of a very silty subgrade. The procedures and calculation of application rates for this project were taken from the ACAA publication "Soil and Pavement Base Stabilization with Self-Cementing Coal Fly Ash" (Ferguson and Levorson, 1999). The fly ash material used on this project was Class C; Department officials determined that the use of Class F for subgrade stabilization is not practical due to the need to add lime to get the cementing action. At this time it is the position of the SD DOT that all future use of fly ash for subgrade stabilization will be Class C.

Wisconsin

Wisconsin – State Regulation

- Chapter NR 538 Wisconsin Administrative Code on beneficial use of industrial byproducts has the following stated purpose: "to allow and encourage to the maximum extent possible, consistent with the protection of public health and the environment and good engineering practices, the beneficial use of industrial byproducts in a nuisance-free manner. The department encourages the beneficial use of industrial byproducts in order to preserve resources, conserve energy, and reduce or eliminate the need to dispose of industrial byproducts in landfills." The "department" is the Wisconsin Department of Natural Resources.
- NR 538 defines an industrial byproduct as "papermill sludge, ash from energy recovery including coal ash and slag, material captured in flue gas desulfurization systems, ferrous and steel foundry excess system sand and slag, lime kiln dust or non-hazardous solid waste with similar characteristics as determined by the department."

- NR 538, specifically NR 538.06, defines parameters for industrial byproduct characterization by putting them into one of five categories based on results of ASTM D3987-85 water leach tests and total elemental analyses performed using EPA SW-846 Methods (see Appendix K). Category 1 byproducts are deemed suitable for the broadest range of beneficial use applications; Category 5 byproducts are those that fail to meet the standards necessary to be placed in Categories 1-4, but are not classified as hazardous wastes. The criteria for each of these categories are in Appendix H.
- According to Wisconsin's Industrial Byproduct Category system, industrial byproducts that fit into categories 1-4 are suitable for use in confined geotechnical fill. To be in category 4, fly ash must meet the standards for the leach test only for boron, cadmium, chromium, selenium, silver, and sulfate. The standards are essentially 5 times MCL values, which is a somewhat less strict standard than the 10X standard used by Iowa, except that fewer analytes are specified. According to Table 4 of NR 538 Appendix J, confined geotechnical fill includes, though is not limited to: commercial, industrial or institutional building subbase; paved lot base, subbase and subgrade fill; paved roadway base, subbase and subgrade fill; soil and pavement base stabilization; flowable fill (see Appendix G). A recent paper by Bin-Shafique et al. (2006) presents data for cadmium, chromium, selenium, and silver from five power plants, including the King plant in Minnesota, that show typical fly ash sources in the region are safe by the Wisconsin standards.
- The section defining beneficial uses, NR 538.10, includes the following rules for base course, subbase, or subgrade fill for the construction of a paved, federal, state or municipal roadway:
 - Industrial byproducts placed as part of construction of the paved federal, state or municipal roadway may not extend beyond the subgrade shoulder point and the depth of the fill may not exceed 4 feet except for incidental sections of the fill. Any area where industrial byproducts are not directly beneath the pavement structure shall be sloped to prevent ponding of water, covered with base course or native soil including topsoil and seeded as soon as practical after placement of the industrial byproduct. Placement of the pavement structure shall be completed as soon as practical after placement of the fill material. For fills greater than 4 feet in depth using category 4 industrial byproducts, the design criteria in sub. (6) shall be required. For fills greater than 4 feet in depth using category 3 or less industrial byproducts, the design criteria in sub. (7) shall be required. The use of industrial byproducts as paved roadway subbase or base fill is prohibited in residential areas, unless used in a roadway designed with a rural type cross-section.
 - A residential area is defined in NR 538.03 as properties that are zoned as residential, are in areas planned for residential zoning under a master plan approved or adopted by a local municipal authority or an area within 100 feet of a human

residence. A rural type cross section is defined as one that does not include curbs and gutters.

- NR 538.10 also includes the following rules for industrial byproducts used in soil and pavement stabilization and flowable fill:
 - Soil and Pavement Base Stabilization - Industrial byproducts used as soil and pavement base stabilization for structural improvements listed in pars. (a) to (c) shall be used in accordance with ASTM C618–03 (standard for ash added to concrete), or the Wisconsin department of transportation specifications for highway and structure construction, or other good engineering practices acceptable to the department. The use of industrial byproducts as soil and pavement base stabilization is allowed in residential areas for those beneficial uses specified in par. (c) if approved by the local unit of government with jurisdiction over the roadway.
 - Controlled low strength material (flowable fill) – Industrial byproducts incorporated into controlled low strength material for structural improvements listed in pars. (a), (d), (e) and (f) shall be used in accordance with ACI 229R–99 or the Wisconsin Department of Transportation specifications for highway and structure construction, or other good engineering practices acceptable to the department.

- Capped and encapsulated transportation facility embankments are required to be constructed following guidelines separate from those for confined geotechnical fill. Embankments, such as linear roadway sound and sight barrier berm embankments, airport embankments and roadway bridge or overpass embankments, using more than 100,000 cubic yards of industrial byproducts, or with a maximum thickness of industrial byproduct greater than 20 feet, must be constructed, documented and monitored according to the criteria set forth in subsections 6 and 7 of NR 538.10. Included in these criteria are:
 - How the embankment shall be monitored
 - The design specifications of the embankment cover and sidewalls and recompacted clay base
 - Soil cover requirements for any portion of the clay top cover or sidewalls of the embankment not covered by the pavement structure
 - Specifications for documentation testing for the recompacted clay base, sidewalls and top cover
 - Site construction report requirements
 - Requirements for final grading and maintenance of the embankment slopes
 - Measures to be taken to limit blowing and tracking of the industrial byproduct during transportation and placement

- The Wisconsin Department of Transportation has special provisions beyond what is required by NR 538 for fly ash use in subgrade stabilization; the WisDOT

requirements for fly ash use in subgrade stabilization are attached in Appendix I. These special provisions do not apply to embankment fill projects; embankment fill projects are completed according to the requirements of NR 538.

Wisconsin – Department of Transportation Specifications

- According to Bruce Pfister, WisDOT Chief Geotechnical Engineer, WisDOT is progressing with the use of fly ash stabilization of subgrade soils; over the last 5 years they have used it on several projects (Pfister, personal communication, Dec. 2005). There are special provisions for fly ash subgrade stabilization (Appendix J); below are a few excerpted summary points from these special provisions.
 - Materials
 - Fly ash shall comply with the requirements of the item, Fly Ash, Furnished for Subgrade Stabilization (Appendix I).
 - Fly ash shall comply with the physical requirements of ASTM D-5239 6.4 and the chemical requirements of ASTM C-618, Table 1 for Class C fly ash. The engineer may approve other fly ash materials that do not meet these requirements if the fly ash is determined to be self-cementing, the sulfur trioxide content does not exceed 10%, and the required degree of stabilization can be achieved.
 - Equipment
 - The machinery, tools, and equipment necessary for proper execution of the work shall be on the project and approved by the engineer prior to beginning of stabilization operations.
 - The machine used to blend and mix the fly ash with the subgrade shall be capable of reaching a depth of 12 inches in one pass and shall have a recycling or mixing drum equipped with a water spray bar.
 - Methods
 - The subgrade shall be stabilized to a depth of 12 inches below final grade unless otherwise shown on the plans or directed by the engineer.
 - The work shall be carried out in such a manner to produce a completed section of stabilized subgrade that contains a uniform mixture of fly ash and subgrade soil with no loose or segregated areas, has uniform density and moisture content, and is well bound for its full depth.
 - Fly ash mixing operations shall not be performed when the ground temperature is below 35 degrees F, the air temperature is below 50 degrees F, or there is imminent danger of rain.
 - Prior to placement of the fly ash, the subgrade shall be brought to the lines and grades shown on the plans and shall be brought to a condition which will allow uniform distribution of the fly ash.
 - The fly ash shall be spread evenly on the prepared subgrade at the estimated rate of 135 lb. per square yard of required stabilized

surface area. The engineer will determine the actual application rate.

- Mixing operations shall begin no later than 60 minutes after the beginning of fly ash application unless otherwise approved by the engineer. The fly ash and the subgrade soil shall be thoroughly mixed by the approved equipment until a homogenous, friable mixture of material free from lumps and clods is obtained.
- The allowable moisture range for the stabilized subgrade material shall be 3 percentage points below to 2 percentage points above the established optimum moisture.
 - It is the contractor's responsibility to maintain moisture within this range. WisDOT project staff will check moisture content with a nuclear gauge on a periodic basis to ascertain that the contractor is meeting this requirement. Inspectors will also run a moisture check at any time the material gives appearances of being either too wet or too dry. As the specification states, the contractor may add water during the mixing operation to correct a too dry situation. However, if the material is too wet, WisDOT does not allow aeration to reduce moisture content; additional fly ash must be added to reduce the moisture content (Pfister, personal communication, Feb. 2006).
- Compaction shall begin immediately after mixing is completed and the fly ash / soil mixture is determined to be within the specified moisture range.
- Compaction of each established section of the stabilized subgrade shall be completed within two hours after incorporation of the fly ash.
- After the stabilized section has been satisfactorily compacted, it shall be immediately brought to the final lines and grades shown on the plans.
- After the stabilized section has been finished as required, the surface shall be protected against rapid drying for a period of not less than three days.

Summary

All of the nearby states (and Manitoba) are struggling with development of regulations, rules, and guidelines for use of fly ash in fill and soil stabilization in road construction projects. Illinois, Iowa and Wisconsin are the most advanced in this process. All three use a water leaching test to decide whether fly ash can be used as part of fill and soil stabilization mixes when leaching might be expected. Illinois and Wisconsin use the ASTM 3987 20:1 distilled water leach, while Iowa uses the Synthetic Precipitation Leaching Procedure (SPLP), a 20:1 leach with a small amount of acid. Illinois requires that the leachate meet drinking water standards while Iowa requires the leachate to be within 10X of drinking water standards. Wisconsin requires the ash to meet a standard that is 5 times drinking water standards, but only for boron, cadmium, selenium, chromium, silver, and sulfate. All of these standards seem to be designed to protect groundwater.

When fly ash is mixed with soil materials for stabilization of subbase soil or for fill and it is covered with an engineered barrier, the rules and/or regulations of Iowa and Illinois allow for use without leachate testing. Also, notification of the state environmental agency is not required in the case of subbase stabilization, and in fill projects notification is only required for larger projects.

Wisconsin requires all fly ash used in soil stabilization and fill meet the leachate criteria and that fill be “confined.” Embankment fill must be “capped and encapsulated.” Subbase stabilization with fly ash cannot be done for streets in residential areas unless the road does not have curb and gutter. Curb and gutter promotes leaching through the pavement.

Only Iowa is concerned with the possible human health risk by direct contact with fly ash treated soils. Their rules specifically allow for fly ash/soil mixtures exposed to the surface, which is prohibited in Wisconsin and not specifically allowed in Illinois. The rules specify that when ash/soil mixtures are on the surface the pH of the mixture must be within a range of 5 to 8, to allow for healthy plant growth. In this case the mixture must meet risk-based criteria that are calculated like the Soil Reference Values (SRV) of the Minnesota Pollution Control Agency (MPCA). Like the MPCA SRV, most of the limits are based on ingestion.

In both North Dakota and South Dakota only a few projects using fly ash have been conducted. In North Dakota they use a modification of SPLP analysis for guidance but regulators have a lot of leeway in working with the project engineers. The South Dakota regulators also have a lot of leeway.

In Manitoba the only use of fly ash is for lagoon sludge from wet scrubbing that can be used in fill.

REFERENCES

- ACAA-International. 2005. 2004 Coal Combustion Product (CCP) Production and Use Survey [Online]. Available at [http://www.aaa-usa.org/PDF/2004_CCP_Survey\(9-9-05\).pdf](http://www.aaa-usa.org/PDF/2004_CCP_Survey(9-9-05).pdf) (modified 9 Sept. 2005; accessed 20 Jan. 2006; verified 27 Jan. 2006). American Coal Ash Association, Aurora, CO.
- Bin-Shafique, S., C.H. Benson, T.B. Edil, K. Hwang. 2006. Leachate concentrations from water leach and column leach tests on fly ash-stabilized soils. *Environ. Eng. Sci.* 23(1): 53-67.
- Baba, A., and Kaya, A. 2004. Leaching characteristics of solid wastes from thermal power plants of western Turkey and comparison of toxicity methodologies. *Environmental Management J.* 73: 199-207.
- Ferguson, G., S.M. Levorson. 1999. Soil and pavement base stabilization with self-cementing coal fly ash [CD-ROM]. ACAA, Alexandria, VA.
- Illinois Administrative Code. 1994. Title 35: Environmental Protection, Part 620: Groundwater Quality [Online]. Available at <http://www.ilcode.net/CodeText.asp?citeid=843854> (copyright 2003; accessed 16 Nov. 2005). Jupiter Publishing Company, LLP, Springfield, IL.
- Illinois Department of Transportation. 2004. Special Provision for Soil Modification [Online]. Available at <http://www.dot.il.gov/desenv/pdf/80135.pdf> (modified 1 Nov. 2004; accessed 14 Dec. 2005). Illinois Department of Transportation-Bureau of Materials and Physical, Springfield, IL.
- Illinois General Assembly. Environmental Safety: (415 ILCS 5/) Environmental Protection Act [Online]. Available at <http://www.ilga.gov/legislation/ilcs/ilcs5.asp?ActID=1585&ChapAct=415%20ILCS%205%2F&ChapterID=36&ChapterName=ENVIRONMENTAL+SAFETY&ActName=Environmental+Protection+Act%2E> (accessed 14 Dec. 2005). Illinois General Assembly-Legislative Information System, Springfield, IL.
- Iowa Administrative Code. 2003. Environmental Protection [567] Chapter 108 Beneficial Use Determinations [Online]. Available at <http://www.legis.state.ia.us/Rules/Current/iac/567iac/567108/567108.pdf> (modified 19 March 2003; accessed 10 Oct. 2005). Iowa Legislature, Des Moines, IA.
- Iowa Administrative Code. 1998. Environmental Protection [567] Chapter 137 Iowa Land Recycling Program and Response Action Standards [Online]. Available at <http://www.iowadnr.com/land/consites/documents/chap137.pdf> (modified 18 Nov. 1998; accessed 10 Oct. 2005). Iowa Legislature, Des Moines, IA.

- Iowa DOT Materials Documents. 2004. Document Matls. IM 491.17, Inspection and Acceptance, Fly Ash [Online]. Available at http://www.erl.dot.state.ia.us/Oct_2005/IM/frames.htm (modified 19 Oct. 2004; accessed 16 Nov. 2005). Iowa Department of Transportation-Office of Materials, Ames, IA.
- MnTAP. 2006. Minnesota Technical Assistance Program [Online]. Available at <http://mntap.umn.edu/us/aboutus.htm> (modified 9 Jan. 2006; accessed 20 Jan. 2006; verified 27 Jan. 2006). Minnesota Technical Assistance Program, Minneapolis, MN.
- North Dakota Department of Health. 2001. Guideline 11 – Ash Utilization for Soil Stabilization, Filler Materials and Other Engineering Uses [Online]. Available at <http://www.health.state.nd.us/wm/pdf/guide11.pdf> (modified April 2001; accessed 21 Nov. 2005) North Dakota Department of Health – Division of Waste Management, Bismarck, ND.
- US EPA – Coal Combustion Products Partnership. 2005. Using CCPs [Online]. Available at <http://www.epa.gov/epaoswer/osw/consERVE/c2p2/use/using.htm> (modified 8 Nov. 2005; accessed 17 Jan. 2006; verified 27 Jan. 2006). US EPA-Office of Solid Waste, Washington, DC.
- US EPA – Coal Combustion Products Partnership. 2005. Regulatory Resources [Online]. Available at <http://www.epa.gov/epaoswer/osw/consERVE/c2p2/resources/resources.htm> (modified 8 Nov. 2005; accessed 19 Jan. 2006; verified 27 Jan. 2006). US EPA-Office of Solid Waste, Washington, DC.
- White, D.J., D.S. Harrington, Z. Thomas. 2005. Fly ash Soil Stabilization for Non-Uniform Subgrade Soils, Volume I: Engineering Properties and Construction Guidelines [Online]. Available at http://www.ctre.iastate.edu/reports/tr461_vol1.pdf (modified 30 April 2005; accessed 5 Oct. 2005; verified 20 Jan. 2006). Center for Transportation Research and Education, Iowa State University, Ames, IA.
- White, D.J., D.S. Harrington, H. Ceylan, T. Rupnow. 2005. Fly ash Soil Stabilization for Non-Uniform Subgrade Soils, Volume II: Influence of Subgrade Non-Uniformity on PCC Pavement Performance [Online]. Available at http://www.ctre.iastate.edu/reports/tr461_vol2.pdf (modified 30 April 2005; accessed 5 Oct. 2005; verified 20 Jan. 2006). Center for Transportation Research and Education, Iowa State University, Ames, IA.
- Wisconsin Administrative Code. Wis. Adm. Code Ch NR 538 – Beneficial Use of Industrial Byproducts [Online]. Available at

<http://www.legis.state.wi.us/rsb/code/nr/nr538.pdf> (accessed 17 Oct. 2005).
Wisconsin State Legislature, Madison, WI.

Wisconsin Department of Natural Resources. 2003. Grant of Exemption for the Beneficial Use of Self-Cementing Coal Fly Ash in Soil and Pavement Base Stabilization [Online]. Available at <http://www.dnr.state.wi.us/org/aw/wm/solid/beneficial/ashsoilstabilization41.pdf> (accessed 17 Oct. 2005). Wisconsin Department of Natural Resources, Madison, WI.

Wisconsin Department of Natural Resources. 1999. Grant of Exemption for the Beneficial Use of Certain Industrial Byproducts in Controlled Low-Strength Materials [Online]. Available at <http://dnr.wi.gov/org/aw/wm/solid/beneficial/WisreadyMixConAss-clsmfinal exemp.pdf> (accessed 17 Oct. 2005). Wisconsin Department of Natural Resources, Madison, WI.

APPENDICES

Appendix A: 35 Illinois Adm. Code 620.410a – Class I Groundwater Standards

Appendix B: Iowa Adm. Code 567 Ch. 137 – Statewide Standards for Soil

Appendix C: Iowa DOT Materials IM 491.17 – Appendix A

Appendix D: Manitoba Department of Transportation and Government Services – Department Info and Requirements for Lagoon Ash

Appendix E: North Dakota Department of Health, Division of Waste Management – Guideline 11

Appendix F: North Dakota DOT Standard Specs for Roads and Bridges – Sections 234 and 820

Appendix G: Wisconsin Administrative Code Chapter NR 538 – Appendix I

Appendix H: Wisconsin Administrative Code Chapter NR 538 – Industrial Byproduct Categories

Appendix I: Wisconsin Department of Transportation Document – Fly Ash Specifications for Subgrade Stabilization

Appendix J: Wisconsin Department of Transportation Document – Placing Fly Ash

Appendix K: Testing and Specification Descriptions

Appendix A: 35 Illinois Adm. Code 620.410a – Class I Groundwater Standards

**Class I Groundwater Standards as defined in Illinois Administrative Code, 35 Ill
Adm. Code 620.410a**

Except due to natural causes or as provided in Section 620.450, concentrations of the following chemical constituents must not be exceeded in Class I groundwater:

Constituent	Units	Standard
Antimony	mg/L	0.006
Arsenic	mg/L	0.05
Barium	mg/L	2
Beryllium	mg/L	0.004
Boron	mg/L	2
Cadmium	mg/L	0.005
Chloride	mg/L	200
Chromium	mg/L	0.1
Cobalt	mg/L	1
Copper	mg/L	0.65
Cyanide	mg/L	0.2
Fluoride	mg/L	4
Iron	mg/L	5
Lead	mg/L	0.0075
Manganese	mg/L	0.15
Mercury	mg/L	0.002
Nickel	mg/L	0.1
Nitrate as N	mg/L	10
Radium-226	pCi/l	20
Radium-228	pCi/l	20
Selenium	mg/L	0.05
Silver	mg/L	0.05
Sulfate	mg/L	400
Thallium	mg/L	0.002
Total Dissolved		
Solids (TDS)	mg/L	1200
Zinc	mg/L	5

Appendix B: Iowa Adm. Code 567 Ch. 137 – Statewide Standards for Soil

CHAPTER 137
IOWA LAND RECYCLING PROGRAM AND
RESPONSE ACTION STANDARDS

567—137.1(455H) Authority, purpose and applicability.

137.1(1) Authority. This chapter is adopted under the authority of Iowa Code Supplement chapter 455H. These rules establish the policy and procedures for the voluntary enrollment of contaminated property in the “land recycling program” established under chapter 455H. These rules also establish the response action standards which participants must meet in order to qualify for a no further action certificate and the statutory protections and immunities which follow from it.

137.1(2) Purpose. Consistent with the declaration of policy stated in Iowa Code Supplement section 455H.104, these rules are intended to achieve the dual objective of addressing the current and future risks associated with contaminated property and thereby enhancing the market conditions which can lead to development of these properties into their highest productive use. These objectives can in part be met through a program which encourages voluntary participation by persons who may have a legal duty to address, in whole or in part, the contamination within an affected area as well as persons who might not have a legal obligation but who have an interest in development of enrolled sites. These rules attempt to provide a degree of certainty in the response action process as an incentive to participants and as a means of assisting participants in quantifying their financial investment. The following statement of principles is intended as a guide both in the interpretation of these rules and as a statement of the department’s regulatory philosophy.

a. It is the objective of the department and these rules to establish a collaborative process between the participant(s) and department staff as the most effective means of achieving consensus and resolving disputes on issues which are not or cannot be fully defined and anticipated by rule.

b. Although participation in this program is voluntary, these rules establish basic standards which must be met in order to obtain regulatory closure from the department through issuance of a no further action certificate.

c. Although the scope of the response actions addressed under these rules may not in every case address all known or unknown releases within an affected area, it should be the objective of both the department and the participants to work together and to use all resources available to address all known releases within an affected area in the interest of protecting public health, safety and the environment as well as achieving regulatory finality.

137.1(3) Applicability. These rules shall apply only to releases of contaminants which are being addressed at enrolled sites. The department may in its discretion apply the response action rules in 137.4(455H) through 137.10(455H) to releases of contaminants at sites which are not enrolled. These rules do not in any way limit the statutory liabilities of participants or nonparticipants except as expressly provided within the context of enrollment and Iowa Code Supplement chapter 455H. Consistent with Iowa Code Supplement section 455H.505, these rules do not limit the authority of the department or the responsibility of statutorily responsible persons to provide notice of hazardous conditions under 567—Chapter 131 or to respond to new releases and undertake emergency response actions under 567—Chapter 133. For sites which are not enrolled, 567—Chapter 133 rules will remain in effect and for enrolled sites 567—Chapter 133 shall apply to the extent it is not inconsistent with this chapter.

567—137.2(455H) Definitions.

“*Affected area*” means any real property affected, suspected of being affected, or modeled to be likely affected by a release occurring at an enrolled site.

“*Affiliate*” means a corporate parent, subsidiary, or predecessor of a participant, a co-owner or co-operator of a participant, a spouse, parent, or child of a participant, an affiliated corporation or enterprise of a participant, or any other person substantially involved in the legal affairs or management of a participant as defined by the department.

"Background standard" means a standard which represents concentrations of contaminants which are naturally occurring or are generally present and not related to a readily identifiable release.

"Carcinogenic health risk" means the incremental risk of a person developing cancer over a lifetime (70 years) as a result of exposure to a hazardous substance, expressed as a probability such as one in a million (10⁻⁶). The contaminant level for the probability value is derived from application of certain designated exposure assumptions and a slope factor.

"Contaminant" means any hazardous substance found in the various media of the environment.

"Contaminant of concern" means specific hazardous substances that are identified for evaluation in the risk assessment process. Identification can be based on their historical and current use at the site, detected concentrations in environmental media and their mobility, toxicity, and persistence in the environment.

"Cumulative risk" means a summation of cancer and noncancer risks, determined separately, based on exposure to multiple contaminants from the same medium and exposure of the same individual to contaminants in multiple media.

"Enrolled site" means any property which has been or is suspected to be the site of or affected by a release and which has been enrolled pursuant to this chapter by a participant.

"Environmental protection easement" means an institutional control created under Iowa Code Supplement section 455H.206 which is a statutorily authorized restriction on land use.

"Exposure pathway" means the course a contaminant of concern may take from its source area to an exposed organism. Each exposure pathway includes a source or release from a source, a point of exposure, and an exposure route.

"Exposure route" means the manner in which a contaminant of concern comes in contact with an organism (e.g., ingestion, inhalation, dermal contact).

"Free product" means a hazardous substance that is present as a nonaqueous phase liquid (e.g., liquid not dissolved in water) or is present as a solid in its original form as a product or waste material.

"Gross contamination" means contamination present at concentrations in an amount sufficient to reasonably expect that institutional or technological controls will not be adequately protective of human health or the environment.

"Group A, B, C, D and E chemicals" means hazardous substances which have been classified based on the weight of evidence of human carcinogenicity. Group A substances are carcinogenic to humans. Group B substances are likely to be carcinogenic to humans. Group C substances have suggestive evidence of human carcinogenicity, but not sufficient evidence to assess human carcinogenic potential. Data are inadequate to assess human carcinogenic potential for Group D substances. Group E substances are not likely to be carcinogenic to humans.

"Hazardous substance" means any substance or mixture of substances that presents a danger to the public health or safety and includes, but is not limited to, a substance that is toxic, corrosive, or flammable, or that is an irritant or that generates pressure through decomposition, heat, or other means. "Hazardous substance" may include any hazardous waste identified or listed by the administrator of the United States Environmental Protection Agency under the Solid Waste Disposal Act as amended by the Resource Conservation and Recovery Act of 1976, or any toxic pollutant listed under Section 307 of the federal Water Pollution Control Act as amended to January 1, 1977, or any hazardous substance designated under Section 311 of the federal Water Pollution Control Act as amended to January 1, 1997, or any hazardous material designated by the Secretary of Transportation under the Hazardous Materials Transportation Act.

"Hydraulic conductivity" means a measure of the capacity of a porous medium (rock or soil) to transmit water. It is expressed as the volume of water that will flow through a unit length of a unit cross-sectional area of the porous medium in a unit time with a unit head loss.

"Institutional controls" means a nonphysical action which restricts land use to reduce or eliminate exposure to the contaminants of an affected area.

"Lifetime health advisory level (HAL)" means an advisory level established by the United States Environmental Protection Agency which represents the concentration of a single contaminant in drinking water which is not expected to cause adverse health effects over lifetime exposure.

"Maximum contaminant level (MCL)" means a standard for drinking water established by the United States Environmental Protection Agency under the Safe Drinking Water Act which is the maximum permissible level of a contaminant in water which is delivered to any user of a public water supply.

"No further action certificate" means the same as no further action letter in Iowa Code Supplement section 455H.301. It is a document issued by the department to the participant certifying no further response action is required at an enrolled site for those conditions classified as no further action except the monitoring or the maintenance of institutional or technological controls when required.

"No further action certification" means the department has determined an enrolled site has met all standards applicable for the identified hazardous substances and no further response action is required except the monitoring or the maintenance of institutional or technological controls when required.

"Noncancer health risk" means the potential for adverse systemic or toxic effects caused by exposure to noncarcinogenic hazardous substances expressed as the hazard quotient for a hazardous substance. A hazard quotient is the ratio of the level of exposure of a hazardous substance over a specified time period to a reference dose derived for a similar time period.

"Nonresidential land-use area" means any area that is not a residential land-use area.

"Participant" means any person who enrolls property pursuant to this chapter. A participant is a participant only to the extent the participant complies with the requirements of this chapter.

"Point of compliance" means a location selected within the affected area where the concentration of contaminants of concern must be at or below the target levels established for that point.

"Point of exposure" means the location at which an individual or population may come in contact with a contaminant of concern from the enrolled site.

"Protected groundwater source" means a saturated bed, formation, or group of formations which has a hydraulic conductivity of at least 0.44 meters per day (m/d) and a total dissolved solids concentration of less than 2,500 milligrams per liter (mg/l).

"Receptor" means an individual or population that is or may be affected by a release from the enrolled site.

"Reference dose," expressed in units of milligrams per day exposure to the contaminant per kilogram of body weight of the exposed individual, means the amount of contaminant that an individual can ingest on a daily basis for a lifetime that is not likely to result in adverse noncancer health effects. A reference dose is protective of the entire human population, including sensitive subpopulations.

"Release" means any spilling, leaking, pouring, emitting, emptying, discharging, injecting, escaping, leaching, dumping, or disposing into the environment of a hazardous substance, including the abandonment or discarding of barrels, containers, and other closed receptacles containing any hazardous substance, but excludes all of the following:

1. Any release which results in exposure to persons solely within a workplace, with respect to a claim which such persons may assert against the employer of such persons.
2. Emission from the engine exhaust of a motor vehicle, rolling stock, aircraft, vessel, or pipeline pumping station engine.

3. The release of source, by-product, or special nuclear material from a nuclear incident, as those terms are defined in the federal Atomic Energy Act of 1954, if such release is subject to requirements with respect to financial protection established by the Nuclear Regulatory Commission under 42 U.S.C. § 2210 or, for the purposes of 42 U.S.C. § 9604 or any other response action, any release of source, by-product, or special nuclear material from any processing site designated under 42 U.S.C. § 7912(a)(1) or § 7942(a).

4. The use of pesticides in accordance with the product label.

“Residential land-use area” means an area zoned for residential use or an area where residential use currently exists, is planned, or is not otherwise precluded. In addition, a residential land-use area includes other areas where frequent, long-term, close contact with soils is likely to occur (e.g., playgrounds, sport fields, gardens, child care facilities).

“Response action” means an action taken to reduce, minimize, eliminate, clean up, control, assess, or monitor a release to protect the public health and safety or the environment. “Response action” includes, but is not limited to, investigation, excavation, removal, disposal, cleaning of groundwaters or surface waters, natural biodegradation, institutional controls, technological controls, or site management practices.

“Risk evaluation/response action document” means a document based on the site assessment for the enrolled site which includes a risk evaluation, proposed response action, and proposed compliance verification strategy for the enrolled site.

“Site assessment plan” means the optional plan submitted to the department which lays out the rationale and the steps to be followed in the conduct of a site assessment for the enrolled site.

“Site assessment report” means the report of the site assessment which defines the nature and extent of contamination, identifies likely exposure pathways, and allows for characterizing potential and current exposure risks posed by the enrolled site.

“Site-specific standard” means a standard for a specific site which represents a concentration of a contaminant in a media of an affected area at which exposure through a specific pathway is considered unlikely to pose a threat to human health, safety, or the environment given site-specific factors related to contaminant transport and likely exposure.

“Slope factor” means an upper bound estimate that approximates a 95 percent confidence limit of the increased cancer risk from a lifetime exposure to a contaminant. This estimate is expressed in units of the proportion of a population that is affected per milligram per day exposure to the contaminant per kilogram of body weight of the exposed individual.

“Statewide standard” means a standard which represents a concentration of a contaminant in a specific media of an affected area at which normal, unrestricted exposure through a specific exposure pathway is considered unlikely to pose a threat to human health, safety, or the environment.

“Surface water” means general use segments as provided in 567—paragraph 61.3(1)“a” and designated use segments of water bodies as provided in 567—paragraph 61.3(1)“b” and 567—subrule 61.3(5).

“Target level” means a concentration of a contaminant of concern required to establish compliance with background, statewide or site-specific standards.

“Target organ” means the biological organ(s) most adversely affected from exposure to the contaminant of concern. A “reference dose” used to calculate noncancer health risk is normally established based on adverse impact to a target organ or organs from exposure to the contaminant of concern.

“Technological control” means a physical action whose main purpose is to reduce or eliminate exposure to the contaminants of an affected area.

567—137.3(455H) Enrollment in land recycling program.

137.3(1) *Property eligible for enrollment.* Unless excluded by statute or this rule and subject to eligibility conditions specified in this chapter, property which has been or is suspected to be the site of or affected by a release of a hazardous substance as defined in Iowa Code Supplement section 455H.103 is eligible for enrollment beginning October 27, 1998. The following sites shall not be enrolled in the land recycling program:

a. Property with petroleum releases associated with underground storage tanks subject to regulation under Iowa Code chapter 455B, division IV, part 8; and department rules under 567—Chapter 135. (However, property affected by releases of “regulated substances” from underground storage tanks other than petroleum as defined in rule 567—135.2(455B) subject to regulation under 567—Chapter 135 may be enrolled under this chapter.) Property enrolled and affected by a release from underground storage tanks of regulated substances other than petroleum will be subject to the response action standards in this chapter rather than those in 567—135.8(455B) through 135.12(455B). See also 567—paragraph 135.1(3)“e.”

b. Property which has been placed or is proposed to be included on the national priorities list established pursuant to the federal Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), 42 U.S.C. Section 9601 et seq. A property will be considered proposed at the time that a public notice of intent to list the property on the national priorities list is published in the Federal Register in accordance with 40 CFR 300.425.

c. An animal feeding operation structure as defined in Iowa Code section 455B.161.

d. Properties subject to administrative or judicial enforcement action by the department or the Environmental Protection Agency or subject to an administrative or judicial consent order addressing environmental conditions. These properties may be eligible for enrollment only with the written approval of and under such terms as determined by the enforcing agency.

e. Eligible properties which are or may be affected by or commingled with ineligible releases or conditions will be evaluated on a case-by-case basis to determine their appropriateness for enrollment. Only the eligible property and participant(s) will be afforded the benefits and immunities available under Iowa Code Supplement chapter 455H. Any protections provided by issuance of a no further action certificate will be limited by and may be subject to reopening due to future conditions associated with the ineligible release. Considerations for enrollment or exclusion include but are not limited to the following:

(1) The extent to which eligible releases and site conditions can be assessed and response action(s) designed and implemented independent of the ineligible releases and property.

(2) The extent to which the liability and other protections offered by Iowa Code Supplement chapter 455H and the conditions of a no further action certificate can reasonably be defined to apply to the eligible site without consideration of or dependence on future conditions associated with the ineligible release and property.

(3) The extent to which a participant is willing to conduct all response action(s) necessary to address the health, safety and environmental conditions implicated by both eligible and ineligible releases and conditions. The extent to which a nonparticipant responsible for the ineligible release and property can establish an intention and ability to cooperatively address and share costs associated with the commingled conditions and satisfy both the standards in this chapter and any other regulatory standards applicable to the ineligible release or condition.

137.3(2) Enrollment policy and procedures. Prior to enrollment, the applicant/participant(s) should have conducted sufficient preliminary site investigation and project planning to be prepared to show that a site is eligible for enrollment and the participant(s) is ready and capable of initiating and completing a response action in accordance with these rules. The applicant/participant(s) must submit a completed program application and participation agreement form as supplied by the department. The program application shall contain at least the following information.

a. An acknowledgment of access/control of the site signed by the participant if that person is a fee titleholder in the affected property; if the applicant/participant(s) is not a fee titleholder, then an acknowledgment by the fee titleholder of the affected property. If acknowledgment of access cannot be obtained, the participant must describe efforts to obtain access and reasons why it has been refused.

b. The name, address and other relevant information of each current and anticipated participant(s). The description should include a brief statement of the reasons for each person's participation including but not limited to that person's interest in and legal relationship to the property enrolled and the expected role and scope of any participation. Other persons who are not participants but who may have an interest in the project should be identified, such as state and local development agencies, community groups, and financing sources.

c. The applicant/participant(s) must demonstrate the presence of hazardous substances at concentrations that warrant response action(s) under the standards in this chapter. At a minimum the environmental condition to be addressed must be documented by the submission of a report which includes the following:

(1) Soil and groundwater samples of hazardous substances which have been analyzed by a laboratory certified under 567—Chapter 83 for the analytes being tested. The laboratory analysis should establish the presence of hazardous substances under conditions which exceed or are likely to exceed a statewide standard, if a statewide standard is available. Copies of the laboratory analytical report, boring logs and a site diagram showing the location of the sampling points in relation to the site should be included.

(2) A description of the current and historical uses of the property based on a reasonable and diligent inquiry. This must include a description of the following: known sources and probable locations of hazardous substances and probable location of the sources at the property which the participant proposes to address as part of the project; a general description of the historical uses of the property and probable hazardous substances which could reasonably be associated with past land use; and a general description of the surface characteristics of the property and surrounding areas such as current zoning, residential, commercial and industrial uses, and current uses of adjoining properties.

d. Any assessments or other reports relating to contamination at the property in excess of a statewide standard or reportable under 567—Chapter 131 which are known to and within the control of the applicant/participant shall be submitted. If the applicant/participant intends to claim that information constitutes a privileged environmental audit as provided in 1998 Iowa Acts, House File 681, the applicant must notify the department of the claim and resolve the issue of privilege prior to submittal. The applicant shall not submit to the department a report or any part of a report which it claims to be privileged and any information submitted under this paragraph shall be deemed a nonprivileged submittal as provided in section 6, paragraph (1)"a," of the Act. This provision does not relieve the applicant/participant of any obligation to notify the department of a hazardous condition as provided in Iowa Code section 455B.386 and rules under 567—Chapter 131.

e. A statement of the project objectives which includes the current use of the property, proposed development activities, and an expected time frame for meeting these objectives. The statement should include a general description of the scope of the proposed environmental condition to be addressed and a proposed schedule for initiation and submittal of site assessment activities pursuant to rule 137.8(455H). The statement should describe any foreseeable barriers toward achieving project objectives such as access to property, financing uncertainties, legal actions, allocation of responsibility amongst parties.

f. A list of all known permits and regulatory actions and directives associated with an environmental condition at the site. If any parcel of the proposed enrolled site is subject to any federal regulatory corrective action directives, administrative orders or judicial actions, these must be explained. The applicant must submit written proof that the appropriate federal regulatory agency has been notified of the applicant's desire to participate in the Iowa land recycling program. Objections, concerns or issues which could lead to disputes regarding dual or conflicting jurisdiction should be resolved prior to application, if possible, and before admission.

g. The department will respond in writing within 60 days of receipt of the enrollment application. The department will notify the applicant/participant(s) whether the site has been accepted and an expected time line for assignment of the project to a manager. If the site is not accepted, the department will notify the applicant of the reason(s). Upon notification of admission, the property shall be considered enrolled. Once the department has assigned the enrolled site to a project manager, the department will enter into a participation agreement with the participant(s).

137.3(3) Enrollment fees and oversight costs. A nonrefundable enrollment fee of \$750 must be submitted with the program application. This fee is intended to cover the department's cost of reviewing the program application and a minimum amount of subsequent oversight costs. Subsequent fees in excess of the minimum \$750 may be assessed for actual oversight costs incurred by the department as provided in this chapter. Department oversight activities may include, but are not limited to: review of documents, meetings with the participant(s), site visits, sampling, and laboratory costs related to verification of submitted materials. The total fees for oversight costs shall not exceed \$7,500 per enrolled site. Fees shall be assessed and collected as follows:

a. Hourly billing rate. Project oversight fees shall be based on an hourly rate to cover wages and overhead costs of personnel employed by the department in the land recycling program. The department shall calculate and publish on an annual basis an hourly billing rate at which oversight fees shall be calculated.

b. Quarterly payments. The department shall bill the participant(s) on a quarterly basis for additional oversight costs beyond the review of the application incurred by the department. The participant(s) shall pay the department within 30 days after receiving the department's quarterly fee statement. If there is more than one participant, each shall be jointly and severally responsible for payment. The department will provide split billings if provided with an enforceable written contract allocating the fees amongst the participants.

c. Failure to pay required fees. If the participant(s) fails to pay department oversight fees that are required under this subrule, the department shall cease to provide oversight to the participant(s) and terminate enrollment of the site as described in subrule 137.3(7).

137.3(4) Participation agreement. All participants shall enter into a participation agreement. This agreement shall be executed at the time the project is assigned to a project manager. At a minimum, the agreement shall establish the following:

a. A requirement that the participant(s) agree and provide necessary documentation to ensure reasonable access to the affected property by department staff and other authorized representatives of the department.

b. A requirement that the participant(s) reimburse the department for the actual costs assessed as provided in 567—subrule 137.3(3).

c. A requirement that the participant(s) certify that the participant(s) has the financial means to complete the project based on an initial estimate of completion costs. The department may require modification and amendment of the financial certification at any stage in the project and may require the participant(s) to provide financial documentation as necessary to support the certification.

d. A requirement that the participation agreement include a general description of the scope of the project and the goals to be achieved, a general time frame for submission and review of documents in accordance with this chapter, allocation of responsibility amongst multiple participants and other appropriate milestones. Either the participant(s) or the department may request a meeting to develop a statement describing the scope, goals, and time frames for the project.

137.3(5) *Prioritization.* Eligible sites will be enrolled in the order in which they are received. The department reserves the right to elevate the priority of a given site if it determines the threat to the public health or environment or environmental conditions in combination with the development objectives consistent with Iowa Code Supplement section 455H.104 is significantly greater than those of sites with an earlier enrollment date.

137.3(6) *Withdrawal procedures.* Enrollment and continued participation in the program are voluntary. The participant(s) may withdraw the enrolled site and individual participants may withdraw from further participation in the land recycling program at any time upon written notice to the department. Any participant who withdraws an enrolled site from further participation in the program shall not be entitled to any refund or credit for the \$750 enrollment fee and shall be liable for any oversight costs actually incurred by the department up to the cap of \$7,500 per enrolled site. A participant who withdraws a site prior to completion of all response action(s) required by this chapter and issuance of a no further action certificate in accordance with rule 137.11(455H) forfeits all benefits and immunities provided by this chapter and Iowa Code chapter 455H. Prior to withdrawal, the participant(s) shall submit a plan, which must be approved by the department, for stabilization of conditions at the site or a justification for why further action to stabilize the site is not necessary. Participants shall be required to take such actions as the department determines necessary to stabilize conditions at the site, including, but not limited to, securing or properly abandoning monitoring wells, removing or otherwise properly disposing of all contaminated soil excavations, removing or properly disposing of exposed or exhumed contaminants, filling or properly fencing open excavations, and posting safety notices.

137.3(7) *Termination of enrollment.* Enrollment of the participant(s) may be terminated based on a finding of material noncompliance with department rules and statutory requirements including but not limited to the following:

a. Significant failure, after written notice, to comply with schedules for completion and submission of reports and implementation of response action(s) required by these rules or otherwise agreed upon in writing by the department and participants. Written requests for reasonable schedule extensions may be granted upon a showing of extenuating circumstances beyond the control of the participant(s) and the participant(s) agent/contractor.

b. Failure to proceed in a timely manner after written notice in performing the additional response action required due to a failure of technological and institutional controls pursuant to rule 137.7(455H).

c. Material misstatement or omission of fact in reports submitted to the department by the participant or agents of the participant.

d. Evidence that the site falls under one of the exclusion categories in subrule 137.3(1).

e. Failure to pay required fees to the department as required in subrule 137.3(3).

137.3(8) *Appeal rights.* The department will notify participant(s) of a denial of enrollment or of an intent to terminate enrollment and provide a statement of reasons. The participant(s) shall have a right to appeal the decision to deny enrollment or to terminate enrollment. Upon timely appeal, contested case procedures shall be initiated pursuant to 561—Chapter 7.

567—137.4(455H) Background standards.

137.4(1) Purpose. This rule defines the basis and procedure for establishing background standards in groundwater, soil, surface water, and air. Background standards represent concentrations of contaminants that are naturally occurring or generally present and not related to a readily identifiable release. Background standards provide a baseline for assessing impacts of contaminant releases from within the affected area.

137.4(2) Determination of background standards. Background standards shall be based on sampling at appropriate site-specific background locations. Background sampling locations shall be outside the influence of any possible contamination associated with releases occurring on the property in which the enrolled site is located. Sufficient supporting information shall be provided to demonstrate the appropriateness of background sampling locations. Appropriateness for background sampling locations has two aspects which shall be addressed:

a. Background samples shall be collected from a location which represents a true background condition with respect to the enrolled site. For example, a background groundwater sample will be collected from an upgradient location relative to groundwater movement.

b. Background samples will represent conditions which are comparable to the contaminated media being addressed. In the case of soils, samples from the affected area and the background areas will be comparable in physical, chemical, and biological attributes.

Sampling conducted for the purpose of establishing a background standard shall meet quality criteria specified for the site assessment, rule 137.8(455H). The minimum number of samples to be collected from the medium of concern for which a background standard is being established shall be consistent with rule 137.10(455H), regarding demonstration of compliance.

567—137.5(455H) Statewide standards.

137.5(1) Purpose. This rule defines the basis and procedure for establishing statewide standards for contaminants in groundwater, soil, and surface water. Statewide standards for groundwater and soil represent concentrations of contaminants in these media at which normal exposure via ingestion and dermal contact with soil is considered unlikely to pose a threat to human health. Statewide standards for surface water are based on protection of aquatic life and protection of human health. This rule also describes how air standards are to be addressed.

137.5(2) Scope. Statewide standards described herein address what are considered to be the most likely, normal exposure situations. Statewide standards for groundwater address direct exposure via ingestion to individual contaminants in the media of concern only. Statewide standards for soil address direct exposure to individual contaminants via ingestion and dermal contact. In the event exposure to multiple contaminants may occur or exposure from more than one medium may occur, statewide standards alone may not be protective of human health; therefore, cumulative risk standards must be met in accordance with subrule 137.10(7). In addition, the department may deny the use of the statewide standards prescribed herein and require the use of site-specific standards based on site-specific conditions pursuant to subrule 137.6(10).

Examples of exposure concerns not anticipated by the statewide standards might include, but are not limited to:

- Significant plant uptake of contaminants from soil or groundwater;
- Contaminants entering drinking water lines from contact with soil or groundwater;
- Ecological concerns, other than for surface water;
- Groundwater in a nonprotected groundwater source that is used or likely to be used for drinking water or other use.

137.5(3) Establishment of risk-based contaminant concentrations.

a. Risk-based concentration formula. Risk-based contaminant concentrations for soil and groundwater, except lead, shall be computed using the following formula, where appropriate:

(Formula I)

$$C = \frac{RF \times AT \times 365 \text{ days/year}}{\text{Abs} \times [(ER_c \times EF_c \times ED_c) \div BW_c + (ER_a \times EF_a \times ED_a) \div BW_a] \times CF}$$

NOTE: When a risk-based concentration is computed for two routes of exposure to the same medium (e.g., soil oral exposure and soil dermal exposure), the composite risk-based concentration equals the multiple of the risk-based concentration for each route of exposure divided by the sum of the risk-based concentration for each route of exposure.

Where: C = Concentration of contaminant (soil: mg/kg, water: mg/l)
RF = Risk factor

For protection from cancer health risks:

$$RF = TR \div SF$$

Where: TR = Target cancer risk (unitless)
SF = Slope factor [(mg/kg)/day]⁻¹ for a route of exposure; see paragraph "c" for source.

For protection from noncancer health risks:

$$RF = THQ \times RfD$$

Where: THQ = Target hazard quotient (unitless)
RfD = Reference dose (mg/kg)/day for a route of exposure; see paragraph "c" for source.

AT = Averaging time (years); time over which exposure is averaged and potential adverse effects may occur

Abs = Absorption factor (unitless); portion of exposed contaminant absorbed by the body

ER_c = Exposure rate by a child (soil: mg/day, water: l/day)

EF_c = Exposure frequency by a child (days/year)

ED_c = Exposure duration by a child (years)

BW_c = Body weight of exposed child (kg)

ER_a = Exposure rate by an adult (soil: mg/day, water: l/day)

EF_a = Exposure frequency by an adult (days/year)

ED_a = Exposure duration by an adult (years)

BW_a = Body weight of exposed adult (kg)

CF = Conversion factor: 10⁻⁶ kg/mg for soils; 1 (unitless) for water

b. *Carcinogenic classification of chemicals.* The potential carcinogenicity of chemicals will be based on the weight-of-evidence classification system utilized by the U.S. Environmental Protection Agency (EPA). Risk-based concentrations will be based on cancer health effects for individual chemicals that are classified as Group A or Group B. The risk-based concentration for an individual chemical will be based on noncancer health effects for chemicals that are classified as Group C, Group D or Group E. In the absence of such classification for a chemical, the Group D classification will be assumed. Noncancer risks for a Group A or Group B chemical will be included in the determination of cumulative noncancer risk in accordance with subrule 137.10(7), if a reference dose exists for that chemical. Cancer risk associated with a Group C chemical shall be included in the determination of cumulative cancer risk in accordance with subrule 137.10(7), if a cancer slope factor exists for that chemical.

c. *Source of toxicity values.* EPA's Integrated Risk Information System (IRIS) shall be the primary source of information on toxicity factors (e.g., oral reference doses and oral slope factors), carcinogenic classification for chemicals, and the target organs. Such information that is not available on IRIS shall be obtained from other sources consistent with current EPA guidelines. The Iowa department of public health shall be consulted regarding toxicity values not available on IRIS. Absorption factors for dermal soil exposure shall be based on best available information, which will usually be obtained from EPA guidance documents.

137.5(4) Statewide standards for groundwater.

a. *Protected groundwater source.* Statewide standards for groundwater in a protected groundwater source will be the enforceable Maximum Contaminant Level (MCL) established by the EPA pursuant to the Safe Drinking Water Act, if an MCL exists. If no enforceable MCL exists, the statewide standard for chemicals will be the lifetime health advisory level (HAL) as provided in the latest "Drinking Water Regulations and Health Advisories" by the EPA's Office of Water or equivalent. If no MCL or HAL exists, the statewide standard for a chemical will be calculated using Formula I and input variables for groundwater ingestion in accordance with Table I.

b. *Groundwater in a nonprotected groundwater source.* The statewide standard for a chemical in groundwater in a nonprotected groundwater source will be five times the statewide standard for the chemical in a protected groundwater source or a risk-based concentration using Formula I with input variables specified in Table I, whichever is larger. The statewide standards for groundwater in a nonprotected groundwater source are based on groundwater ingestion only.

Table I
Input Variables for Risk-Based Statewide Standards for Groundwater
from Protected and Nonprotected Groundwater Sources

Parameter	Units	Cancer	Protected	Nonprotect
		Group		ed
TR	unitless	A, B	5×10^{-6}	1×10^{-4}
SF	$[(\text{mg/kg})/\text{day}]^{-1}$	A, B, C	Chem.– spec.	Chem.– spec.*
THQ	unitless	C D, E	0.02 0.2	0.1/1* 1
RfD	(mg/kg)/day	C, D, E	Chem.– spec.	Chem.– spec.
AT	years	A – E	70	70
Abs	unitless	A – E	1	1
ER _c	l/day	A – E	1	1
EF _c	days/yr	A – E	0	0
ED _c	years	A – E	6	6
BW _c	kg	A – E	15	15
ER _a	l/day	A – E	2	2
EF _a	days/yr	A – E	365	365
ED _a	years	A – E	70	70
BW _a	kg	A – E	70	70
CF	unitless	A – E	1	1

*The risk-based concentration using Formula I for Cancer Group C chemicals that have an SF value established per paragraph 137.5(3)"c" will be the larger of a value based on the risk factor for protection from noncancer health risks with a THQ = 0.1 or the risk factor for protection from cancer health risks. Risk-based concentrations using Formula I for Cancer Group C chemicals that do not have an SF value established per paragraph 137.5(3)"c" will be a value based on the risk factor for protection from noncancer health risks with a THQ = 1.

137.5(5) Statewide standards for soil. Statewide standards for chemicals in soil, except lead, will be calculated using Formula I based on incidental ingestion of soil and dust and dermal contact with soil with input variables in accordance with Table II. The statewide standard for lead in soil shall be 400 mg/kg.

Table II
Input Variables for Statewide Soil Standards

<u>Parameter</u>	<u>Units</u>	<u>Cancer Group</u>	<u>Route of Exposure</u>	
			<u>Oral</u>	<u>Dermal</u>
TR	unitless	A, B	5×10^{-6}	5×10^{-6}
SF	₋₁ [(mg/kg)/day]	A, B, C*	Chem.– spec.	Chem.– spec.
THQ	unitless	C* D, E	0.1/1 1	0.1/1 1
RfD	(mg/kg)/day	C, D, E	Chem.– spec.	Chem.– spec.
AT	years	A, B C, D, E	70 6	70 6
Abs	unitless	A – E	1	Chem.– spec.
ER _c	mg/day	A – E	200	560**
EF _c	days/yr	A – E	350	350
ED _c	years	A – E	6	6
BW _c	kg	A – E	15	15
ER _a	mg/day	A – E	100	400**
EF _a	days/yr	A – E	350	350
ED _a	years	A, B C, D, E	24 0	24 0
BW _a	kg	A – E	70	70
CF	kg/mg	A – E	10^{-6}	10^{-6}

*The risk-based concentration using Formula I for Cancer Group C chemicals that have an SF value established per paragraph 137.5(3)“c” will be the larger of a value based on the risk factor for protection from noncancer health risks with a THQ = 0.1 or the risk factor for protection from cancer health risks. Risk-based concentrations using Formula I for Cancer Group C chemicals that do not have an SF value established per paragraph 137.5(3)“c” will be a value based on the risk factor for protection from noncancer health risks with a THQ = 1.

**Dermal exposure rate is based on 2,800 cm² of exposed skin on a child with 0.2 mg/cm² of soil adhering to the child’s skin and 5,700 cm² of exposed skin on an adult with 0.07 mg/cm² of soil adhering to the adult’s skin per each dermal exposure event. A dermal exposure event is assumed to be one event per day of exposure.

137.5(6) *Statewide standards for surface water.* Water quality standards pursuant to 567—Chapter 61 shall be considered statewide standards for surface water. If a promulgated water quality standard does not exist for a contaminant of concern, the department may establish an appropriate standard in a manner consistent with 567—Chapter 61.

137.5(7) *Statewide standards for air.* Ambient air quality standards pursuant to 567—Chapter 28 constitute statewide standards for air. Air emission sources must meet air quality emission standards as set forth in 567—Chapters 20 through 31 inclusively, as applicable. Any relevant air quality standard that is subsequently promulgated by statute or rule shall become a statewide standard for air upon the effective date of adoption by the state. In the absence of applicable, adopted standards, site-specific air standards must be met, in accordance with subrule 137.6(9), when air quality issues are addressed at a site.

137.5(8) *Point of exposure for statewide standards.* The point of exposure associated with the use of only statewide standards in the determination of compliance will be assumed to be anywhere and everywhere, except for surface water. The point of exposure associated with the use of statewide standards for surface water will be assumed to be the point of groundwater or other site runoff immediately before it discharges to the surface water body.

137.5(9) *Practical quantification limits.* In no case will the statewide standard be less than the practical quantification limit, as determined by the department.

137.5(10) *Maintenance of statewide standards.* The toxicity values, absorption factors for dermal exposure to soils, and promulgated standards that are a basis for statewide standards are subject to periodic revision due to actions not governed under this rule. The department in conjunction with the Iowa department of public health will maintain a guidance document that contains a current list of toxicity values, absorption factors for dermal exposure to soils, target organs for cumulative noncarcinogenic health risks, promulgated standards, and the resultant statewide standards that will be readily available to the public. This guidance document will reference all the sources of the information. In the absence of a dermal slope factor or a dermal reference dose for a chemical, the oral slope factor or oral reference dose will be used with adjustments made to account for differences in oral and dermal absorption rates in accordance with current EPA guidance. Statewide standards for individual sites will be locked-in at the beginning of the site assessment process (rule 137.8(455H)). If a statewide standard does not exist for a chemical, it will be the department's responsibility to establish a statewide standard, pursuant to subrules 137.5(4) and 137.5(5), for groundwater and soil, and to add the newly established statewide standard to the comprehensive list of statewide standards in the guidance document maintained by the department.

567—137.6(455H) Site-specific standards.

137.6(1) *Purpose.* As opposed to statewide standards, site-specific standards are derived by applying exposure and risk assumptions applicable to the conditions at a particular site. Like statewide standards, site-specific standards must always be shown to be protective of public health and safety and the environment. Statewide standards may be used in combination with site-specific standards to address different exposure pathways. Site-specific standards may be required to address exposure pathways which the department determines must be evaluated to be protective of human health, safety and the environment and for which statewide standards have not been established under rule 137.5(455H). Site-specific standards may involve development of target levels for contaminants of concern based on site-specific exposure assumptions for use in lieu of background or statewide standards. Site-specific standards may also include consideration of the actual or potential location where exposure to contaminants occurs or may occur, the likelihood of an exposure occurring, and the overall magnitude and extent of contamination. Site-specific standards may involve use of site-specific target levels for contaminants of concern alone or in conjunction with other site-specific criteria, such as the location where the standard is applied.

137.6(2) General provisions.

a. This rule establishes a minimum protocol that must be met at all enrolled sites which have not established compliance by application of background or statewide standards. Groundwater ingestion and soil ingestion pathway standards under this rule must be evaluated. Surface water and air quality standards under subrules 137.6(8) and 137.6(9) must be met whenever exposure concerns are evident and the participant or the department determines these pathways may present an unacceptable risk for current or future exposures. This rule is not intended to preclude the department or the participant from addressing other exposure pathways, and the department expressly reserves the right to require evaluation of other exposure pathways and compliance with site-specific standards developed for them, such as dermal contact, ingestion of vegetables containing contaminants from soil or irrigation water, migration of contaminants from groundwater or soil into water distribution lines or into air in a confined space, migration of contaminants from soil to groundwater, and migration of contaminants in a nonprotected groundwater source to a protected groundwater source. Participants must establish compliance with standards applicable to all exposure pathways required by the department under this rule in order to qualify for no further action classification under rule 137.11(455H) unless granted a variance as provided in Iowa Code section 455H.205.

b. Site-specific standards are subject to the approval of the department. Assurances in the form of technological or institutional controls (rule 137.7(455H)) will be required, as needed, to ensure continued protectiveness of site-specific standards.

c. The following subrules provide options for the site-specific standards. The participant may select any of these options, or combinations thereof, for use as site-specific standards.

137.6(3) Site-specific groundwater point of exposure. A site-specific groundwater standard may be an appropriate target level applied at groundwater points of exposure that are limited by technological or institutional controls.

a. A point of exposure for groundwater is a location within the affected area where a well exists or could be placed (potential point of exposure). Where technological or institutional controls are determined to effectively restrict the placement of groundwater wells, the points of exposure apply outside the area of restriction. A sufficient number of points of exposure may be established for determining compliance such that compliance with appropriate target levels at these points will ensure compliance at all points of exposure. Normally a compliance point of exposure will be a location at the boundary of the area restricted by an institutional control where a groundwater well could be installed that would have the highest contaminant concentration. Generally more than one compliance point of exposure must be established due to uncertainties, such as spatial and temporal variabilities in groundwater flow and contaminant occurrence.

b. Target levels. The point of exposure target level for drinking water wells is the statewide standard applicable to groundwater ingestion or an alternative site-specific target level approved under subrule 137.6(10) or 137.6(11). The point of exposure target level for non-drinking water wells is the statewide standard applicable to nonprotected groundwater or an alternative site-specific target level approved under subrule 137.6(10) or 137.6(11). The point of exposure target level for nonused groundwater meeting the conditions in subrule 137.6(5) is the statewide standard for a nonprotected groundwater source.

c. Nonprotected groundwater sources. A nonprotected groundwater source which is affecting or likely to affect an existing drinking water well shall be required to meet the same site-specific standards, including point of exposure target level(s), as applied to a protected groundwater source.

d. Unless conditions can be demonstrated to be stable, predictive techniques in accordance with subrule 137.9(4) must be used to determine the future effects of groundwater contamination on existing drinking and non-drinking water wells and to determine the area predicted to exceed the point of exposure target level(s) where wells could be installed. When using predictive techniques, determining the location(s) where the applicable point of exposure target level is expected to be exceeded may involve comparison of the appropriate numerical standard to the predicted contaminant concentration at a passive monitoring well at the groundwater point of exposure. Alternatively, predictive techniques using site-specific models (paragraph 137.9(4)“b”) may involve simulation of pumping at a well located at the point of exposure, in which case the pumping rate used in the simulation shall be the rate that is reasonably possible for the area that yields water with the highest contaminant concentration. In absence of site-specific justification for doing otherwise, long-term pumping will be assumed to be at a rate of 100 gallons per day; the sustainable yield, if less than 100 gallons per day; or a reasonable, higher rate, if such a rate results in higher contaminant concentration.

e. Institutional controls. For a protected groundwater source or a nonprotected groundwater source as described in paragraph “b” above, institutional controls must be shown to effectively prohibit the installation of wells for the period of time in which contaminant concentrations might otherwise be expected to result in an exceedance of the appropriate target levels. For a nonprotected groundwater not described as in paragraph “b” above, a less stringent standard of effectiveness as well as the type of future well installation to be restricted may be utilized for those areas of potential concern. Unless there is a history of usage of what might otherwise be considered nonprotected groundwater or there is uncertainty as to the uniformity in the hydraulic characteristics of the nonprotected groundwater source, notice to the authority responsible for permitting private wells under 567—Chapters 39 and 49 may be adequate especially if combined with a municipal or county ordinance prohibiting installation of private wells based on the availability of a public water supply.

137.6(4) Site-specific groundwater point of compliance. A site-specific standard may be established for a site-specific groundwater point of compliance that is different from a compliance point of exposure. A site-specific groundwater point of compliance must be used in conjunction with all groundwater compliance points of exposure pursuant to subrule 137.6(3) to provide an alternative monitoring location. Target levels for contaminants of concern at a site-specific groundwater point of compliance must be established using predictive techniques as specified in subrule 137.9(4). A target level established for a groundwater point of compliance must ensure that the appropriate target level at the groundwater compliance points of exposure will be achieved. A groundwater point of compliance shall be located on the contaminant migration path from the contaminant source to the point of exposure to the maximum extent practicable.

137.6(5) Nonused groundwater in a protected water source. Statewide standards for groundwater in a nonprotected groundwater source, pursuant to paragraph 137.5(4)“b,” may be used as target levels for contaminants in an otherwise protected groundwater source when groundwater in the affected area is not used and is not likely to be used in the future in accordance with the following. It must be demonstrated to the satisfaction of the department that contaminants from the enrolled site do not currently, and likely will not in the future, have an impact on any existing water supply well. Any detection, or predicted detection above the practical quantification limit, of a chemical that can be attributed to a release from the enrolled site will be considered to constitute an impact. In addition, it must be demonstrated to the satisfaction of the department that the impacted or potentially impacted aquifer is not a locally significant water resource. Factors that will go into this determination may include, but are not limited to:

- Existence of a nonimpacted public water supply in the potentially affected area;
- General availability of other water resources in the vicinity;
- Plans for development of public water supplies in the vicinity;
- Potential for use of the impacted aquifer as a water supply (e.g., yield, natural water quality); and
- Identification of the aquifer(s) commonly used for water supply in the vicinity.

A local ordinance prohibiting installation of private drinking water wells or notification to the local water utility and water permitting authority, or both, may constitute acceptable institutional controls for site-specific standards under this subrule.

The target levels that may be used in accordance with this subrule are based solely on groundwater ingestion. Compliance with this site-specific standard will not guarantee that contaminants in groundwater may not cause unacceptable exposure via other pathways (e.g., groundwater to air in a confined space, groundwater to surface water, or groundwater to a water distribution line).

137.6(6) *Site-specific soil standards based on land use and soil depth.* Site-specific soil standards based on land use and soil depth in conjunction with institutional controls may be used. Predetermined site-specific soil exposures based on land use and soil depth are provided in the following paragraphs. Lists of resulting site-specific soil standards for individual contaminants for these land-use and soil-depth categories will be maintained by the department in a guidance document and made readily available to the public. Use of these site-specific soil standards must be supported by appropriate institutional controls. Site-specific soil standards based on land use and soil depth, as described herein, address ingestion of and dermal contact with soil. Compliance with these standards will not guarantee that contaminants in soils may not cause unacceptable exposure via other pathways (e.g., ecological exposure, soil to groundwater, subsurface movement of vapors from soil to indoor air). In addition, the risk factors that form the bases for site-specific soil standards for individual contaminants, with the exception of some Group C chemicals, are the same as acceptable cumulative risk factors allowed for exposure to multiple contaminants in the same medium and multiple media. Therefore, compliance with site-specific soil standards for individual contaminants may not result in compliance with cumulative risk requirements pursuant to rule 137.10(455H).

a. Deep soil in a residential land-use area. Site-specific soil standards for deep soils equaling ten times the statewide standard for soils, except for lead, may be used. The site-specific standard for lead in deep soil in a residential land-use area shall be calculated using the most current version of EPA's Exposure Model for Assessing Risk Associated with Adult Exposures to Lead in Soil. Soils at a depth of ten feet and greater will normally be classified as deep soils. The department may deny the use of a deep soil standard associated with a residential land use or require a modification to the standard due to site-specific considerations including topography, development potential, and actual development plans. The use of a site-specific standard for deep soil in a residential land-use area shall be supported by an institutional control that permanently records the existence of contaminants above statewide standards in deep soils and restricts excavation resulting in deep soils being placed on the surface.

b. Nonresidential land use. The nonresidential land-use designation will be applicable to areas that are not classified as residential. Site-specific soil standards, except for lead, for nonresidential areas may be based on Formula I using the risk and exposure factors shown in Table III. A value of 1,100 mg/kg may be used as a site-specific soil standard for lead in soils less than 2 feet deep in a nonresidential land-use area. In lieu of this default site-specific lead standard, a site-specific standard for lead in soil less than 2 feet deep may be calculated using the most current version of EPA's Exposure Model for Assessing Risk Associated with Adult Exposures to Lead in Soil. The site-specific standard for lead in soils greater than 2 feet deep in a nonresidential land-use area shall be calculated using the most current version of EPA's Exposure Model for Assessing Risk Associated with Adult Exposures to Lead in Soil. The use of a nonresidential land-use classification must be supported by an environmental protection easement that prevents a change in land use to residential.

Table III
Input Variables for Site-Specific Soil Standards for Individual Contaminants for
Nonresidential Area Land-Use Designation

Parameter	Units	Cancer Group	Soil Depth (ft.)	
			≤ 2	≥ 2
TR	unitless	A, B	1×10^{-4}	1×10^{-4}
SF (oral)	$[(\text{mg}/\text{kg})/\text{day}]^{-1}$	A, B, C*	Chem.-spec.	Chem.-spec.
SF (dermal)	$[(\text{mg}/\text{kg})/\text{day}]^{-1}$	A, B, C*	Chem.-spec.	Chem.-spec.
THQ	unitless	C*	0.1/1	0.1/1
		D, E	1	1
RfD (oral)	(mg/kg)/day	C, D, E	Chem.-spec.	Chem.-spec.
RfD(dermal)	(mg/kg)/day	C, D, E	Chem.-spec.	Chem.-spec.
AT	years	A, B	70	70
		C, D, E	1	1
Abs (oral)	unitless	A – E	1	1
Abs (dermal)	unitless	A – E	Chem.-spec.	Chem.-spec.
ER _c	mg/day	A – E	0	0
EF _c	days/yr	A – E	0	0
ED _c	years	A – E	0	0
BW _c	kg	A – E	15	15
ER _a (oral)	mg/day	A, B	100	330
		C, D, E	330	330
ER _a (dermal)	mg/day	A, B	660**	990**
		C, D, E	660**	990**
EF _a	days/yr	A, B	225	200
		C, D, E	200	200
ED _a	years	A, B	25	1
		C, D, E	1	1
BW _a	kg	A – E	70	70
CF	kg/mg	A – E	10^{-6}	10^{-6}

NOTE: Oral and dermal factors are the same unless otherwise noted.

*The risk-based concentration using Formula I for Cancer Group C chemicals that have an SF value established per paragraph 137.5(3)"c" will be the larger of a value based on the risk factor for protection from noncancer health risks with a THQ = 0.1 or the risk factor for protection from cancer health risks. Risk-based concentrations using Formula I for Cancer Group C chemicals that do not have an SF value established per paragraph 137.5(3)"c" will be a value based on the risk factor for protection from noncancer health risks with a THQ = 1.

**Dermal exposure rate is based on 3,300 cm² of exposed skin on an adult with 0.2 mg/cm² of shallow soil adhering to the skin and 0.3 mg/cm² of deep soil adhering to the skin per each dermal exposure event. A dermal exposure event is assumed to be one event per day of exposure.

c. *Restricted access land use*. Rescinded IAB 7/21/04, effective 8/25/04.

137.6(7) Site-specific cumulative risk for residential exposures to soil. A cumulative risk standard may be used as a site-specific standard for soil in lieu of statewide standards that are provided in subrule 137.5(5) for individual chemicals and soil. Cumulative risk will be determined using the toxicity values and exposure factors (i.e., the input variables less TR and THQ) from Table II in subrule 137.5(5). Criteria for compliance with the cumulative risk standard are specified in subrule 137.10(7). No institutional control will be required with the use of this site-specific standard.

137.6(8) Site-specific surface water standards. The department will establish site-specific surface water standards at the request of the participant. The participant shall provide the department with information necessary to make this determination upon request from the department. Site-specific surface water standards will be generally equivalent to effluent limitations under a National Pollutant Discharge Elimination System (NPDES) permit pursuant to 567—Chapter 62. Mixing zones and allocation of contaminant loads in a surface water body will be considerations in attainment of in-stream water quality standards. If the site-specific surface water quality standards are met, best practical control technology currently available will not be imposed.

137.6(9) Site-specific air standards. If there are air quality concerns at a site, they will normally be addressed with site-specific standards until such time as ambient air quality or source-specific standards are adopted for hazardous air pollutants.

a. Explosivity. In no case shall contaminants from the enrolled site cause an explosivity level in a confined space of greater than 10 percent of the lower explosivity limit.

b. Background. In addition to the establishment of a background standard pursuant to rule 137.4(455H), a site-specific air standard may be set at twice the typical background level based on published information for a comparable setting, if approved by the department.

c. Health risk. The U.S. Department of Labor Occupational Safety and Health Administration (OSHA) limits for air contaminants pursuant to 29 CFR 1910, Subpart Z, may be utilized for site-specific standards in workplace settings where the OSHA standards are applicable and the contaminant of concern is used. For locations where OSHA standards are not applicable, site-specific standards for air in a confined space shall be risk-based using the chemical-specific toxicity values of inhalation unit risk (UR) and inhalation reference concentration (RfC) determined in accordance with paragraph 137.5(3)"c." Formulas II and III shall be used to calculate risk-based, site-specific air standards based on carcinogenic and noncarcinogenic effects, respectively, where C is the risk-based contaminant concentration in air. If a value for both RfC and UR exists for a compound, the risk-based site-specific standard will be the smaller of C resulting from Formulas II and III.

(Formula II)

$$C = AF \times TR \div UR$$

(Formula III)

$$C = AF \times RfC$$

The UR and RfC toxicity values are based on a continuous exposure of 20 cubic meters per day by a 70 kg adult. The adjustment factor (AF) in Formulas II and III may be used to adjust for site-specific exposure conditions. A target cancer risk (TR) of 10^{-4} shall be used unless another value is approved by the department.

d. Institutional or technological controls. Institutional or technological controls may be used to prevent future exposure to contaminants in air in confined spaces and will be required to prevent residential use of the affected area when a nonresidential air standard is used.

137.6(10) *Site-specific standards based on site-specific factors.* Numerical site-specific standards (i.e., target levels) for groundwater or soil may be established using site-specific exposure factors in Formula I. Site-specific pumping rates greater than specified in paragraph 137.6(3)“d” herein may be used when approved by the department. Site-specific exposure factors must be approved by the department. For the department to approve any such site-specific factor there must be well documented rationale for doing so and appropriate institutional or technological controls must be provided.

137.6(11) *Site-specific standards or approaches not anticipated by this rule.* Nothing in this rule precludes the use of site-specific standards derived in some way not anticipated by this rule, provided that the rationale is adequately presented and the approach is both approved by the department and provides a level of protection comparable to standards set forth under this rule.

567—137.7(455H) Institutional and technological controls.

137.7(1) *Technological controls.* The purpose of a technological control is to effectively sever a pathway by use of technologies such that an applicable receptor could not be exposed to hazardous substances above an applicable target risk level. Subject to limitations in this chapter, technological controls are an acceptable response action either alone or in combination with other remediation systems and institutional controls. The purpose of technological controls may be to control plume migration through use of containment technologies, barriers, or other methods, as an interim or permanent response action or to permanently sever a pathway to a receptor. Technological controls may also be appropriate to treat or control contamination at the point of exposure. Any technological control proposed as a permanent response action option without meeting the reduction in contaminant concentrations objectives must establish that the pathway to a receptor will be permanently severed or controlled. The effectiveness of a technological control must be monitored under a department-approved plan. The department may require reasonable proof of financial assurance when necessary to ensure that a technological control remain effective.

137.7(2) *Institutional controls.* The purpose of an institutional control is to restrict access to or use of an affected area such that an existing or future receptor could not be exposed to hazardous substances addressed by the controls for as long as the target level is exceeded at applicable points of exposure and compliance. Single or multiple institutional controls may be used alone or in combination and may also be employed with technological controls and response action to effectively achieve, maintain and enforce an approved level of risk reduction and risk management. The following enumeration of types of institutional and technological controls is not a finding that each is per se an effective control. The effectiveness of any institutional or technological control or combination of controls must be evaluated on a case-by-case basis and in accordance with specified conditions in this chapter. Institutional and technological controls include:

- a. A state or federal law or regulation which can be shown to effectively achieve, maintain and enforce the required land-use restrictions and controls.
- b. An ordinance of any political subdivision of the state which can be shown to effectively achieve, maintain and enforce the required land-use restrictions and controls.
- c. A contractual obligation recorded and executed in a manner satisfying Iowa Code chapter 558. Recorded notices and affidavits, including a no further action letter as provided in rule 137.11(455H), which do not create rights or obligations or restrict land use but serve to put current and future property owners on notice of present or future conditions within the affected area.
- d. A control which the participant demonstrates to the department reduces or manages the risk from a release through the period necessary to comply with the applicable standards, including but not limited to informational devices such as public notices, informational registries, notices to regulatory authorities and continuing site activities such as periodic inspections, equipment repair and maintenance, and soil and groundwater monitoring.
- e. An environmental protection easement established in accordance with Iowa Code section 455H.206.

137.7(3) *Environmental protection easements.* An environmental protection easement is a statutorily authorized restriction on land use and shall be the preferred mechanism rather than other contractual, common-law methods such as deed restrictions and restrictive covenants for implementing and enforcing future land-use restrictions. The department reserves the discretion to determine under what conditions an easement or other deed restriction instrument such as a restrictive covenant may be used. An environmental protection easement must be utilized whenever the approved land-use restriction in and around an affected area must be limited to nonresidential uses. Environmental easements may be utilized to implement and enforce other institutional and technological controls, including but not limited to restrictions and regulation of certain construction activities, building location and design limitations, access to and use of groundwater, property access, restrictions on subdivision of property, maintenance and monitoring of technological controls and other response action equipment and activities, and other site inspection and reporting duties. The following minimum requirements must be established to obtain approval of an environmental protection easement:

a. The easement must be granted by the fee titleholder(s) and such other legal and equitable interests in the affected real estate as necessary to establish its validity and enforceability. The department may require persons with property interests other than the fee titleholder(s) to join in the grant or execute appropriate instruments evidencing consent to or subordination of their interests to the terms of the easement, or provide legal notice to such parties as necessary to ensure its validity, effectiveness and enforceability and all legal and equitable interests in the affected area. The participant must provide sufficient documentation, including but not limited to abstracts of title, title opinions, legal descriptions of the affected property and plat maps to enable the department to independently determine the easement will serve its intended purpose and is valid and enforceable.

b. The easement must be filed in the office of the county recorder in the county where the affected real estate is located and in any applicable central registry established by the department or other state, local or federal regulatory agency. After recording of the easement, each instrument transferring an interest in the affected real estate, including lease agreements, must include a specific reference to the recorded easement instrument with sufficient description to put the transferee on notice of its terms. If a transfer instrument fails to include these references, the transferor may lose any of the benefits provided by these rules and Iowa Code Supplement chapter 455H.

c. The form and general terms of the easement must comply with the model forms developed by the department unless otherwise approved by the department. The terms of the easement instrument must include at a minimum the following:

(1) The easement must name the state of Iowa, acting through the department, as a grantee.

(2) The easement must accurately describe the activities being restricted or required.

(3) The easement must run with the land and bind the owner of the land and the owner's successors and assigns.

(4) The easement shall include an acknowledgment by the director of acceptance of the easement by the department.

d. *Modification of environmental protection easements.* An environmental protection easement can only be amended or terminated with approval by the director of the department and by filing an appropriate instrument, executed by the director, and filed with the county recorder.

137.7(4) Public notification. The department shall prepare a public notice prior to approval of any no further action classification which is conditioned upon use of institutional or technological control(s). The public notice will describe the results of the risk assessment conducted in the affected area, any proposed or completed response action, the vertical and horizontal extent and concentrations of existing soil and groundwater contamination in the affected area, and the actual and potential pathways of exposure the controls are intended to address. The notice will describe the purpose of the institutional and technological control(s) being proposed and the predicted period of coverage. The notice will provide the opportunity for members of the public to review department files, make written comments and request a public hearing. The department may schedule a public hearing on the basis of requests from the public and when it determines the particular remedial options proposed for a site warrant public consideration, for example, when issues of whether and to what concentrations gross contamination should be allowed to remain within the affected area given the relative effectiveness of institutional controls and other community concerns and development plans.

a. The notice will be served by certified mail on all property owners that the actual or modeled data indicates are or may be affected by the present or future conditions addressed by the control. The notice will be published in a newspaper of general circulation most likely to reach persons in the immediate locality.

b. If the controls are intended to restrict surface or subsurface future land use, the notice shall be sent to each local regulatory body having jurisdiction and control over or a direct interest in regulation of these activities. These may include but are not limited to municipal or county zoning boards, municipal building authorities, public utilities and economic development agencies. If the controls are intended to restrict groundwater use, the notice shall be sent to the county or city board of health responsible for private well permitting.

c. Failure to provide notice to an interested party shall not constitute a basis for invalidating a subsequently approved no further action classification.

137.7(5) No further action certificates. Any no further action certificate shall contain a specific reference to any applicable institutional and technological control and shall meet the requirements in rule 137.11(455H). The reference must identify the location of any recorded instrument, contractual agreement or other documents applicable to the control, provide a brief description of the terms of the control and, where appropriate, site diagrams.

137.7(6) Enforcement of institutional and technological controls. Institutional and technological controls which have been incorporated into a no further action certificate pursuant to rule 137.10(455H), or have been approved prior to issuance of a no further action certificate, may be enforced in Iowa district court by the department, a political subdivision of this state, the participant or any successor in interest to the participant as provided in Iowa Code Supplement section 455H.206(4).

137.7(7) Failure of an institutional and technological control(s). The effectiveness of institutional and technological controls may be jeopardized for several reasons including situations where the technological controls are no longer effective in achieving their technical objectives, the validity of technological or institutional control is challenged due to a pending or final administrative or judicial action or legislative action changing its regulatory effect (e.g., change in an ordinance), or persons fail to comply with the terms of the institutional or technological control. The effect of the failure of a technological or institutional control to achieve its intended purpose is to remove the no further action classification and put all interested parties in the same position had the no further action classification not been made. When the department has reason to believe technological or institutional control(s) is jeopardized or determines that the control is no longer effective, the following policy and procedure shall apply:

a. The department shall make reasonable efforts to provide notice of the failure or noncompliance to the participant(s), protected parties, persons having legal standing to enforce the terms of the controls, other persons who may be legally responsible for contamination at the site and persons legally obligated to comply with the terms of the controls. The notice shall inform these parties of the consequences of failure of the controls and provide the opportunity for one or more of them to correct the deficiency by taking further response action or undertaking enforcement action to obtain compliance with the terms of the controls.

b. The participant(s) and other persons legally responsible for contamination at the site shall have primary responsibility to correct deficiencies or seek enforcement of the terms of controls, if they wish to maintain a no further action classification and any attendant statutory protections. The department may in its discretion seek enforcement of controls where persons fail to comply with the terms when it determines there is a strong likelihood of success, other participant(s) or legally responsible persons are unable or unwilling to undertake enforcement, and utilization of the controls remains consistent with these rules and site conditions currently in effect at the site. However, the department is not obligated to seek enforcement of the terms of any technological or institutional controls nor does the election not to undertake enforcement constitute a defense to further action by responsible parties or a basis for challenging the rescission of the no further action classification.

c. The department may also elect to require statutorily responsible parties to correct the deficiency as an alternative to rescinding the no further action classification.

d. Failure of a participant to timely undertake additional response action and response may result in termination of enrollment and loss of benefits under these rules and Iowa Code Supplement chapter 455H. Any person found to have intentionally violated an environmental protection easement or other institutional or technological control, whether included in a no further action letter or as part of an approved response action, may lose any of the benefits under these rules or Iowa Code Supplement chapter 455H.

137.7(8) Modification and termination of institutional and technological controls. A participant or successor in interest to a participant, or an owner of property subject to an institutional or technological control, may seek approval from the department for the removal, discontinuance, modification or termination of an institutional or technological control. The persons must demonstrate that the control in its present form is no longer required to ensure compliance with applicable standards. The person seeking revision must undertake sufficient risk assessment and provide sufficient assessment data to establish that the applicable compliance standards can be met based on the proposed modification. The department may also determine based on a revised assessment that the applicable controls are no longer effective to meet compliance standards and may require other response action. The department shall issue an amendment to any previously issued no further action letter specifying the approved modification of the institutional or technological controls.

567—137.8(455H) Site assessment.

137.8(1) Purpose. The purpose of the site assessment is to define the nature and extent of contamination, along with identifying likely exposure pathways, with the aim of characterizing potential, current and future risks and making an informed decision concerning an appropriate response in the context of probable future land uses at the site and in the surrounding area. Assessment is to be conducted with the recognition that contaminant fate and transport may alter the current areal extent and depth of contamination. It is recognized that the scope of such an assessment may be appropriately varied dependent upon interrelated factors including the nature and severity of the contamination, the complexity of specific details of the site and its setting, and the nature of the chosen response, if known.

137.8(2) Site assessment plan. The participant is encouraged, but not required, to submit for department review a site assessment plan, prior to proceeding with the site assessment. Participants choosing to initiate site assessment without department review and approval of a work plan shall notify the department in writing of their intentions. Likewise, participants choosing to proceed to the risk evaluation/response action phase in accordance with rule 137.9(455H) without seeking review of the site assessment report shall give prior notice to the department of their intentions. The notice shall include a schedule for implementation and completion, a description of the area to be assessed and the scope of the proposed assessment to be undertaken, any planned construction activities in the affected area and a proposed date for submission of the site assessment report for department review. If the notice includes an intention to go directly to the risk evaluation/response action phase, it shall also include a general description of the site assessment results, a schedule for submission of the risk evaluation/response action document and the reasons for not requesting department review and approval of the site assessment report.

The plan is intended to lay out the rationale to be followed in the conduct of the site assessment. The purpose for this optional stage is to provide an opportunity for the participant and the department to reach a consensus regarding the appropriate scope of the site assessment. The development of a consensus should serve to diminish the likelihood that the department will find the final site assessment to be deficient and, for the benefit of the participant, to avoid the expenditures and time associated with the collection of what may ultimately prove to be unnecessary data.

In order to accomplish this, it is suggested that the plan should address relevant, known characteristics related to the site and its history as well as plans for addressing pertinent details spelled out in the subsequent sections on the site assessment and the site assessment report. Departmental review may result in suggestions from the department regarding perceived shortcomings or proposed activities which are deemed to be unnecessary.

The participant may find it desirable to conduct some preliminary investigation in order to develop a site assessment plan.

137.8(3) Site assessment details. In order to meet the stated purpose of the site assessment, it will be necessary to characterize numerous attributes related to the enrolled site and its setting. The following objectives are intended to provide a framework in which to accomplish this purpose. It is recognized that these objectives may exceed the appropriate scope of some site assessments and that there may be situations in which it may be necessary to define additional objectives. Any such deviation would preferably be addressed in a site assessment plan. The department may also develop guidance documents that recommend more specific procedures for accomplishing site assessment objectives. Such guidance documents will be readily available to the public. In general, an acceptable site assessment should address the following items.

a. Identify and address the medium or media of concern associated with the contamination situation for which the site is enrolled. The regulatory classification or jurisdiction of contaminants shall be indicated if applicable and, if known, e.g., the compound is regulated under the Resource Conservation and Recovery Act (RCRA), Toxic Substances Control Act (TSCA), or Federal Insecticide, Fungicide and Rodenticide Act (FIFRA).

b. Characterize the nature, extent, and degree of contamination in both horizontal and vertical dimensions. This should involve appropriate sample numbers and locations within the contaminated area and beyond the area contaminated in excess of the background or statewide standard. Analyses should be conducted for the contaminants of concern, breakdown products, and other contaminants likely to be present at significant levels. The department may also require analyses for additional contaminants which are not the focus of enrollment in the program, but which may be of special concern. Special concerns might include waste handling or treatment problems posed by the additional contaminants, or unacceptable risks remaining unaddressed within the affected area, due to the presence of the additional contaminants. In the case of groundwater, attention should also be given to the possibility of contaminant accumulation in strata overlying confining layers and to the possible presence of non-aqueous phase liquids (NAPL). In the case of groundwater, more than one round of sampling shall be incorporated, appropriately separated in time. In the case of soils, particular attention should be given to characterizing shallow soil contamination, from zero to six inches in depth.

c. Characterize the nature of the source of contamination or propose a conceptual model explaining the presence of the contamination of concern.

d. Characterize local contamination maxima or hot spots for the purposes of evaluation against relevant standards and to identify handling or treatment concerns that they may pose.

e. Characterize the stratigraphy. This should be done to a depth extending to the first significant confining layer below the deepest contamination. Descriptions should rely primarily on results gathered in the site assessment, but relevant reference materials or geologic logs from other sources may be incorporated as a supplement.

f. Characterize the hydrologic properties of the site and its vicinity to a distance appropriate to the fate, transport and exposure concerns associated with the site. This characterization should consider both horizontal and vertical components of groundwater movement as well as other influences on groundwater hydrology such as pumping wells, injection wells, surface water bodies, effects of seasonal or precipitation-driven variability, and possible aquifer interconnections, including those related to existing or abandoned wells. Water level measurements, related to a common datum, screening of appropriate depth intervals, and determination of hydraulic conductivity will generally be considered as necessary.

g. Characterize physical and chemical properties of the site and its environs associated with contaminant fate and transport, e.g., percent organic matter, redox potential, soil bulk density, and transmissivity.

h. Characterize topographic and cultural features of the site and its immediate vicinity. Cultural features may include, but not be limited to, buildings, basements, paved areas, roadways, utilities, storage tanks and associated piping, piles, impoundments, wells, and waste disposal systems.

i. Evaluate concerns related to whether the contamination situation is dynamic or stable; if dynamic, address fate and transport and breakdown products appropriately.

j. Identify and characterize receptor or exposure concerns. This most clearly involves concerns for drinking water and exposures to contaminated soils, as suggested by the statewide standards, but additional concerns should be identified and addressed by the participant or the department, as the situation warrants, e.g., vapors to basements, threats to water supply lines, threats to surface waters, or environmental threats.

k. Characterize current and probable future uses of the site and its surroundings. If probable future uses differ significantly from current uses, then characterize them separately and conduct the assessment in a fashion which addresses concerns arising from the possible change in use.

l. Evaluate the potential for contaminants to migrate from one medium to another. The following subparagraphs prescribe requirements for assessing potential migration of contamination from one medium to another. Requirements in the following subparagraphs may be waived if it can be demonstrated in accordance with procedures established in 567—Chapter 135 or the latest version of ASTM Standards related to the Phase II environmental site assessment process that migration of contamination from one medium to another will not cause a violation of the applicable standard in the receiving medium. The assessment activities prescribed in the following subparagraphs are intended to determine if significant migration of contamination from one medium to another has occurred. If evidence of significant migration of contamination from one medium to another (i.e., generally a contaminant concentration in the receiving medium in excess of the statewide standard) is discovered, full-scale characterization of the receiving medium may be required.

(1) The water from any pond or lake on the site or within 300 feet of the site shall be sampled and analyzed for the contaminants of concern, if it is reasonably possible that contaminants from the site could impact the pond or lake. Any surface stream that runs through the site or within 300 feet of the site should be sampled at a location downstream of any potential impact from the site and analyzed for the contaminants of concern. Depending on the characteristics of the contaminants (e.g., solubility), associated sampling and analysis of sediments may be required.

(2) Groundwater at the location most likely to be impacted by each known substantial area of soil contamination shall be sampled and analyzed for the contaminants of concern. If the area of soil contamination exceeds 10,000 square feet, additional groundwater samples may be required.

(3) Soil vapors in each area that is most likely to be impacted by known groundwater or soil contamination shall be sampled and analyzed for the volatile organic contaminants of concern. If the area of soil or groundwater contamination exceeds 10,000 square feet, additional soil vapor samples may be required. If vapors may be impacting an existing enclosed space, a soil vapor sample shall be collected from a location that is most likely to have vapor contamination adjacent to the enclosed space.

If the potential for the existence of problematic concentrations of the vapors in the enclosed space cannot be dismissed based on soil vapor sampling, sampling and analysis of vapors inside the enclosed space may be conducted to determine whether or not a problem exists. Appropriate measures for distinguishing between contaminant vapors originating from within the enclosed space versus those from the external sources that are under investigation may be made with the approval of the department.

Ambient air sampling may be required if a very large area or extremely high concentrations of highly volatile contaminants exist in shallow soil or evidence of vapor contamination exists, such as odors or a high vapor reading on a vapor-screening instrument.

(4) If a water line exists within the zone of known organic contamination of soil, groundwater or soil vapor and the potential for significant diffusion of contaminants into the water line cannot otherwise be dismissed, a sample from the water line shall be collected at the nearest location where any impact may exist and that sample shall be analyzed for the organic contaminants of concern. All such samples should be collected at times following minimum movement within the water line (e.g., early morning following a weekend).

137.8(4) Site assessment report. The site assessment report shall include the presentation of all information gathered relative to the foregoing description of the site assessment, arranged in appropriate sections of the report. It shall include a summary of preliminary information on which the site assessment is based, e.g., background and site history. The report shall discuss the sampling strategy and methods used in the assessment. The department encourages the use of innovative or screening techniques to expedite investigations and to control costs, provided that such techniques are approved by the department and are supported through verification by accepted scientific practices. The report shall also include a description of the quality assurance/quality control (QA/QC) protocols followed during the investigation. QA/QC protocols shall be consistent with accepted scientific practices, including those set forth in appropriate EPA or ASTM guidance or otherwise approved by the department.

The presentation should be organized so as to facilitate the assimilation of information by the reader. Maps to be presented, as appropriate, might include maps illustrating the location of the site in a larger geographical context; maps showing cultural features associated with the site and its environs; maps illustrating the contamination extent and concentration in three dimensions; maps illustrating the site hydrology in three dimensions; and maps illustrating receptors, potential receptors, and relevant pathways of exposure. Cross-sectional diagrams should be included to illustrate stratigraphy, geological boring information, and hydrologic and contaminant factors with depth. Tables and graphs should be designed for the purpose of summarizing data in a meaningful fashion, including information about successive rounds of sampling. Appendices should include well logs, copies of laboratory analytical reports, and raw data used to calculate parameters presented elsewhere in the report. Appended material shall be labeled in a fashion permitting the cross-referencing of appended materials and the body of the report.

137.8(5) Approval of site assessment report. The department suggests, but does not require, that the site assessment report be approved prior to proceeding with the subsequent risk evaluation/response action phase. Unless notice has already been given prior to initiation of the site assessment, participants choosing to proceed to the risk evaluation/response action phase without department review and approval of the site assessment report must notify the department in advance as provided in subrule 137.8(2).

137.8(6) Public notification. Before or upon completion of the site assessment, the participant shall provide the department with the names and addresses of the owners and occupants of all property adjacent to the site enrolled in the land recycling program and any additional properties where contaminants from the enrolled site have migrated or are likely to migrate in the future. The department shall notify by direct mailing all such property owners and occupants, the city or county in which the property is located, and officials of any potentially impacted public water supply of the site's enrollment in the land recycling program and of the scope of work described in the participation agreement. The department shall give the notified parties the opportunity to obtain updates regarding the status of activities relating to the site that is enrolled in the land recycling program. The department may also require the participant of a site enrolled in the land recycling program to publish public notice in a local newspaper if the department determines that widespread interest in the site exists or is likely to exist. The department may provide additional opportunities for public participation if, after consultation with the participant, the department determines such opportunities are warranted.

567—137.9(455H) Risk evaluation/response action.

137.9(1) Purpose. The purpose of risk evaluation/response action is to utilize information from the site assessment as a basis for:

- a. Determining whether current exposures result in risks deemed to be excessive, based on evaluation against appropriate background, statewide, or site-specific standards.

b. Determining whether future exposures may result in risks deemed to be excessive, based on evaluation against appropriate background, statewide, or site-specific standards. This will likely include:

(1) Evaluation of potential changes in usage, e.g., installation of a new well, change in land use, or other activities, which result in unacceptable, potential exposures not evaluated as current exposures, and

(2) Evaluation of exposure concerns related to the movement of contamination such that potential exposures might arise which are not considered under current exposure assumptions, e.g., groundwater plume migration creating a potential for future contamination of existing wells or creating newly contaminated areas in which new well installation may result in unacceptable exposures.

c. Proposing an appropriate and acceptable response action or strategy to address the identified, unacceptable exposures or potential exposures.

d. Establishing the test criteria to be applied under rule 137.10(455H) for determining final compliance with the selected standard. In some cases this may consist of proving that standards are currently met; in other cases it may result in an assessment of whether the response action succeeds in bringing about compliance with a selected standard.

The risk evaluation/response action is intended only for application to the specific contaminants and situations for which the site is enrolled.

137.9(2) Risk evaluation. The risk evaluation/response action document shall identify all locations or areas, and associated exposure pathways, where exposure currently exceeds a statewide standard or where a statewide standard may be exceeded in the future, due to either a change in exposure-related usage or contaminant migration. Current and future exposure pathways shall be evaluated and presented separately. This evaluation shall not be limited to exposure pathways for which the department has formulated risk-based values in rule 137.5(455H) (the statewide standard) or 137.6(455H) (the site-specific standard) but should include any pathway related to the situation for which the site is enrolled, for which a no further action certificate is sought, or for which an unacceptable risk may now or in the future exist, e.g., high concentrations of volatile compounds in proximity to a confined space, high concentrations of solvents in proximity to a water distribution line, or environmental concerns unrelated to human health.

In a case where a background standard is to be applied and there is no violation of a statewide standard, it will be necessary to identify only locations or areas where the background standard is exceeded.

In some instances it is anticipated that the risk evaluation may be appropriately abbreviated from the preceding description, based on the specific details of the contamination and the proposed response action. Participants are strongly urged to discuss the appropriate scope of their risk evaluation with the department.

137.9(3) Establishing cleanup standards. The risk evaluation/response action document shall identify the cleanup standards to be applied in accordance with rule 137.4(455H), 137.5(455H), or 137.6(455H) of this chapter, outlining respectively the background, statewide, or site-specific standards. These standards may be applied in any combination to address specific components of the contamination problem for which the site is enrolled. If cleanup standards other than those specifically formulated under the statewide standard (rule 137.5(455H)) are to be applied, then the rationale behind the determination of such standards shall be justified, in the document, to the department's satisfaction.

137.9(4) *The use of models.* The department recognizes that the use of numerical models will likely be necessary in order to evaluate potential future exposures or that models may be used to develop target levels.

a. Standard models. Standard models may be used to predict future contaminant concentrations at potential points of exposure to contaminants or at other locations used for determining compliance when such models are appropriate, as determined by the department. Applicable Tier 2 models approved for use in accordance with 567—Chapter 135 for underground storage tanks (USTs) and applicable Tier 2 models provided in American Society for Testing of Materials (ASTM) standards are acceptable standard models. Models which provide a two-dimensional representation of groundwater flow will not be considered to be appropriate when significant three-dimensional components to groundwater flow are anticipated. Default values for input parameters for ASTM and UST Tier 2 models, as provided in applicable ASTM standards and approved for use in accordance with 567—Chapter 135, may be utilized without approval by the department. The department will maintain a guidance document which includes a list of other chemical-specific default values for all chemicals having statewide standards. The use of other, site-specific input parameters is addressed under site-specific modeling in paragraph “b” below.

b. Site-specific models. Site-specific models may be used to predict future contaminant concentrations at potential points of exposure to contaminants or at other locations used for determining compliance when such models are appropriate, as determined by the department. Site-specific models may include standard models with site-specific input parameters or models utilizing more sophisticated analytical techniques. The department will utilize versions of A Modular Three-Dimension Finite-Difference Ground-Water Flow Model (MODFLOW) as developed by the United States Geological Survey in conjunction with A Modular Three-Dimensional Transport Model (MT3D) by S.S. Papadopoulos & Associates, Inc. as a site-specific model for assessment of potential future exposures to contaminants in groundwater. MODFLOW and MT3D will be considered to be appropriate site-specific groundwater and contaminant transport models for any situation. Other site-specific groundwater and contaminant transport models may be utilized with the approval of the department. In general, a site-specific groundwater model shall have proven reliability and be able to simulate, as needed:

- A fixed contaminant source,
- Groundwater and contaminant flow in three dimensions,
- Groundwater and contaminant flow through as many distinct geologic layers as necessary for the site in question,
- Effects of pumping,
- Effects of groundwater recharge and discharge,
- Impacts of hydrologic boundaries,
- Contaminant advection, dispersion and chemical reactions, as appropriate for the site in question, and
- Other site-specific variables as appropriate.

Default values for input parameters approved for standard models will be approved for use in site-specific models. Otherwise, input parameters used in site-specific models are subject to the department's approval.

137.9(5) Response action. The risk evaluation/response action document shall include a proposal for a response action or strategy to achieve and maintain compliance with the selected standard(s). This may consist of activities designed to remove or treat contaminants, prevention of exposure to unacceptable levels of contamination through technological/institutional controls or monitoring, or it may consist of a combination thereof. If the response action involves the use of a standard which is less stringent than the statewide standard, it will generally be necessary to implement institutional controls to prevent the type of exposure on which the statewide standard is based. It is the intent of the department to permit the participant to identify and carry out those options by which this may be accomplished, insofar as the department deems the selected options to be reasonable, protective of human health and the environment, and consistent with provisions of the rule.

137.9(6) Free product and gross contamination. The response action or strategy for an enrolled site shall take into account a stated policy of the Act to encourage environmental cleanup. To this end, the department requires that contaminants present as free product and gross contamination shall not be addressed through the implementation of institutional or technological controls. For purposes of this rule, gross contamination will be considered to be contamination present at concentrations in excess of a standard by an amount sufficient to reasonably expect that institutional or technological controls will not be adequately protective of human health or the environment.

The department recognizes that treatment or removal of free product or gross contamination may not, in some cases, be feasible. In such cases the department may grant a variance to this portion of the rule. It will be the responsibility of the participant to make a sufficient case that such a variance is warranted.

137.9(7) Compliance verification strategy. The risk evaluation/response action document shall outline a strategy for determining whether the relevant standards are met by the site and will continue to be met in the future. In some cases this may consist of sampling and statistical tests to verify that the standard has already been met, while in other cases the sampling and statistics may be used to demonstrate that a response action has achieved its stated goals and the site is now in compliance with standards. Some response strategies may also call for longer term monitoring. In this latter case, standard-based values shall be identified which, if exceeded, would indicate a failure of the response action and necessitate the development and implementation of a new response action. The terms under which monitoring may cease should also be proposed. The proposed strategy shall be consistent with rule 137.10(455H), dealing with demonstration of compliance, and shall indicate the standard to be applied and the point of compliance at which it is to be applied, consistent with rules 137.4(455H), 137.5(455H), and 137.6(455H) (the background, statewide, and site-specific standards, respectively).

137.9(8) Risk evaluation/response action document submission. A risk evaluation/response action document shall be submitted for review by the department. When considered in conjunction with the site assessment report, these documents shall present a complete picture of the site from its characterization, through the evaluation of risk, to the development of a strategy to address the situation. An effort shall be made to ensure that the reviewer, or other interested parties, can easily move back and forth through the documents to gain an understanding of the existing situation and proposed actions. The risk evaluation/response action document shall include a summary of findings regarding present risks and potential future risks; a pathway-specific identification of the standards to be applied, including the supporting rationale, if appropriate; a discussion of the proposed response actions, including remedial actions to be taken and institutional or technological controls to be implemented; and a discussion of the proposed verification strategy. Any modeling used for purposes of assessing future risk or establishing site-specific standards shall be presented in sufficient detail to permit evaluation of the results by the department. Any permits which will be necessary to implement the response action shall be identified to the department for inclusion in a consolidated standards permit.

137.9(9) Department review and approval. It is strongly recommended that the document be submitted for review and approval prior to proceeding with implementation of the response action. The final, department-approved document will be the basis for assessing subsequent activities at the site. Parties choosing to proceed with response actions without prior review and approval by the department proceed at their own risk and may not assume the response action implemented will result in a no further action certificate.

Parties choosing to implement a response action without prior review and approval by the department shall submit to the department a proposed risk evaluation/response action document accompanied by an explanation of the reason(s) for proceeding without prior approval. Documentation shall also include a schedule for implementation, a description of construction or other activities to be undertaken, and date for submission of the final report demonstrating compliance, as described in rule 137.10(455H).

The department shall provide opportunity to comment on proposed response actions to any party that is potentially impacted by off-site migration of contaminants for which notification is required in accordance with subrule 137.8(6). The department shall consider reasonable comments from potentially impacted parties in determining whether to approve or disapprove a proposed response action or site closure.

567—137.10(455H) Demonstration of compliance.

137.10(1) Purpose. The purpose of the demonstration of compliance section is to provide a mechanism by which to verify that:

- a. Appropriate and acceptable standards are complied with and that compliance can be reasonably expected to continue in the future;
- b. Any and all remedial measures proposed under rule 137.9(455H) have achieved their purpose; and
- c. Appropriate institutional and technological controls, or monitoring mechanisms, have been successfully put in place.

In some cases the demonstration of compliance may mark the final step, taken by the participant, prior to the issuance of a no further action certificate. In other cases it may mark the transition to the longer term closure activities associated with the site, such as monitoring, maintenance of technological controls, and continuing enforcement of institutional controls. In this latter case, demonstration of compliance activities may or may not result in the issuance of a no further action certificate, depending on the approach proposed in the response action. In some cases it may be necessary to successfully complete a monitoring program (or to fulfill other agreed-upon obligations) prior to the issuance of the no further action certificate.

In all cases, sampling of environmental media shall comply with QA/QC requirements addressed elsewhere in this rule.

137.10(2) General requirements for demonstrating compliance with soil standards.

a. For the standard being applied, the demonstration of compliance shall be at the point of compliance or point of exposure as set forth in rule 137.4(455H), 137.5(455H), or 137.6(455H) relating to background standards, statewide standards, and site-specific standards, and described in a site-specific context pursuant to subrule 137.9(7), relating to risk evaluation/response action.

b. Minimum sample numbers for the demonstration of compliance with the background standard for soils (paragraph 137.10(4)“b”) or with the statewide standard when applying subparagraph 137.10(5)“a”(1) shall be based on the volume of soil to which the selected standard is being applied as follows:

- (1) For volumes less than or equal to 125 cubic yards, a minimum of 8 samples.
- (2) For volumes greater than 125 cubic yards, but less than or equal to 3,000 cubic yards, a minimum of 12 samples.

(3) For each additional volume of less than or equal to 3,000 cubic yards, a minimum of 12 additional samples.

(4) Additional samples may be required based on site-specific conditions.

c. When applying the 95 percent upper confidence limit, according to EPA guidance, to demonstrate compliance with the statewide standard for soils (subparagraph 137.10(5)“a”(2)) or a site-specific standard for soils (subrule 137.10(6)), the minimum sample number shall be as specified in that guidance.

d. Sample locations for demonstration of compliance shall be selected in a systematic random fashion to be representative, both horizontally and vertically, of the volume of soil being evaluated for compliance.

e. Sampling for the purposes of demonstrating compliance shall be conducted after the completion of site assessment activities and after the implementation of applicable remedial measures.

137.10(3) General requirements for demonstrating compliance with groundwater standards.

a. For the standard being applied, the demonstration of compliance shall be at the point of compliance or point of exposure as set forth in rule 137.4(455H), 137.5(455H), or 137.6(455H), relating to background standards, statewide standards, and site-specific standards, and described in a site-specific context pursuant to subrule 137.9(7), relating to risk evaluation/response action.

b. Monitoring wells installed for the purpose of demonstrating compliance shall be of sufficient number and appropriate location to evaluate all hydrologic strata of concern, based on site-specific considerations, as identified pursuant to subrule 137.9(7), relating to risk evaluation/response action.

c. For statistical methods under subparagraph 137.10(5)“b”(1), compliance with the statewide groundwater standard shall be based on eight consecutive quarters of groundwater data.

As an alternative, the department may accept four consecutive quarterly sampling events or less with written approval from the department under the following conditions:

(1) There is adequate spatial monitoring of the plume upgradient which indicates a decreasing concentration trend toward the downgradient property boundary.

(2) Parameters affecting the fate and transport of regulated substances within the plume have been fully evaluated.

(3) Concentrations of regulated substances in the plume at the point of compliance monitoring wells along the downgradient property boundary are all less than or equal to the groundwater standard or the limit relating to the PQL, whichever is higher, in all samples collected during the quarters of monitoring.

(4) One of the following is met:

1. The age of the plume is sufficiently well known to permit a judgment to be made regarding its stability.

2. The remediation includes source removal or containment actions which would reduce chemical flux into the plume.

d. When applying the 95 percent upper confidence limit, according to EPA guidance, to demonstrate compliance with the statewide standard for groundwater (subparagraph 137.10(5)“b”(2)) or a site-specific standard for groundwater (subrule 137.10(6)), the minimum sample number shall be as specified in that guidance.

e. Sampling for the purposes of demonstrating compliance shall be conducted after the completion of site assessment activities and after the implementation of applicable remedial measures.

137.10(4) Demonstration of compliance with a background standard.

a. To apply a background standard the participant shall demonstrate to the department, in writing, that the apparent background contamination at the site is due to widespread or naturally occurring contamination and shall obtain the department's approval to use this subrule. Data collected for the purpose of determining the applicable background standard is subject to department approval, interpretation, and manipulation, if necessary for the purpose of establishing a meaningful background standard.

b. For soil, the minimum sample number to determine the background standard shall be 10 (unless a lesser number is approved by the department) and the number of samples from the affected area shall be based on volume as described in 137.10(2)"b." No sample collected from the affected area may exceed the sum of the background arithmetic mean and three times the sample standard deviation, as calculated based on the background sampling.

c. For groundwater, a minimum of 12 locations shall be sampled in the background reference area (unless a lesser number is approved by the department) and an equal number shall be collected from the affected area. In areas involving more than one hydrologic strata, more samples may be required. Sampling shall be conducted concurrently in the background reference area and the affected area. No sample collected from the affected area may exceed the sum of the background arithmetic mean and three times the sample standard deviation, as calculated based on the background sampling.

137.10(5) *Demonstration of compliance with the statewide standard.* The following requirements shall be met in order to demonstrate compliance with the statewide standard. Testing shall be performed individually for each contaminant being addressed and for which a no further action certificate is sought.

a. To demonstrate compliance with the statewide standard for soils in each affected area, in addition to (1) or (2) as follows, all other applicable requirements of this rule shall be met.

(1) Seventy-five percent of all soil samples, collected during a single event, shall be less than or equal to the statewide standard, with no individual sample exceeding 10 times the statewide standard.

(2) In accordance with EPA-approved methods, the 95 percent upper confidence limit of the arithmetic mean of soil sample values from the affected area shall be at or below the statewide standard.

b. To demonstrate compliance with the statewide standard for groundwater in each compliance monitoring well, in addition to (1) or (2) as follows, all other applicable requirements of this rule shall be met.

(1) Seventy-five percent of all samples collected in each compliance monitoring well over time shall be less than or equal to the statewide standard, with no individual sample exceeding 10 times the statewide standard.

(2) In accordance with EPA-approved methods, the 95 percent upper confidence limit of the arithmetic mean of samples collected from a compliance well over time shall be at or below the statewide standard.

137.10(6) *Demonstration of compliance with a site-specific standard.* To demonstrate compliance with a site-specific standard, the participant shall use the tests identified in 137.10(5)"a"(2) and 137.10(5)"b"(2), except that the 95 percent upper confidence limit of the arithmetic mean for samples from the medium of concern shall be at or below the site-specific standard.

137.10(7) *Compliance with cumulative risk.* In addition to or, for soil only, in lieu of compliance with standards for individual contaminants as prescribed above, cumulative risk criteria must be attained. Cumulative carcinogenic health risks shall not exceed 1 in 10,000. Noncarcinogenic health risks affecting the same target organ shall not exceed a cumulative hazard quotient of 1. Cumulative risk criteria are applicable to multiple contaminants in the same medium and multiple media in which exposure is likely to occur to the same individual. Cumulative risks shall be based on the same exposure assumptions that are used for determining the selected standard.

Risks associated with background levels of contaminants shall not be included in the cumulative risk determination. Background levels of contaminants shall be determined in accordance with subrule 137.10(4) or, if approved by the department, by the use of generally available information on background levels of contaminants.

In situations where the risk associated with exposure to a contaminant at a concentration equal to the selected standard is greater than the acceptable cumulative risk, the cumulative risk may be calculated assuming the risk associated with exposure to the contaminant at a concentration equal to the selected standard is equal to the acceptable cumulative risk criterion. The department will provide a guidance document for calculating cumulative risk and make it readily available to the public.

137.10(8) Final report. A final report shall be submitted which documents the accomplishment of all provisions set forth in the risk evaluation/response action document. This shall include, as applicable to the specific situation, discussions related to verification of compliance with selected standards; successful completion of approved remedial actions; implementation of necessary institutional or technological controls; and initiation of any required monitoring strategy. Sufficient details shall be included to permit the department to verify that the terms proposed in the response action have been met with regard to the statistical determination of compliance with standards.

137.10(9) Department review and approval. The final report is subject to review and approval by the department. Following review, the department will either approve the report or make a written response indicating the reason(s) why the report is unacceptable. Acceptance of the report may result in the issuance of a no further action certificate or it may mark a transition to the long-term closure activities associated with the site, as proposed in the response action. A decision that the report is unacceptable may be based upon an insufficiency of the report or it may be based on a judgment that the terms of the response action have not been met.

In cases where a participant has elected to proceed through this program without department interaction and without submitting site assessment (pursuant to rule 137.8(455H)) or risk evaluation/response action documents (pursuant to rule 137.9(455H)), the final report shall contain the substantive information related to those rules in addition to information required under this rule. The intent is to create a document for departmental review and approval which clearly sets forth, in substance, the same process which would have been developed had the participant engaged in a stepwise approach including interaction with the department during the process.

567—137.11(455H) No further action classification.

137.11(1) Eligibility. An enrolled site shall be eligible to obtain a no further action classification, when the department determines the participant has met all compliance standards of this chapter applicable to the affected area and the hazardous substances actually identified and evaluated such that no further response action is required other than maintenance of institutional or technological controls or certain specified continuing site activities. Upon request of a participant or a protected party and compliance with applicable standards, the department will issue a no further action letter to each protected party requesting it.

A no further action classification may be conditioned upon the continued maintenance and effectiveness of any applicable institutional or technological control in accordance with rule 137.7(455H).

137.11(2) No further action certificate. A no further action letter shall be in a form recordable in the county real estate records as provided in Iowa Code chapter 558 and consistent with the model forms developed by the department. The no further action letter may be recorded as provided by law.

137.11(3) No further action certificates conditioned on institutional and technological controls. A no further action certificate conditioned upon the continuing effectiveness and maintenance of institutional and technological controls or other continuing requirements must be recorded with the consent of the fee titleholder for each parcel of affected property subject to the controls and for parcels of property for which prevention of exposure is dependent upon the continuing effectiveness and maintenance of the controls. If a participant is not able to record the no further action letter on a parcel within the affected area due to objections of the fee titleholder or other legal restraints, this alone shall not be a basis for denying or rescinding the no further action classification or the certificate or the legal protections attendant to the no further action classification. Any modification or termination of institutional and technological controls shall be noted in an amended no further action certificate and shall be recorded as to any property subject to an earlier recorded certificate or institutional control. If a no further action certificate is required to be recorded, the no further action classification is not effective until the document is recorded with the county recorder.

137.11(4) Scope of liability protection. Upon issuance of the no further action letter by the department, the liability protection provisions contained in Iowa Code Supplement chapter 455H, subchapter 3, apply. The scope of the no further action classification and the scope of liability protection extend only to that area of affected property as defined by actual and modeled contaminant data and the specific environmental condition for which a regulatory standard has been met and approved by a no further action classification. The scope of protection corresponds to the scope of the site assessment conducted by the participant, the exposure pathways actually evaluated by the assessment report and reviewed by the department, and the hazardous substances identified in that assessment for which compliance with a department-approved standard has been achieved. Liability protection does not apply to releases, sources of contamination, hazardous substances or other environmental conditions not expressly addressed in the participant's site assessment, response action or specifically referenced in the no further action certificate.

The no further action classification and certificate shall be void if the department demonstrates by clear, satisfactory, and convincing evidence that any approval under this chapter was obtained by fraud or material misrepresentation, knowing failure to disclose material information, or false certification to the department.

137.11(5) Reopener and reclassification conditions.

a. The department shall have grounds to reopen and rescind a no further action classification and consider reclassification of the affected area if specified conditions of the no further action classification and certificate are not maintained, or if institutional or technological controls fail to meet their intended purpose or are determined to be ineffective and unenforceable. If the conditions upon which the no further action classification was issued cannot be corrected or reinstated, the department may rescind the classification. The effect of termination is to put all parties in the same position as if the no further action letter had not been issued.

b. If a no further action certificate is issued without conditions or technological and institutional controls and conditions should arise which might require further corrective action, the department may require further response action by a participant or protected party only as provided in Iowa Code Supplement section 455H.301. The department may require further response action against a statutorily responsible party who is not a participant or a protected party. If the participant was a person having control over a hazardous substance, as defined in Iowa Code section 455B.381, at the time of the release, a no further action certificate may provide or the department may require further response action to protect against an imminent and substantial threat to public health, safety, and welfare. A protected party who was a person having control over a hazardous substance, as defined above, may be required by the department to conduct a further response action, where appropriate, to protect against an imminent and substantial threat to public health, safety, and welfare.

These rules are intended to implement Iowa Code Supplement chapter 455H.

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Appendix C: Iowa DOT Materials IM 491.17 – Appendix A

APPROVED CERTIFIED SOURCES
Class C Fly Ash

Source	Class Ash	Nearest City	Marketer	Specific Gravity	%Available Alkali	Code
Burlington Generating Station	C	Burlington, IA	Headwaters Resources, Inc.	2.72	1.55	FA000C
Coal Creek Power Plant	C	Bismark, ND	Headwaters Resources, Inc.	2.65	0.75	FA003C
Columbia Generating Station #1	C	Portage, WI	Lafarge North America	2.75	0.99	FA001C
Columbia Generating Station #2	C	Portage, WI	Lafarge North America	2.60	1.15	FA002C
Council Bluffs Unit #3	C	Council Bluffs, IA	Headwaters Resources, Inc.	2.74	1.06	FA004C
Edgewater Unit 5 Generating Station	C	Sheboygan, WI	Lafarge North America	2.72	0.93	FA020C
Hawthorn Generating Station	C	Kansas City, MO	Lafarge North America	2.61	1.21	FA006C
Iatan Generating Station	C	Weston, MO	Lafarge North America	2.65	0.95	FA007C
Lansing Generating Station	C	Lansing, IA	Headwaters Resources, Inc.	2.84	0.96	FA008C
Louisa Generating Station	C	Grandview, IA	Headwaters Resources, Inc.	2.65	1.14	FA009C
Muscatine Power & Water	C	Muscatine, IA	Lafarge North America	2.74	0.55	FA010C
Nebraska City Station	C	Nebraska City, NE	Nebraska Ash	2.53	1.25	FA011C
North Omaha Generating Station	C	Omaha, NE	Nebraska Ash	2.65	1.23	FA012C
Ottumwa Generating Station	C	Chillicothe, IA	Headwaters Resources, Inc.	2.75	1.75	FA013C
Pleasant Prairie Generating Station	C	Kenosha, WI	Lafarge North America	2.54	1.05	FA014C
Port Neal #3	C	Sioux City, IA	Headwaters Resources, Inc.	2.70	1.17	FA015C

**Class C Fly Ash
 (Continued)**

Source	Class Ash	Nearest City	Marketer	Specific Gravity	%Available Alkali	Code
Joppa Power Plant	C	Joppa, IL	Mineral Resource Technologies, LLC	2.68	1.48	FA023C
Labadie Power Plant	C	Labadie, MO	Mineral Resource Technologies, LLC	2.72	1.02	FA022C
Labadie Power Plant	C	South Beloit, MO	Mineral Resource Technologies, LLC	2.72	1.02	FA024C
M.L. Kapp	C	Clinton, IA	Headwaters Resources, Inc.	2.64	1.11	FA018C
Port Neal #4	C	Sioux City, IA	Headwaters Resources, Inc.	2.59	0.89	FA016C
Rush Island Power Plant	C	Festus, MO	Mineral Resource Technologies, LLC	2.78	1.37	FA021C
Thomas Hill Energy Center	C	Clinton Hill, MO	Headwaters Resources, Inc.	2.64	1.36	FA025C
Weston Units	C	Weston, WI	Lafarge North America	2.66	1.30	FA026C

Class F Fly Ash

Source	Class Ash	Nearest City	Marketer	Specific Gravity	%Available Alkali	Code
Joliet	F	Joliet, IL	Lafarge North America	2.54	N/A	FA017F
Monticello	F	Monticello, TX	Boral Material Technologies	2.45	0.44	FA021F

Appendix D: Manitoba Department of Transportation and Government Services –
Department Info and Requirements for Lagoon Ash

MANITOBA DEPARTMENT OF TRANSPORTATION AND GOVERNMENT SERVICES

PRODUCT DESCRIPTION, REQUISITION STATEMENT AND DEPARTMENT SPECIFICATIONS

MAIN CATEGORY	SOIL TREATMENTS
SUB-CATEGORY	ADDITIVES
PRODUCT TYPE	MIXED LAGOON ASH
APPLICATIONS	AS A COURSE MINERAL FINES FOR UNSTABILIZED BASE COURSE AS AN EMBANKMENT MATERIAL FOR ROADS FILLS AND DIKES
PREV. REVISION	n/a
LAST REVISION	October 10, 2003
CATEGORY REF. NO.	13.1.1

REQUISITION STATEMENT:

Bid Item

_____ units of mixed lagoon ash.

Special Terms and Conditions:

1. This item has been approved for the following applications only:
 - As a course material fines for unstabilized base and subbase course aggregates
 - As an embankment material for roads, are fills and dikes, requiring a minimum cover.
2. The supplier must ensure that the ash is transported off the site of the generating station in vehicles or containers which are covered in a manner that would prevent the release of fugitive particles, and that the transporting agent is made aware, in writing, that proper containment of the ash is expected up to the time of delivery.
3. The lagoon ash utilization method is approved on the condition that it is utilized in accordance with the precautions set out in the Dillon Consulting report entitled "Coal Combustion By-Products Reuse Class Environmental Assessment", dated December 11, 1996, and that no ash remains indefinitely uncovered by some type of soil, or subject to ongoing erosion by wind, water or vehicle traffic.
4. The delivery and unloading costs shall be included in the price of the mixed lagoon ash.
5. Approvals:

This item must be approved as identified on the Department's Products Standards List or be approved for use by the Department to qualify for purchase.

The item must have Environmental Approval: Clause 24 of the Environmental Act License NO. 1703R.

Department Drawings

Not applicable.

Departmental Contact:

Materials Engineering Branch (204) 945-8982.

<i>PRODUCT EVALUATION AND SUPPLIERS LIST</i>			
<i>PRODUCT TYPE</i>	<i>MANUFACTURERS</i>	<i>SUPPLIERS</i>	<i>STATUS</i>
Lagoon Ash	Manitoba Hydro Brandon Thermal Generation Station Brandon, MB	Manitoba Hydro Brandon Thermal Generating Station	Approved ¹

- Notes: 1. Only approved for the following applications:
- as a course mineral fines for unstabilized base and subbase course aggregates and
 - as an embankment materials for roads, area fills and dikes (with minimum cover).

Specifications

Sample requisition for Materials or Services

Appendix E: North Dakota Department of Health, Division of Waste Management –
Guideline 11



GUIDELINE 11 - ASH UTILIZATION FOR SOIL STABILIZATION, FILLER MATERIALS AND OTHER ENGINEERING USES

North Dakota Department of Health - Division of Waste Management
Telephone 701-328-5166 • Fax 701-328-5200 • Website www.health.state.nd.us
Rev: 04/02

Attachment: Parameters and Methods for Assessing Leachability* of Fly Ash and Runoff from Fly Ash Utilization Sites in North Dakota (Parameters may be reduced based upon review.)

North Dakota Department of Health is working with a number of power plants, coal-fired boiler operators, coal mines, and other entities wishing to utilize waste materials such as coal-fired fly ash and/or bottom ash for engineering purposes. Some projects such as road stabilization, underground mine stabilization, controlled strength flowable fill, and other uses have been reviewed and approved by the Department based on an evaluation of the material's engineering and environmental properties. Persons proposing use of waste materials for beneficial reuse need to demonstrate that the material will be beneficially used without adversely impacting the environment.

Beneficial reuse must be carefully considered to ensure it is not simply "*use constituting disposal*" or "*sham recycling*." Proposers should be familiar with the state's environmental laws and rules, including the North Dakota Solid Waste Law, Chapter 23-29 North Dakota Century Code (NDCC); the North Dakota Solid Waste Management Rules, Article 33-20 North Dakota Administrative Code (NDAC); as well as the state's Water Pollution laws, Chapter 61-28 NDCC, which includes Section 61-28-06 which states in part:

"It shall be unlawful for any person:

- a. To cause pollution in any waters of the state or to place or cause to be placed any wastes in a location where they are likely to cause pollution of any waters of the state . . . "

The Department needs to review important aspects of any proposal, including, but not limited to, the ash quality and quantity, the proposed use of the ash, site characteristics, potential receptors, how the material will be handled, contingency plans in case adverse environmental conditions arise, how the site will be monitored to ensure environmental protection, what will be done when use of the material is completed, any local health or zoning issues, site closure and reclamation, etc. At a minimum, any proposal should address the following:

1. **Background information on the source, quality, and quantity of the ash** including the generator of the ash; the type of facility, the boilers, the pollution control equipment, etc., used in generating and collecting the ash; the source and the type of fuel used in the process; the variability of the ash; whether it is a mixture of other materials or waste streams, how it is stored and handled prior to any disposal or use, and any other information necessary.
2. **Analysis of the ash**, including both existing information and, as necessary, some leach analysis. Information that might be provided would include mineralogical properties and

total analysis plus an assessment of the environmental leachability of the ash materials. At a minimum, an ash leach test on one or more representative samples utilizing either: (1) a **modified** EPA Synthetic Precipitation Leaching Procedure (SPLP) Method 1312, with a *solution to solid ratio 4:1*, or (2) A modified ASTM D-3987 procedure with a *solution to solid ratio of 4:1*. A list of chemical parameters is attached to this memorandum. The detection limits for analysis must be substantially below the safe drinking water standards.

3. **A discussion and details on the proposed use of the ash**, including any admixtures, fill materials, soil, etc., should be provided. Information that is essential for review includes a description of the actual beneficial use; the mix ratio and design lift thickness; type and quality of fill materials, moisture levels, compaction, and engineering properties (including the strength and durability of materials), and what the material will be covered with, assessment of weathering, material breakup, etc., should be provided.
4. **A laboratory simulation** of the environmental properties of the proposed use should be addressed. Laboratory simulation testing to replicate field conditions determine leachability of the material as-placed should be provided. Upon discussion with the Department, a field simulation test should be agreed upon that will be adequate to determine any impact on the environment from initial waste placement, and any impact through continued weathering, mechanical abrasion, erosion, field runoff, etc. Various simulation tests have been approved by the Department, including kinetic tests simulating infiltration of water through fill materials.

One publication that has been utilized for evaluating ash utilization in a mine setting is the publication "*Draft Guidelines and Recommended Methods for the Prediction of Metal Leaching and Acid Rock Drainage at Mine Sites in British Columbia*" by Dr. William A. Price, Reclamation Section, Energy and Minerals Division, Ministry of Employment and Investment, Bag 5000, Smithers, British Columbia, V0J2N0. Other information is available in Departmental files or may be proposed by the applicant based on the conceptual field application. Laboratory simulation of the field application methods might also entail testing of the materials due to its fate in the environment through weathering, breakup, erosion, abrasion, excavation, etc.

5. **The site characteristics**, including soils, topography, geology, hydrogeology, groundwater quality, surface water conditions and flow, vegetation, etc.
6. **Potential receptors**, including nearby communities, residences, parks, natural areas, neighboring land use, waterways, site drainage, groundwater conditions and quality groundwater wells, and any other information necessary to assess potential impacts to health and the environment.
7. **Description of the material handling and conceptual construction**, including transport and storage of materials, placement of materials, equipment, construction techniques, moisture application and monitoring, mixing, testing, etc., as well as controls and monitoring of windblown dust, stormwater and/or any ponded water must be described.
8. **The proposal should address reasonable contingencies** such as discontinuance of the application methods, cleanup of the site should environmental damage occur, final disposal of placed materials after the life of the project, etc.

9. **Approval by any local health, environmental, and permitting authorities** must be obtained before the project is conducted. Any Departmental approval is contingent upon and does not supersede compliance with all local environmental, health, and building code requirements.
10. **Monitoring of surface, groundwater, air, and soil** may be required.
11. The proposer should provide routine reports on construction and operation progress, monitoring results, final construction details and, for ongoing projects, periodic re-analysis of the ash material on an annual basis or, more often, under the following circumstances:
 - a. The process generating that waste changes, such as the installation of different boilers, burners, pollution control equipment, or any other process change which might influence the character of the waste being utilized;
 - b. In the event that the raw material or type of fuel changes; and
 - c. Any other changes or variances which may influence the characteristics of the ash/product or the mixture used in the construction project.

This outline is provided for guidance purposes only. Additional requirements or conditions may be stipulated by the Department, dependent on the particular application, site characteristics, or other regulatory requirements.

Should you have any questions regarding these matters, please feel free to contact the Department at (701) 328-5166. More information on the state's environmental laws and rules are available at our Website www.state.nd.us

North Dakota Department of Health - Division of Waste Management

**Parameters and Methods for Assessing Leachability* of Fly Ash
and Runoff from Fly Ash Utilization Sites in North Dakota
(parameters may be reduced based upon review)**

a. Basic water parameters:

- (1) Appearance (including color, foaming, and odor)
- (2) pH¹
- (3) Specific conductance²
- (4) Temperature

b. General geochemical parameters:

- | | |
|----------------------|------------------------------------|
| (1) Ammonia nitrogen | (11) Chloride |
| (2) Total hardness | (12) Fluoride |
| (3) Iron | (13) Nitrate + Nitrite, as N |
| (4) Calcium | (14) Total phosphorus |
| (5) Magnesium | (15) Sulfate |
| (6) Manganese | (16) Sodium |
| (7) Potassium | (17) Total dissolved solids (TDS) |
| (8) Total alkalinity | (18) Total suspended solids (TSS) |
| (9) Bicarbonate | (19) Cation/anion balance |
| (10) Carbonate | (20) Sodium Adsorption Ratio (SAR) |

c. Heavy Metals:

Group A:

- (1) Arsenic
- (2) Barium
- (3) Boron
- (4) Cadmium
- (5) Chromium
- (6) Lead
- (7) Mercury
- (8) Selenium
- (9) Silver

Group B:

- (10) Antimony
- (11) Beryllium
- (12) Cobalt
- (13) Copper
- (14) Nickel
- (15) Thallium
- (16) Vanadium
- (17) Zinc

d. For Fly Ash waste analysis, naturally occurring radionuclides:

- (1) Gross Alpha Particle Radioactivity (pCi/1)
- (2) Radium 226 and 228 (pCi/1)
- (3) Uranium

*Ash leach test on one or more representative sample(s) using a **modified** EPA Synthetic Precipitation Leaching Procedure (SPLP) method 1312 with a **solution to solid ratio of 4:1**. **A modified ASTM D-3987 procedure with a solution to solid ratio of 4:1 may also be used.** Laboratory detection limits must be substantially below the level of any state or federal drinking water standard or goal.

Rev: 04/02

Appendix F: North Dakota DOT Standard Specs for Roads and Bridges – Sections 234
and 820

Sections 234 and 820

North Dakota

Standard Specifications for Road and Bridge Construction

SECTION 234 STABILIZED SUBGRADE

234.01 DESCRIPTION.

This work consists of treating the top layer of subgrade with lime or lime-fly ash.

234.02 MATERIALS.

Materials shall meet the following:

Item

Lime Fly Ash Water

234.03 EQUIPMENT.

Equipment shall meet the following:

Item

General Material Hauling Equipment
Water-Hauling Equipment
Tow-Type
Pneumatic-Tired Rollers
Self-Propelled Pneumatic-Tired Rollers 141

234.04 CONSTRUCTION REQUIREMENTS.

The roadbed shall be shaped to the cross section shown on the Plans. The roadbed material shall be scarified or disked to a depth of 6 inches, 12 inches, 18 inches, 24 inches, or more as required. Any work that the Engineer requires to be done below a 24-inch depth will be paid according to Section 104.03 D. The bottom 6 inches of the scarified or disked depth shall remain on the roadway, mixed with lime, and worked in place. The subgrade shall be replaced in 6 inch lifts, aerated, mixed with lime or lime-fly ash, and recompact as directed by the Engineer. Section 104.03 B will not apply to lime or lime-fly ash. Any wet or unstable materials below the scarified section shall be corrected as directed by the Engineer.

A. **Spreading.** The lime or lime-fly ash shall be spread by dry application or slurry at the rates shown on the Plans. The lime and fly ash may be applied together or separately, provided the lime is applied before the fly ash. Both lime and fly ash shall be distributed uniformly without loss of material by wind or other causes. Lime or fly ash shall not be applied by dry application when the wind is 15 mph or greater.

Slurry shall be used in areas adjacent to residential or other developed areas so the

lime or lime-fly ash does not damage, discomfort, or be an inconvenience to public or private property. The lime or lime-fly ash shall be premixed with water in approved agitating equipment in proportions so that the "Dry-Solids Content" is at least 30% by weight. Lime or lime-fly ash and water may be similarly proportioned in distributing equipment, provided the equipment contains approved metering devices which accurately meters the quantity of water, lime, or lime-fly ash into the distributing tank to provide positive controls for proper proportioning of the mixture.

All distributing equipment shall provide continuous and adequate agitation until the slurry is applied to the roadbed. The slurry shall be applied through pressurized distributing spray bars. Adequate means of accurately determining distribution of lime or lime-fly ash on each area shall be provided. Each distributing unit shall be provided with a metering device which accurately determine the "Dry-Solids Content" applied to any area, based on the percentage of lime or lime-fly ash in the slurry. The application of lime or lime-fly ash may also be controlled by weight or by measuring and converting to weight each load or partial load applied, and basing the dry-solids content on the percentage of lime or lime-fly ash in the slurry.

The total application of lime or lime-fly ash ordered shall be attained by successive passes of the distributing equipment over a measured area.

The slurry may be applied directly to the scarified or disked subgrade, provided no loss of lime or lime-fly ash slurry is evident and uniform distribution into the soil can be made.

B. **Mixing.** The lime or lime-fly ash shall be thoroughly mixed with the material to be processed with enough water added to the mixture to maintain not less than optimum moisture content. Mixing shall be accomplished by the use of a rotary mixer. It shall be mixed so that 100% of the material passes a one inch sieve. If the material does not readily mix with the lime or lime-fly ash, it shall be thoroughly mixed, brought to the proper moisture content, and left to cure 24 to 48 hours.

C. **Compacting and Finishing.** Compaction shall begin immediately after the material has been spread to the specified section. The stabilized subgrade shall be compacted to the density specified in the Plans.

If 6 inches are scarified or disked, the 6 inches shall be compacted until a uniform specified density is obtained. If more than 6 inches are scarified or disked, the top 12 inches shall be compacted until a uniform specified density is obtained.

Subgrade material that cannot be compacted to the required stability shall be removed and replaced with approved material. Rocks, roots, and any other material that may interfere with compaction and shaping to grade and cross section shall be removed and disposed of under Section 203.02 D. If the required stability cannot be achieved through manipulation and drying after the subgrade is scarified to the required depth, the Engineer will determine what further subgrade work is necessary.

When imprints from equipment are left in the finished surface, the surface shall be

lightly scarified and recompact. The moisture content of the surface material must be maintained at its specified optimum during all finishing operations.

The Engineer may suspend the work if instability of the subgrade is caused by frost or excess moisture. A suspension for these reasons shall not constitute a basis for a claim for payment of any Contractor losses.

Mixing shall not be performed after October 1 and shall not be resumed in the spring until the ground is frost free.

- D. **Curing.** The completed surface of the treated subgrade shall be kept in a continuously moist condition until an application of bitumen is applied to the surface as a protective cover to prevent moisture loss.

Liquid Asphalt for curing shall be applied according to Section 401.

234.05 METHOD OF MEASUREMENT.

- A. **Lime or Lime-Fly Ash Treated Subgrade.** Lime Treated Subgrade or Lime-Fly Ash Treated Subgrade will be measured by the Square Yard or Mile. At any given area, only one of the Treated Subgrade bid items will be paid, unless a second depth is specified by the Engineer. When a second depth of treatment is ordered, payment will be made for both the first and the second depth of "Lime or Lime-Fly Ash Treated Subgrade" at the price bid.

Cost associated with scarification and recompaction of the subgrade will not be paid separately but shall be included in the price bid for "Lime or Lime-Fly Ash Treated Subgrade."

- B. **Lime.** Lime will be measured by the Ton.

- C. **Water.** Water will be measured under Section 216.

- D. **Liquid Asphalt.** Liquid Asphalt will be measured under Section 109.

- E. **Fly Ash.** Fly Ash will be measured by the Ton.

234.06 BASIS OF PAYMENT.

Payment will be made at the Contract Unit Price for the following:

Pay Item Pay Unit

Lime Treated Subgrade _____ inches	Square Yard or Mile	Lime-Fly Ash Treated Subgrade _____ inches	Square Yard or Mile	Hydrated Lime	Ton	Fly Ash	Ton	Water	M. Gallons
Liquid Asphalt for Curing									
Gallons									

This payment will be full compensation for all labor, equipment, and materials necessary to complete the work.

SECTION 820 FLY ASH

820.01 GENERAL.

Fly ash shall meet the following for the specific type of work:

Type of Work Specification

Portland Cement Concrete AASHTO M-295 Lime Fly Ash Treated Subgrade
ASTM C-593 Econocrete AASHTO M-295 Aggregate Base ASTM C-593

Sampling and testing all fly ash shall be at the Contractor's expense.

The requirement for loss on ignition in AASHTO M-295 (table 1 chemical requirements) is modified from 5.0% to 2.0% max. Also the optional requirements in Table 2 are required.

Fly ash shall be from an electrical generating plant using a single coal source. Fly ash produced at plants where the limestone injection process is used for controlling air pollutants will be considered unacceptable for use in Portland Cement Concrete. The Contractor shall provide weather-tight storage facilities for the fly ash either at the source or on the Project site.

Fly ash delivered to the Department and the Project shall be accompanied by a Certificate of Compliance based on a testing program which ensures a satisfactory and uniform product relative to these Specification requirements. The Certificate of Compliance covering material shipped in each car or tank truck shall be furnished in triplicate at the time of shipment. The original is to be furnished to the Materials and Research Engineer, Department of Transportation, 300 Airport Road, Bismarck, North Dakota 58504, with one copy going to the consignee and one copy to the Project Engineer.

The certificate shall contain the following information:

- A. Project number and name of Contractor.
- B. Fly ash source by name of company and location of plant.
- C. Quantity contained in tank truck or railroad car.
- D. Gross, tare, and net weight if shipped by truck.
- E. Car initials and number or tank truck number.
- F. Date of shipment.
- G. Statement that the material meets all Specification requirements.
- H. Signature of the person having legal authority to bind the supplier.

Appendix G: Wisconsin Administrative Code Chapter NR 538 – Appendix I

Unofficial Text (See Printed Volume). Current through date and Register shown on Title Page.

APPENDIX I

Table 1A

Category 1 ASTM Water Leach Test

Standard (mg/l)	Parameter	Ferrous Foundry Excess System Sand	Ferrous Foundry Slag	Coal Ash	Other ¹
1.5	Aluminum (Al)	X	X	X	X
0.0012	Antimony (Sb)	X	X	X	X
0.005	Arsenic (As)	X	X	X	X
0.4	Barium (Ba)	X	X	X	X
0.0004	Beryllium (Be)	X	X	X	X
0.19	Boron (B)			X	X
0.0005	Cadmium (Cd)	X	X	X	X
125	Chloride (Cl)			X	X
0.010	Chromium, Tot. (Cr)	X	X	X	X
0.130	Copper (Cu)	X	X	X	X
0.040	Total Cyanide	X	X		X
0.8	Fluoride (F)	X	X		X
0.15	Iron (Fe)	X	X	X	X
0.0015	Lead (Pb)	X	X	X	X
.025	Manganese (Mn)	X	X	X	X
0.0002	Mercury (Hg)	X	X	X	X
0.05	Molybdenum (Mo)			X	X
0.020	Nickel (Ni)	X	X	X	X
2.0	Nitrite & Nitrate (NO ₂ +NO ₃ -N)			X	X
1.2	Phenol	X			X
0.010	Selenium (Se)	X	X	X	X
0.010	Silver (Ag)			X	X
125	Sulfate	X	X	X	X
0.0004	Thallium (Tl)	X	X	X	X
2.5	Zinc (Zn)	X	X	X	X

¹ As provided under s. NR 538.06 (1), the testing program for materials other than ferrous foundry system sand, ferrous foundry slag and coal ash must be approved by the department prior to characterization. For other materials the department may modify the list of parameters required to be analyzed for and may establish standards on a material specific basis for additional parameters.

Note: All testing is to be conducted on a representative sample of a single industrial byproduct prior to commingling with other materials, unless otherwise approved by the department.

Unofficial Text (See Printed Volume). Current through date and Register shown on Title Page.

Table 1B

Category 1 Total Elemental Analysis

Standard (mg/kg)	Parameter	Ferrous Foundry Excess System Sand	Ferrous Foundry Slag	Coal Ash	Other ¹
6.3	Antimony (Sb)	X	X	X	X
0.042	Arsenic (As)	X	X	X	X
1100	Barium (Ba)		X	X	X
0.014	Beryllium (Be)	X	X	X	X
1400	Boron (B)			X	X
7.8	Cadmium (Cd)			X	X
14.5	Chromium, Hex. (Cr)	X	X	X	X
50	Lead (Pb)		X	X	X
4.7	Mercury (Hg)			X	X
78	Molybdenum (Mo)			X	X
310	Nickel (Ni)			X	X
9400	Phenol				X
78	Selenium (Se)				X
9400	Silver (Ag)				X
9400	Strontium (Sr)				X
1.3	Thallium (Tl)	X	X	X	X
110	Vanadium (V)			X	X
4700	Zinc (Zn)			X	X
900	Acenaphthene	X		X	X
8.8	Acenaphthylene	X		X	X
5000	Anthracene	X		X	X
0.088	Benz(a)anthracene	X		X	X
0.0088	Benzo(a)pyrene	X		X	X
0.088	Benzo(b)fluoranthene	X		X	X
0.88	Benzo(ghi)perylene	X		X	X
0.88	Benzo(k)fluoranthene	X		X	X
8.8	Chrysene	X		X	X
0.0088	Dibenz(ah)anthracene	X		X	X
600	Fluoranthene	X		X	X
600	Fluorene	X		X	X
0.088	Indeno(123-cd)pyrene	X		X	X
8.8	1-methyl naphthalene	X		X	X
8.8	2-methyl naphthalene	X		X	X
600	Naphthalene	X		X	X
0.88	Phenanthrene	X		X	X
500	Pyrene	X		X	X

¹ As provided under s. NR 538.06 (1), the testing program for materials other than ferrous foundry system sand, ferrous foundry slag and coal ash must be approved by the department prior to characterization. For other materials the department may modify the list of parameters required to be analyzed for and may establish standards on a material specific basis for additional parameters.

Note: All testing is to be conducted on a representative sample of a single industrial byproduct prior to commingling with other materials, unless otherwise approved by the department.

Unofficial Text (See Printed Volume). Current through date and Register shown on Title Page.

Table 2A

Category 2 and 3 ASTM Water Leach Test

Standard (mg/l)	Parameter	Ferrous Foundry Excess System Sand	Ferrous Foundry Slag	Coal Ash	Other ¹
0.012	Antimony (Sb)	X	X	X	X
0.05	Arsenic (As)	X	X	X	X
4.0	Barium (Ba)	X	X	X	X
0.004	Beryllium (Be)	X	X	X	X
1.9	Boron (B)			X	X
0.005	Cadmium (Cd)	X	X	X	X
1250	Chloride (Cl)				X
0.10	Chromium, Tot. (Cr)	X	X	X	X
1.30	Copper (Cu)				X
0.40	Total Cyanide				X
8.0	Fluoride (F)	X			X
1.5	Iron (Fe)	X	X		X
0.015	Lead (Pb)	X	X	X	X
.25	Manganese (Mn)	X	X	X	X
0.002	Mercury (Hg)	X	X	X	X
0.20	Nickel (Ni)				X
20	Nitrite & Nitrate (NO ₂ +NO ₃ -N)				X
12	Phenol	X			X
0.10	Selenium (Se)	X	X	X	X
0.10	Silver (Ag)			X	X
1250	Sulfate			X	X
0.004	Thallium (Tl)			X	X
25	Zinc (Zn)				X

¹ As provided under s. NR 538.06 (1), the testing program for materials other than ferrous foundry system sand, ferrous foundry slag and coal ash must be approved by the department prior to characterization. For other materials the department may modify the list of parameters required to be analyzed for and may establish standards on a material specific basis for additional parameters.

Note: All testing is to be conducted on a representative sample of a single industrial byproduct prior to commingling with other materials, unless otherwise approved by the department.

Unofficial Text (See Printed Volume). Current through date and Register shown on Title Page.

Table 2B

Category 2 Total Elemental Analysis

Standard (mg/kg)	Parameter	Ferrous Foundry Excess System Sand	Ferrous Foundry Slag	Coal Ash	Other ¹
21	Arsenic (As)	X	X	X	X
7	Beryllium (Be)	X	X	X	X
	Acenaphthene	X		X	X
	Acenaphthylene	X		X	X
	Anthracene	X		X	X
44	Benz(a)anthracene	X		X	X
4.4	Benzo(a)pyrene	X		X	X
44	Benzo(b)fluoranthene	X		X	X
	Benzo(ghi)perylene	X		X	X
	Benzo(k)fluoranthene	X		X	X
	Chrysene	X		X	X
4.4	Dibenz(ah)anthracene	X		X	X
	Fluoranthene	X		X	X
	Fluorene	X		X	X
44	Indeno(123-cd)pyrene	X		X	X
	1-methyl naphthalene	X		X	X
	2-methyl naphthalene	X		X	X
	Naphthalene	X		X	X
	Phenanthrene	X		X	X
	Pyrene	X		X	X
100 ²	Total PAHs	X		X	X

¹ As provided under s. NR 538.06 (1), the testing program for materials other than ferrous foundry slag, ferrous foundry slag and coal ash must be approved by the department prior to characterization. Also, for industrial byproducts not listed, department concurrence is necessary prior to classification as a category 2 industrial byproduct. For other materials the department may modify the list of parameters required to be analyzed for and may establish standards on a material specific basis for additional parameters. For these materials the total elemental analysis shall also include aluminum, antimony, barium, boron, cadmium, hexavalent chromium, cobalt, copper, lead, mercury, molybdenum, nickel, phenol, selenium, silver, strontium, thallium, vanadium and zinc, unless otherwise approved by the department.

² If total polyaromatic hydrocarbons exceed 100 mg/kg, department concurrence is necessary prior to classification as a category 2 industrial byproduct.

Note: All testing is to be conducted on a representative sample of a single industrial byproduct prior to commingling with other materials, unless otherwise approved by the department.

Unofficial Text (See Printed Volume). Current through date and Register shown on Title Page.

Table 3

Category 4 ASTM Water Leach Test

Standard (mg/l)	Parameter	Ferrous Foundry Excess System Sand	Ferrous Foundry Slag	Coal Ash	Other ¹
0.03	Antimony (Sb)				X
0.25	Arsenic (As)				X
10	Barium (Ba)	X			X
0.02	Beryllium (Be)				X
4.8	Boron (B)			X	X
0.025	Cadmium (Cd)	X	X	X	X
2500	Chloride (Cl)				X
0.5	Chromium, Total (Cr)			X	X
6.5	Copper (Cu)				X
1	Total Cyanide				X
20	Fluoride (F)				X
3	Iron (Fe)	X	X		X
0.075	Lead (Pb)	X	X		X
0.5	Manganese (Mn)				X
0.01	Mercury (Hg)	X	X		X
0.5	Nickel (Ni)				X
50	Nitrite & Nitrate (NO ₂ +NO ₃ -N)				X
30	Phenol				X
0.25	Selenium (Se)			X	X
0.25	Silver (Ag)			X	X
2500	Sulfate			X	X
0.01	Thallium (Tl)				X
50	Zinc (Zn)				X

¹ As provided under s. NR 538.06 (1), the testing program for materials other than ferrous foundry system sand, ferrous foundry slag and coal ash must be approved by the department prior to characterization. For other materials the department may modify the list of parameters required to be analyzed for and may establish standards on a material specific basis for additional parameters.

Note: All testing is to be conducted on a representative sample of a single industrial byproduct prior to commingling with other materials, unless otherwise approved by the department.

Unofficial Text (See Printed Volume). Current through date and Register shown on Title Page.

Table 4

Beneficial Use Methods

	Industrial Byproduct Category				
	5	4	3	2	1
(1) Raw Material for Manufacturing a Product	X	X	X	X	X
(2) Waste Stabilization / Solidification	X	X	X	X	X
(3) Supplemental Fuel Source / Energy Recovery	X	X	X	X	X
(4) Landfill Daily Cover / Internal Structures	X	X	X	X	X
(5) Confined Geotechnical Fill (a) commercial, industrial or institutional building subbase (b) paved lot base, subbase & subgrade fill (c) paved roadway base, subbase & subgrade fill (d) utility trench backfill (e) bridge abutment backfill (f) tank, vault or tunnel abandonment (g) slabjacking material (h) soil and pavement base stabilization (i) controlled low strength material (flowable fill)		X	X	X	X
(6) Encapsulated Transportation Facility Embankment		X	X	X	X
(7) Capped Transportation Facility Embankment			X	X	X
(8) Unconfined Geotechnical Fill			X	X	X
(9) Unbonded Surface Course				X	X
(10) Bonded Surface Course				X	X
(11) Bonded Surface Course (Federal, state or municipal roadways)			X	X	X
(12) Decorative Stone				X	X
(13) Cold Weather Road Abrasive				X	X
Note: General beneficial use in accordance with s. NR 538.12 (3)					X

Note: Refer to s. NR 538.10 for description of each beneficial use

Appendix H: Wisconsin Administrative Code Chapter NR 538 – Industrial Byproduct
Categories

NR 538.08 Industrial byproduct categories. The categories of industrial byproducts, characterized in accordance with s. NR 538.06, for beneficial use are as follows:

(1) CATEGORY 1 INDUSTRIAL BYPRODUCTS. Industrial byproducts that have been determined to contain less than the concentration specified for the parameters listed in Appendix I, Tables 1A and 1B, are category 1 industrial byproducts.

(2) CATEGORY 2 INDUSTRIAL BYPRODUCTS. Industrial byproducts that have been determined to contain less than the concentration specified for the parameters listed in Appendix I, Tables 2A and 2B, and are not category 1 industrial byproducts are category 2 industrial byproducts. If in the total elemental analysis total polyaromatic hydrocarbons exceed 100 mg/kg, department concurrence is necessary prior to classification as a category 2 industrial byproduct. Unless authorized by the department the total elemental analysis for industrial byproducts not listed in Table 2B shall also include aluminum, antimony, barium, boron, cadmium, hexavalent chromium, cobalt, copper, lead, mercury, molybdenum, nickel, phenol, selenium, silver, strontium, thallium, vanadium and zinc.

(3) CATEGORY 3 INDUSTRIAL BYPRODUCTS. Industrial byproducts that have been determined to contain less than the concentration specified for the parameters listed in Appendix I, Table 2A, and are not category 1 or 2 industrial byproducts are category 3 industrial byproducts. Coal ashes are category 3 industrial byproducts if the concentration of boron is less than 3.4 mg/l and the concentration of all other parameters are less than those concentrations listed in Appendix I, Table 2A.

(4) CATEGORY 4 INDUSTRIAL BYPRODUCTS. Industrial byproducts that have been determined to contain less than the concentration specified for the parameters listed in Appendix I, Table 3, and are not category 1 to 3 industrial byproducts are category 4 industrial byproducts.

(5) CATEGORY 5 INDUSTRIAL BYPRODUCTS. Industrial byproducts that have been determined not to be a hazardous waste as defined in s. NR 600.03 (98) and are not category 1 to 4 industrial byproducts are category 5 industrial byproducts.

(6) CRITERIA AND PROCESS FOR USING CATEGORY STANDARDS.

(a) If a standard for a parameter listed in Appendix I is above the limit of detection and the limit of quantitation, the standard shall be considered to be exceeded if the parameter is reported at or above the standard.

(b) If a standard for a parameter listed in Appendix I is between the limit of detection and the limit of quantitation, inclusive, the standard shall be considered to be exceeded if the parameter is reported at or above the limit of quantitation.

(c) The following applies when a standard for a parameter listed in Appendix I is below the lowest achievable limit of detection:

1. If a parameter is not detected in a sample, the standard will be considered to have been met.
2. If a parameter is reported at or above the limit of detection but below the limit of quantitation, a confirmation analysis shall be conducted. The standard shall be considered to be exceeded if the presence of that parameter has been confirmed by the use of an appropriate analytical method.
3. If a parameter is reported at or above the limit of quantitation, the standard shall be considered to be exceeded.

(7) CASE SPECIFIC. The department may review the characterization results for an industrial byproduct in response to a request from the generator of the industrial byproduct not defined in s. NR 538.03 (4) and assign a category or categories for that material, or conditionally approve a beneficial use that does not meet the beneficial uses or standards specified in this chapter, on a case specific basis. The department may require additional information prior to a case specific approval. Any exemption or approval granted under this subsection shall be in accordance with the applicable requirements of s. 289.43 (4), (7) and (8), Stats.

Appendix I: WisDOT Document – Fly Ash Specifications for Subgrade Stabilization

Fly Ash, Furnished For Subgrade Stabilization

Description

This work shall consist of furnishing and protecting fly ash for subgrade stabilization as directed by the engineer.

Materials

Fly ash shall comply with the physical requirements of ASTM D-5239 6.4 and the chemical requirements of ASTM C-618, Table 1 for Class C fly ash. The engineer may approve other fly ash materials that do not meet these requirements if the fly ash is determined to be self-cementing, the sulfur trioxide content does not exceed 10 %, and the required degree of stabilization can be achieved.

The contractor shall identify all sources of fly ash materials to be used for this work and shall provide the Department with samples for the development of mix design parameters. The contractor shall deliver samples weighing at least 50 lbs. of each of the fly ash materials to the Truax Center, 3502 Kinsman Blvd., Madison, Wisconsin, 53704, or to a site as directed by the engineer.

Construction Methods

Fly ash shall be stored and handled in closed weatherproof containers until immediately before distribution.

The contractor shall furnish the engineer with the weight of each load of fly ash delivered and incorporated into acceptable work on the project. The contractor may furnish an invoice of weight from the supplier, a weight ticket from a certified public scale, or a weight ticket from a standard platform truck scale erected by the contractor at a site approved by the engineer.

Method of Measurement

Fly Ash Furnished for Subgrade Stabilization will be measured for payment by the ton of material furnished and incorporated into acceptable work on the project.

Basis of Payment

The quantity of Fly Ash, Furnished For Subgrade Stabilization, measured as provided above, will be paid for at the agreed unit price per ton. That price shall be full compensation for furnishing and protecting the fly ash; for disposal of excess materials; and for all labor, tools, equipment, and incidentals necessary to complete the work.

Appendix J: WisDOT Document – Placing Fly Ash

Fly Ash Subgrade Stabilization

Description

This work shall consist of stabilizing the prepared subgrade by placing fly ash, mixing it with the subgrade, adjusting moisture content as necessary, compacting the mixture, and trimming, finishing, and curing the subgrade in accordance with these specifications, as shown on the plans, or as directed by the engineer.

Materials

Fly Ash – Fly ash shall comply with the requirements of the item, Fly Ash, Furnished For Subgrade Stabilization

Water – Water used for mixing during the stabilization process shall comply with the requirements of Subsection 501.3.5.

Equipment – The machinery, tools, and equipment necessary for proper execution of the work shall be on the project and approved by the engineer prior to beginning of stabilization operations. The machine used to blend and mix the fly ash with the subgrade shall be capable of reaching a depth of 12 inches in one pass and shall have a recycling or mixing drum equipped with a water spray bar. The spray bar in the mixing drum shall have adequate volume control to maintain the moisture content of the mixed material within the specified range. A vibratory padfoot roller shall be used to achieve compaction of the mixed material. Rubber tired or smooth wheeled rollers shall be used only for final finishing of the stabilized section.

Construction Methods

General – The subgrade shall be stabilized to a depth of 12 inches below final grade unless otherwise shown on the plans or directed by the engineer. The work shall be carried out in such a manner to produce a completed section of stabilized subgrade that contains a uniform mixture of fly ash and subgrade soil with no loose or segregated areas, has uniform density and moisture content, and is well bound for its full depth. The contractor shall regulate the sequence of the work, apply fly ash at the required rate, uniformly mix the fly ash and subgrade to the required depth, obtain required moisture and density levels, maintain the work, and rework areas as necessary to meet all specified requirements. Fly ash mixing operations shall not be performed when the ground temperature is below 35 degrees F, the air temperature is below 50 degrees F, or there is imminent danger of rain. Fly ash exposed to moisture prior to mixing with the subgrade soil shall not be used in the work. The contractor shall be responsible for the protection and quality of the fly ash stabilized subgrade under all weather conditions until the completion of the 3-day curing period. The engineer will establish sections to determine compliance with moisture and compaction requirements. For two lane roadways and for each 2 lane directional roadway of divided highways, sections will be approximately 500 lineal feet in length. For other multi-lane roadways, sections will be of such length to encompass approximately 25,000 square feet of stabilized area. For each section, the engineer will establish maximum density, optimum moisture content, and allowable moisture range for the soil-fly ash mixture. The engineer may divide the section into sub-

sections for testing purposes and will conduct at least one test for moisture content and density within each section or subsection. The test or tests conducted within each section or sub-section will determine compliance for all material within the section or subsection.

Subgrade Preparation – Prior to placement of the fly ash, the subgrade shall be brought to the lines and grades shown on the plans and shall be brought to a condition which will allow uniform distribution of the fly ash.

Fly Ash Application – The fly ash shall be spread evenly on the prepared subgrade at the estimated rate of 135 lb. per square yard of required stabilized surface area. The engineer will determine the actual application rate. The limits of the stabilized subgrade shall extend to 1 foot beyond the curb line in urban sections and to 1 foot inside of the subgrade shoulder point in rural sections. Fly ash shall not be spread or placed within 1 foot of the established lateral limits of stabilization. The engineer may adjust the length of the stabilized area shown in the plans to fit field conditions. The contractor shall remove any fly ash placed or deposited outside of the stabilized area. The contractor shall use necessary methods, procedures, and equipment to minimize fly ash dust during placement and spreading. Fly ash shall not be placed when the engineer determines wind conditions are such that blowing fly ash may become objectionable to adjacent property owners, violate air quality standards, or significantly reduce the amount of fly ash incorporated into the work. If dust resulting from application of fly ash becomes objectionable, the engineer may suspend such application until the contractor presents an acceptable plan to reduce and control dust production.

Mixing – Mixing operations shall begin no later than 60 minutes after the beginning of fly ash application unless otherwise approved by the engineer. The fly ash and the subgrade soil shall be thoroughly mixed by the approved equipment until a homogenous, friable mixture of material free from lumps and clods is obtained. Non-uniform areas shall be corrected as directed by the engineer before mixing is completed.

Moisture Control – The allowable moisture range for the stabilized subgrade material shall be 3 percentage points below to 2 percentage points above the established optimum moisture. The contractor shall produce a fly ash-soil mixture within the allowable moisture range and shall make necessary moisture adjustments prior to or during mixing. If the engineer determines that moisture content is below the specified limit, additional water shall be added by the use of the spray bar in the mixing unit and shall be uniformly blended with the mixture. If the moisture content is determined to exceed the specified limit, additional fly ash shall be added and mixed to lower the moisture content. The mixed material shall not be aerated to lower the water content. The mixed material shall be brought to uniform moisture content before the beginning of compaction. The addition of water to increase moisture content, the addition of fly ash to lower the moisture content, and all necessary associated mixing shall be at the expense of the contractor.

Compaction – Compaction shall begin immediately after mixing is completed and the fly ash / soil mixture is determined to be within the specified moisture range. During

compaction, the subgrade surface shall be sprinkled with water as necessary to maintain moisture within the specified range. The full depth of the stabilized layer shall be compacted to a minimum of 95 percent of the maximum dry density of the mixture as determined by AASHTO T-99, Method C or Method D and shall remain firm and stable under construction equipment. The moisture content of the stabilized material shall be within the allowable moisture range established by the engineer. The engineer will test each section or sub-section after compaction is completed. If the material fails to meet the moisture, density or stability requirements, the engineer may require the contractor to rework the section or subsection as necessary to meet those requirements. In addition, the engineer may suspend stabilization operations until the contractor presents an acceptable plan to obtain the necessary density and stability requirements. Additional fly ash shall be added to any section ordered reworked. The engineer will determine the amount of fly ash to be added. Any area of stabilized subgrade that does not have the required stability, density, or finish before the base course is placed or the work is accepted shall be reprocessed at the expense of the contractor. Reprocessing shall include the addition of fly ash, mixing, compacting and finishing as required in the initial stabilization. Compaction of each established section of the stabilized subgrade shall be completed within two hours after incorporation of the fly ash. Any section or sub-section that does not reach required density within the specified time will be rejected and shall be reprocessed by the contractor.

Finishing and Curing – After the stabilized section has been satisfactorily compacted, it shall be immediately brought to the final lines and grades shown on the plans. The surface shall be finished with compaction equipment capable of removing ruts and irregularities. Construction traffic or placement of Aggregate Base on the stabilized section will not be allowed during the first 24 hours after the completion of compaction. After the stabilized section has been finished as required, the surface shall be protected against rapid drying for a period of not less than three days. During the first 24 hours the section shall be sprayed or lightly sprinkling with water to maintain the section in a moist condition. After that time, the section may continue to be cured by spraying or sprinkling or it may be covered with Aggregated Base that shall be maintained in a moist condition. During the three-day cure time the contractor shall not apply excessive water that may damage the stability of the subgrade. Following the stabilization and curing process, the contractor shall be limited to hauling only legal highway loads over the stabilized area as required in Subsection 108.7.2

Method of Measurement

Fly Ash Subgrade Stabilization will be measured for payment by the square yard of surface area treated and accepted in accordance with the requirements of this specification. No deduction will be made for any manholes, catch basin, or other similar fixtures located within the limits of the stabilized area.

Basis of Payment

The quantity of Fly Ash Subgrade Stabilization measured as provided above will be paid for at the agreed unit price per square yard. That price shall be full compensation for furnishing and placing the fly ash; for mixing it into the subgrade; for adjusting subgrade

moisture as necessary; for compacting the fly ash–soil mixture; for trimming and shaping the stabilized subgrade; for all necessary curing materials and operations; for disposal of excess materials; and for all labor, tools, equipment, and incidentals necessary to complete the work.

Appendix K: Testing and Specification Descriptions

AASHTO Designation: T 99-01 (2004) – Standard Method of Test for Moisture-Density Relations of Soils Using a 2.5-kg (5.5-lb) Rammer and a 305-mm (12-in.)

These methods are intended for determining the relation between the moisture content and density of soils compacted in a mold of a given size with a 2.5-kg (5.5-lb) rammer dropped from a height of 305 mm (12 in.).

More information available at <http://www.transportation.org/?siteid=56&pageid=1305>

AASHTO Designation: T 191-02 – Standard Method of Test for Density of Soil In-Place by the Sand-Cone Method

This method is intended for determining the in-place density of soils. The apparatus described is restricted to tests in soils containing particles not larger than 50 mm (2 in.) in diameter.

More information available at <http://www.transportation.org/?siteid=56&pageid=1313>

AASHTO Designation: T 310-03 – Standard Specification for In-Place Density and Moisture Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

This test method describes the procedure for determining the in-place density and moisture of soil and soil-aggregate by use of nuclear gage. The density of the material may be determined by either direct transmission, backscatter, or backscatter/air-gap ratio method. The moisture of the material is determined only from measurements taken at the surface of the soil (i.e., backscatter)

More information available at <http://www.transportation.org/?siteid=56&pageid=1352>

AASHTO M 295 Class C

Same as ASTM C 618

American Concrete Institute (ACI) 229R-99 – Controlled Low-Strength Material (CLSM)

This report contains information on applications, material properties, mix proportioning, construction and quality-control procedures.

More information available at <http://www.concrete.org/BOOKSTORE/bkstr.htm>

ASTM C 618 – Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete

This specification covers coal fly ash and raw or calcined natural pozzolan for use in concrete where cementitious or pozzolanic action, or both, is desired, or where other properties normally attributed to fly ash or pozzolans may be desired, or where both objectives are to be achieved.

More information available at http://www.astm.org/cgi-bin/SoftCart.exe/STORE/filtrexx40.cgi?U+mystore+bxps9193+L+C618+/usr6/htdocs/astm.org/DATABASE.CART/REDLINE_PAGES/C618.htm

ASTM D3987-85 – Test Method for Shake Extraction of Solid Waste with Water

This test method covers a procedure for leaching of solid waste to obtain an aqueous solution to be used to determine the materials leached under the specified testing conditions. This test method provides for the shaking of a known weight of waste with water of specified composition and the separation of the aqueous phase for analysis. This method uses distilled water as the extracting medium without pH control, a 20:1 liquid to solid ratio, 18-hour extraction time at room temperature (25°C), and tumbler agitation (Bin-Shafique et al., 2006).

More information available at http://www.astm.org/cgi-bin/SoftCart.exe/STORE/filtrexx40.cgi?U+mystore+agxe8872+-L+D3987+/usr6/htdocs/astm.org/DATABASE.CART/REDLINE_PAGES/D3987.htm

ASTM D5239-04 – Standard Practice for Characterizing Fly Ash for Use in Soil Stabilization

This practice lists representative test methods for determining the chemical, physical, and cementitious properties of fly ash. A broad guideline is provided in that explains the significance of these properties in soil stabilization.

More information available at http://www.astm.org/cgi-bin/SoftCart.exe/STORE/filtrexx40.cgi?U+mystore+bxps9193+-L+D5239+/usr6/htdocs/astm.org/DATABASE.CART/REDLINE_PAGES/D5239.htm

EPA Method 1312 – Synthetic Precipitation Leaching Procedure (SPLP)

Method 1312 is designed to determine the mobility of both organic and inorganic analytes present in liquids, soils, and wastes.

The solid phase is extracted with an amount of extraction fluid equal to 20 times the weight of the solid phase. The extraction fluid employed is a function of the region of the country where the sample site is located if the sample is a soil. If the sample is a waste like fly ash the extraction fluid employed is a pH 4.2 solution (adjust pH of distilled water with 60/40 mixture of sulfuric/nitric acid; no buffering).

More information available at <http://www.epa.gov/sw-846/pdfs/1312.pdf>

EPA SW-846 Methods

Test Methods for Evaluating Solid Waste (SW-846) contains over 200 documents and provides a unified, up-to-date source of information on sampling and analysis related to compliance with RCRA regulations. It brings together into one reference all sampling and testing methodologies approved by the Office of Solid Waste for use in implementing the RCRA regulatory program. The manual provides methodologies for collecting and testing representative samples of waste and other materials to be monitored.

More information available at <http://www.epa.gov/sw-846/main.htm>